REAL CORP 2020

Manfred SCHRENK, Vasily V. POPOVICH, Peter ZEILE, Pietro ELISEI,
Clemens BEYER, Judith RYSER, Christa REICHER, Canan ÇELIK (Eds.)

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TAGUNGSBAND

REAL CORP 2020:

25 YEARS OF REAL CORP

SHAPING URBAN CHANGE
LIVABLE CITY REGIONS
FOR THE 21ST CENTURY

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Livable City Regions for the 21st Century

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PREFACE

Manfred SCHRENK

Conference Director,
President CORP – Competence Center of Urban and Regional Planning

WELCOME to REAL CORP 2020, the 25th International Conference on Urban & Regional Development and Spatial Planning in the Information Society!

REAL CORP 2020 under the topic "Shaping Urban Change" tries to explore the common things in different trends which can be seen in urban development around the globe.

Historic administrative boundaries do not represent real urban structures any more, cities expand beyond these boundaries and form metropolitan regions, which may even result in transnational functional urban areas and agglomerations. In almost all cases it is of utmost importance to coordinate urban development between several governments, administrative authorities and institutions on different levels, but this task turns out to be a quite difficult one.

Cities and regions are hungry for resources and see themselves opposed to density and environmental problems as well as other threats, nevertheless sustainability, resilience, high quality of life and considerate exploitation of natural resources are central goals of urban development. New technologies and digitisation play an essential role in the development of cities, urban regions and metropolises – without appropriate urban, environmental and mobility technologies it would hardly be possible to see urban development, maintenance of functionality and creation of livable urban areas.

In some parts of the world – particularly in China and India, but also in Japan and South-East Asia, and in parts of South America, Africa and the Gulf region – cities and metropolises are growing undamped and hundreds of millions of people are attracted to cities. However, in numerous European cities and agglomerations we can currently see two kinds of processes which may appear to be contradictory at first glance: reurbanisation and regionalisation. The return to core cities as a place of life has a lot of reasons, but it is strongly linked to changes in the working environment and the trend to combine working and living much more as it were possible in suburban fringe areas. But many city centres are lacking affordable housing space, whereas there are plenty of vacancies in the surroudings. Wrong allocations create unnecessary commuter flows.

REAL CORP 2020 aims to discuss strategies and concepts for quality change management in the light of the challenges outlined above, which arise in neighbourhoods, cities, urban regions and metropolitan areas. This also raises the question of who the actual actors of current urban, regional and metropolitan regional development are and what role planners can play in the corresponding scenarios.

The renowned RWTH Aachen in the historical European medium sized city of Aachen, in the German federal state of North Rhine-Westphalia with its rich mining and industrial tradition, located in a cross-border city region in the border triangle Germany-Belgium-Netherlands, is the ideal place to discuss these developments and challenges with experts from all over the world.

This year we brought together some 250 participants from more than 40 countries worldwide. The main goal of the REAL CORP conference series isto bring together leading experts in the field of spatial planning, geoinformation and related disciplines to exchange their knowledge, share their ideas, discuss current developments and get together for face to face networking leading to the development of new thoughts, partnerships and projects. The success of the REAL CORP conferences is – clearly without doubt – the result of the efforts of participants, reviewers, and the conference organising team consisting of CORP association and RWTH Aachen – Department of Urban Design. We would like to acknowledge the Reviewer Team and Programme Committee members for their valueable voluntary help with the review process. Our thanks go to all participants and authors of the submitted papers as well.

The proceedings of this year's conference contain 135 scientific papers; 101 of them were selected after a double-blind, double-stage (for both abstracts and full papers) peer-review process for publication and presentation at the 25th International Conference on Urban Planning and Regional Development in the Information Society, REAL CORP 2020. The non-reviewed papers were accepted by the programme committee after a double-blind abstract review. The conference is held from 15 to 18 September 2020 in co-operation with RWTH Aachen – Department of Urban Design and Ministry for Regional Identity, Communities and Local Government, Building and Gender Equality of the Land of North Rhine-Westphalia.

Have a great conference!
Manfred SCHRENK, Clemens BEYER & the REAL CORP Team

PREFACE

Christa Reicher

RWTH Aachen,Professor and Head of Chair and Institute for Urban Design
Local Host of REAL CORP 2020

WELCOME to REAL CORP 2020, the 25th International Conference on Urban Planning, Regional Development, Information Society and Urban, Transport, and Environmental Technologies!

At the beginning of the 21st century, the question of how we should shape the future of our cities and regions is more important than ever. Urban spaces are becoming the central form of organization of almost all human societies. In the emerging and developing countries, the force of the urbanization surge is becoming visible. The urban population is growing as people move out of rural areas; this growth process is accompanied by social change. In many parts of Europe a fundamental paradigm shift is taking place: from a phase of shrinking and stagnation to enormous growth of cities and regions. It is not only the large cities that are coming under real pressure; medium-sized and small towns and cities are also facing the challenge of how to meet the demands of climate change and the associated need to secure open spaces on the one hand, and to densify and make available space for living and working on the other.

Many inner cities lack affordable housing, while at the same time the surrounding area suffers from vacancies. Incorrect allocations generate unnecessary commuter flows. Against this background, intermunicipal cooperation is an obvious way of achieving the necessary balance between different development dynamics. The current intensive discourse on "Low Carbon Cities" or "Smart Cities", the question of the future development of cities under the conditions of climate change, the use of energy-saving technologies and the foreseeable depletion of fossil resources, raises concrete questions about future urban development and urban design that can only be answered in part so far. In the search for concepts and strategies, sustainability, resilience, a high quality of life and careful use of natural resources are among the central objectives of urban and spatial development.

Within the framework of REAL CORP 2020, global transformation processes and experiences will be discussed on the one hand, while on the other hand there will be an in-depth examination of individual German regions such as "Rheinisches Revier" and Lausitz, where political decisions to phase out lignite mining have raised pressing questions about the future prospects of regions: What does a climate-neutral model region of the 21st century look like? What strategies, concepts and processes can be used to successfully restructure a region that has been characterised by mining, industry and resettlement since the 19th century?

The future urban planning objectives will have to provide answers to the general challenges as they apply more or less to all cities and urban regions – regardless of whether cities are growing or shrinking, regardless of whether cities want to become metropolises, regional cities or explicit green cities. Often such simplistic dualisms do not face each other anyway, but are part of a comprehensive and contradictory transformation process that cities go through in the course of their history.

Against the background of the transformation tasks ahead, it is clear that urban design is slowly but noticeably becoming a „supreme discipline" again. This is why REAL CORP 2020 is also the 1st Aachen Conference on Urban Design. This format is intended to lead the international discourse on a contemporary understanding of urban development and to promote an exchange of strategies and concepts between research, practice and politics. After all, urban design and urban development must offer spatial and strategic concepts that ensure a sustainable quality of life for all.

Christa REICHER, Canan ÇELIK
and the whole team of the Institute of Urban Design at RWTH Aachen University

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VORWORT

Ina Scharrenbach

Ministerin für Heimat, Kommunales, Bau und Gleichstellung des Landes Nordrhein-Westfalen

WELCOME to REAL CORP 2020, the 25th International Conference on Urban Planning, Regional Development, Information Society and Urban, Transport, and Environmental Technologies!

Die Städte und Regionen entwickeln sich weltweit mit einer atemberaubenden Dynamik. Rund um den Globus steht die Stadtplanung vor ähnlichen Fragestellungen: Wie sorgen wir trotz hoher Verdichtung für Lebensqualität? Wie machen wir die Städte widerstandsfähig gegenüber extremen Wetterlagen? Wie organisieren wir eine zukunftsfähige Mobilität? Wie kooperieren Großstädte und das Umland, mit dem sie immer enger verflochten sind?

„Shaping urban change" lautet das Gebot der Stunde. Wir müssen und wir können den Wandel der Städte gestalten – auch, indem wir innovative Technologien konsequent nutzen. Die Stadt der Zukunft wird „smart" sein. Wir brauchen digitale Anwendungen, um die begrenzten Ressourcen effizient zu nutzen, die Verkehrsströme intelligent zu lenken und die urbane Infrastruktur insgesamt zu steuern.

Ein Baustein des Erfolgs ist dabei der grenzübergreifende Austausch zwischen Praxis und Wissenschaft. Was lokal erprobt wurde und sich bewährt hat, verdient es, global diskutiert und eingesetzt zu werden. Für diesen internationalen Diskurs sorgen Formate wie die REAL-CORP-Konferenzen. Deshalb kooperiert das Land Nordrhein-Westfalen sehr gern bei der diesjährigen 25. Ausgabe – und das umso mehr, da der Kongress zum 150. Jubiläum der weltweit renommierten RWTH in Zusammenarbeit mit dem dortigen Institut für Städtebau in Aachen stattfindet.

Digitalisierung ist in diesem besonderen Jahr 2020 auch eine Herausforderung für die Veranstalter. Ich wünsche der virtuellen Ausgabe der REAL-CORP-Tagung ein interessiertes weltweites Publikum und allen Konferenzteilnehmerinnen und -teilnehmern erkenntnisreiche Tage, einen lebhaften Austausch und wertvolle Impulse für ihre Arbeit. Schließlich hoffe ich, dass Sie bald auch persönlich die Gelegenheit finden werden, Nordrhein-Westfalen und die ebenso traditionsreiche wie technologieaffine Stadt Aachen zu besuchen.

Ina SCHARRENBACH
Ministerin für Heimat, Kommunales, Bau und Gleichstellung des Landes Nordrhein-Westfalen

VORWORT

Ulrich Rüdiger

Rektor RWTH Aachen
Dr. rer. nat. Dr. h. c. mult., Universitätsprofessor

WELCOME to REAL CORP 2020, the 25th International Conference on Urban Planning, Regional Development, Information Society and Urban, Transport, and Environmental Technologies!

Seit über 150 Jahren wachsen die Stadt Aachen und die RWTH Aachen miteinander und arbeiten in vielen Bereichen sehr gut zusammen. Sie prägen sich dabei gegenseitig in ihrer Entwicklung.

Die RWTH Aachen hat sich im Zuge der Exzellenzinitiative in den letzten Jahren zu einer "Integrierten Interdisziplinären Hochschule für Wissenschaft und Technologie" entwickelt. Damit ist sowohl die Hochschule, als auch die Stadt als Wissenschaftsstandort für Menschen aus Deutschland und der ganzen Welt ein noch attraktiveres Ziel zum Studieren, Forschen und Leben geworden. Diese Entwicklungen und vielfältigen Einflüsse führen nicht nur innerhalb der Hochschule, sondern auch in Bezug auf die Transformation der Regionen, Städte und Quartiere zu immer neuen Anforderungen, die zusätzlich unseren Lebensstilen im 21. Jahrhundert gerecht werden müssen.

Ich freue mich sehr, dass dieses Jahr die 1. Aachener Städtebaukonferenz von der Fakultät für Architektur veranstaltet wird und damit diese großen gesellschaftlichen und räumlichen Herausforderungen thematisiert werden. Im Hinblick auf das Thema „Shaping Urban Change. Livable City Regions for the 21st Century“ werden zukunftsweisende Fragestellungen mit Expertinnen und Experten diskutiert werden können.

Dass die Konferenz aufgrund der Corona-Pandemie nicht wie geplant stattfinden kann, ist natürlich sehr schade, aber – ganz im Sinne der Wissenschaft – haben die Organisatorinnen und Organisatoren zielgerichtet nach alternativen Lösungswegen gesucht und die Konferenz um digitale Komponenten erweitert, damit dieses wichtige Thema ohne Verzögerung bearbeitet werden kann. Denn für uns als Wissenschaftsregion ist es wichtig, Transformationsprozesse anzuregen, mit dem Ziel Technologien, Innovationen und Wissen aus Forschung und Lehre in die Stadtplanung zu integrieren und gleichermaßen mit Blick auf die Stadtentwicklung die Universität zu gestalten.

Ich wünsche Ihnen angeregte Diskussionen und eine interessante Konferenz!

Mit freundlichen Grüßen
Univ.-Prof. Dr. rer. nat. Dr. h. c. mult. Ulrich RÜDIGER

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REAL CORP 2020

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🏆 *reviewed paper*

Analysewerkzeug zur indikatorgestützten Umfeldanalyse – Erkennen, Vergleichen, Übertragen

Katharina Graf, Saoussen Jouini, Sebastian Ebertshäuser, Petra von Both

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1 ABSTRACT

Vor dem Hintergrund situationsgerechte Lösungen zu den großen Herausforderungen beispielsweise bezüglich der Klimakrise oder dem demografischen Wandel zu finden, stehen insbesondere mittelgroße und kleine Kommunen mit geringem Budget vor immer komplexeren Planungsaufgaben. Aufgrund der sich diverfizierenden Vielzahl an Informationen im Rahmen der fortschreitenden Digitalisierung gewinnt bei der Beantwortung von planerischen Fragestellung der Einsatz IT-gestützer Hilfsmittel an Bedeutung. Neben den oftmals nur durch Experten bedienbaren und in der Anschaffung kostspieligen Werkzeugen, wird jedoch aufgrund der unzureichenden Datenverfügbarkeit zur lokalen Situation eine aufwändige Datenerfassung benötigt. Einer integralen Planung folgend stellt die aus der umfänglichen Kenntnis der Situation, auch bezüglich des großmaßstäblichen Kontextes, erkannte Problemstellung eine fundamentale Vorrausetzung zum adäquaten Ansetzen zielgerechter Lösungskonzeptionen . Oftmals werden anstelle einer damit implizierten problemgerechten Zielplanung unreflektierte Quartierskonzepte und Maßnahmenbündel angegangen und in der Umsetzung dann notdürftig an die lokalen Gegebenheiten angepasst. Über frei verfügbare (bundesweite) Datenquellen stehen zwar Informationen zur lokalen Situation zu Verfügung, jedoch fehlen hierzu derzeit noch einfach zu bedienende Hilfsmittel.

Damit unterschiedliche Konzepte an verschiedenen Orte vergleichbar gemacht werden können, setzt im Rahmen von Forschungsprojekten eine Werkzeugentwicklung an, welche das Erstellen eigener Umfeldanalyse und Möglichkeiten des kommunalen Benchmarks unterstützt. Ein prototypisch umgesetztes, freiverfügbares Analysewerkzeug soll es den (technisch unversierte) kommunalen Akteuren ermöglichen zu ihren selbstständig aus den offenen Datenquellen zusammengestellten Datensätze grafische Aufbereitungen und Gegenüberstellungen anzufertigen.

Keywords: Dynamisch, grafische Auswertung, Umfeldanalyse, Benchmarking, Monitoringwerkzeuge, Indikatorenvergleich

2 EINLEITUNG

Durch globale Kontextfaktoren wie die Klimakrise getrieben, mit lokalen Entwicklungen wie dem demografischen Wandel konfrontiert und zugleich mit klammen Kassen ausgestattet steigt der Handlungsdruck auf die Kommunen sich an eine zukünftig stark veränderte Umwelt anpassen zu müssen.

Ein wesentlich bestimmender Faktor bei der Entwicklung situationsgerechter Konzepte besteht in der fundierten Kenntnis der lokalen Situation. Hier gilt es eine Vielzahl von verschiedenen Informationen aus verschiedensten Bereichen zu einem ganzheitlichen Bild der Situation zusammenzustellen, um auf Grundlage einer dadurch ermöglichten holistischen Sicht auf die bebaute Umwelt und die sie belebende Bevölkerung, die situationsgerechten Zielstellung erkennen zu können und entsprechende zukunftsweisenden Maßnahmen zu ergreifen. Dabei sieht sich die Stadtplanung angesichts der fortschreitenden Digitalisierung in unterschiedlichen Geschwindigkeiten in den verschiedenen Bereichen vor die Herausforderung gestellt, die richtigen zielgerechten IT-gestützten Hilfsmittel zur Verarbeitung der Informationsvielfalt einzusetzen. Hinzu kommt, dass sich diese Informationen stetig vor dem Hintergrund komplexer werdender Planungsaufgaben beispielsweise in den Handlungsfeldern einer energieeffizienten und nachhaltigen Quartiersentwicklung diversifizieren.

Zudem birgt eine jeweils situative, sich sehr heterogen darstellende Datenverfügbarkeit und -qualität bei der Anwendung der Tools oftmals große Unsicherheit. Dadurch wird auch die durch die IT-gestützen Werkzeuge designierten Hilfestellungen bezüglich der Lösungsqualität beieinträchtigt. Um diesem entgegenzuwirken wird ein (unverhältnismäßig) hoher Datenerfassungs- bzw. Datenaufbereitungsaufwand erforderlich. Gerade die auf Grundlage einer umfänglichen Kenntnis der gegebenen Situation sowie ihres großmaßstäblichen Kontextes erkannte Problemstellung stellt eine fundamentale Vorrausetzung zum adäquaten Ansetzen zielgerechter Lösungskonzeptionen im Sinne einer Integralen Planung dar (vgl. Dörner,

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2003). Hierbei stehen insbesondere kleinere Kommunen vor dem Problem sich keine kostenintensiven und aufwändigen Datenerhebungen und -auswertungen von externer Hand leisten zu können, um somit ihrem Vorgehen eine problemorientierte Zielplanung voranstellen zu können. Des Weiteren mangelt es aufgrund der schmalen Personaldecke mit wenig divresifiziertem Fachpersonal in den Kommunen an eigenen Experten zur selbstständigen Handhabung der datentechnischen Grundlagen. Um nun diesen kleinen und mittelgroßen Kommunen trotz fehlender Fachexpertise ganzheitliche Situationsanalysen zu ermöglichen, fehlen derzeit noch Planungshilfsmittel, die bereichsübergreifende, komplexe Fragestellungen mittels frei verfügbaren Daten erleichtern. Dabei stehen diese Informationen zu den Kommunen in verschiedenen offen zugänglichen (bundesweiten) Datenbezugsquellen (vgl. beispielsweise Zensus-Daten oder Kommunaldaten der Bertelsmann Stiftung) zur freien Verfügung bereit.

In der Praxis fehlt es somit oftmals nicht generell an einer Datengrundlage, sondern an (IT-gestützten) Hilfsmitteln, die mit analytischen Methoden eine ungünstige Ausgangslage von lücken-, fehlerhaften oder nur aufwändig erfassbaren Daten zu überwinden helfen. Gerade diese Hilfestellung für eine ganzheitliche Bestandsanslyse zur Problemerfassung der vorhandenen Situation ist jedoch wichtig, da ohne sie die Gefahr besteht direkt mit dem oftmals unreflektierten Umsetzen von woanders bewährten Quartierskonzepten und Maßnahmenbündeln zu beginnen. Indem diese Ansätze jedoch für andere Orte entwickelt worden sind, können darauf aufbauende Planungen teilweise oder ganz am vorhandenen Bedarf vorbei gehen. Im Rahmen einer, im ungünstigsten Fall dann mittels „nachträglichen“ Anpassens auf eine lokale Situation bewerkstelligten Zielplanung kommt generell erschwerend eine einseitige Sicht der Planenden auf entweder urbanes Stadt- oder rurales Landleben hinzu, die einer sich im Wandel befindlichen Lebenswelt der Bevölkerung nicht mehr gerecht wird (Graf & von Both, 2019).

Um Potentiale von planungsmethodisch optimierten Vorgehensweisen vor dem Hintergrund eines Umgangs mit den offen verfügbaren Datengrundlagen aufzeigen zu können, werden in diesem Beitrag konkretisierte Problemstellungen aufgriffen, die im thematischen Fokus eines laufenden Verbundprojekt stehen. Bezugnehmend auf eine sich auch durch digitale Medien inzwischen angleichenden Lebenswelt der Bevölkerung, werden tradierte Planungsvorstellungen im Projekt mit dem Konstrukt einer Transformativen Zelle (TZ) zur Überwindung konträrer Planungsichten auf die Stadt bzw. das Land hinterfragt (ebd.). Von den verschiedenen Projektpartnern setzen im thematischen Projektrahmen an unterschiedlichen Orten Umsetzungskonzepte zu einer TZ an. Übergeordnete Fragestellungen zu den lokalen Randbedingungen der Umsetzungsorte bilden den Problemkontext auf dem in diesem Beitrag eingegangen wird. Zum einen stellt sich dabei die Frage nach der skalenübeergreifende Einordnung des Standorts in die Gesamtentwicklung des Umfelds und zum anderen ob und wie sich die in den unterschiedlichen (lokalspezifischen) Handlungsfeldern angesetzten Konzepte auf andere Orte übertragen lassen.

3 METHODIK

3.1 Zielstellung

Für die im Rahmen der Forschungsarbeit konkretisierte Problemstellung werden in diesem Beitrag eine entsprechende Lösung vorgestellt. Dabei bestand das Ziel darin ein IT-gestütztes Hilfsmittel zu entwickeln, dass die Planenen bei der Analysearbeit im Umgang mit den offenverfügbaren Datensätzen unterstützt. In einfach zu bedienenden Werkzeugen des Hilfsmittels soll es Planenden ermöglicht werden jeweils eine indikatorbasierte Analyse auf der von ihnen selbstverwalteten Datengrundlage durchzuführen und das Ergebnis anschaulich aufzubereiten. Durch eine selbstständige Erweiterung der Datensätze mit lokalspezifisch erhobenen Informationen soll generell dabei auch eine weitere Konkretisierung der Analysen ermöglicht werden. Vor dem Hintergrund der beiden im Forschungsprojektrahmen aufgezeigten Problemfälle sollen mit entsprechenden Werkzeugentwicklungen konkrete Hilfestellungen erstellt werden. Zum einen soll ein Werkzeug prototypisch entwickelt werden, das die Darstellung eines Aspekts der lokalen Situation im Kontext seiner zeitichen Entwicklung sowie im Bezug zu entsprechenden Ausprägungen im räumlich übergeordneten Kontext (Stadt, Kreis, Region, Land etc.) ermöglicht. Mit einem weiteren Werkzeug sollen zum anderen für ein Benchmark lokaler Aspekte im Vergleich zu deren Ausprägung in Orten mit ähnlichen Ausgangslagen ermöglicht werden.

3.2 Lösungsansatz

Gemäß der Zielstellung stellt sich der Planende zunächst für seine lokale Situation eine Datenbasis aus frei verfügbaren Daten zusammen. Den Ausgangspunkt hierfür bildet die Bertelsmann Stiftung mit ihren webbasiert, freizugänglichem Wegweiser Kommune als Datenbezugsquelle (Bertelsmann Stiftung, 2019). Hierbei handelt es sich um eine umfängliche Datensammlung thematisch kategorisierter Indikatoren für alle Kommunen[1] in Deutschland. Durch jährliche Erhebungen existieren hier bereits langjährige Datenhorizonte, auf die die Planer in frühen Projektphasen beim Erfassen der lokalen Situation zurückgreifen können. Besonders hervorzuheben sind erste Auswertungen zu Kommunen in Form von kommunalen Profilen sowie vereinfachte Prognoseinformationen. In langen Listen können Indikatoren zu bestimmten Themen zur eigenen nichtkommerziellen Verwertung bezogen werden. Durch die strukturiert abrufbaren Daten ist dem Planenden hierdurch bereits die Möglichkeit gegben die Zusammenstellung der Daten gemäß seiner Fragestellungen zu verändern und beispielsweise durch eigene erhobene Jahreswerte für einen Indikator anzupassen. Darüberhinaus kann er generell auch die Datenbasis nutzen um diese mit weiteren selbst erhobenen Daten bzw. Referenzwerte aus anderen Kommunen zu ergänzen.

Auf dieser selbstverwalteten Datenbasis können gängige Analysemethoden, wie beispielsweise ein interkommunales Benchmark, in einfach zu bedienenden, IT-gestützten Instrumenten aufgebaut werden. Der Planende kann damit dann problemorientiert bei der lokalspezifischen Grundlagenermittlung für die bedarfsgerechte Entwicklung von Stadtplanungskonzeptionen unterstützt werden.

Zum Beispiel beginnt ein strukturierte Vorgehen beim Aufbauen einer Analyse der lokalen Situation mit einer Thesenbildung zur Darstellung eines übergeordneten Sachverhalts. Als Grundlage hierzu liegen eine Vielzahl von Indikatoren zu einzelnen Sachverhalten in verschiedenen Themenfeldern eingeordnet vor. Jahresreihen dieser Indikatoren können bereits zweckgebundene Einzelaspekte aufzeigen wie eine temporale Entwicklung der Bevölkerungsanzahl einer Kommune. Durch Hinzunahme eines zweiten Indikators zur Bevölkerungdichte kann hierauf aufbauend nun beispielsweise die These aufgebaut werden, dass in der Beziehung der beiden Indikatoren ein Urbanisierungsgrad der Kommune aufgezeigt werden kann. Um für diese Art von Thesen des Nutzers ein entsprechendes Auswertungsdiagramm zu erstellen, werden die beiden Indikatorenwerte jeweils auf der X- und Y-Achse eines Diagramms aufgetragen und damit ein Relationswert der beiden Indikatoren angezeigt. Beim weiteren Aufbereiten der Diagrammdarstellung können die Planenden mit zwei Ansichts-Modi in der Verdeutlichung des von ihnen designierten Sachverhaltes unterstützt werden: Wie in Abbildung 1 dazu zum einen im ersten Anwendungsfall verdeutlicht, lassen sich die in Beziehung stehenden Indikatorenwerte einer Kommune für jeden Jahreswert als Entwicklungsgrafik darstellen. Zum anderen können die Relationswerte der beiden Indikatoren durch die Hinzunahme entsprechender Werte vom weiteren Kommunen für jeden Jaheswert in einem Benchmarkdiagramm vergleichend dargestellt werden (vgl. Anwendungsfall 2, Abbildung 1). Indem diese einzelnen jahresbezogenen Diagramme dann in einer Sequenz zusammengestellt werden, können sie in einer Abfolge als „dynamisches Benchmark“ betrachtet, wiederum den zeitlichen Verlauf des Aspekts im kommunalen Vergleich verdeutlichen.

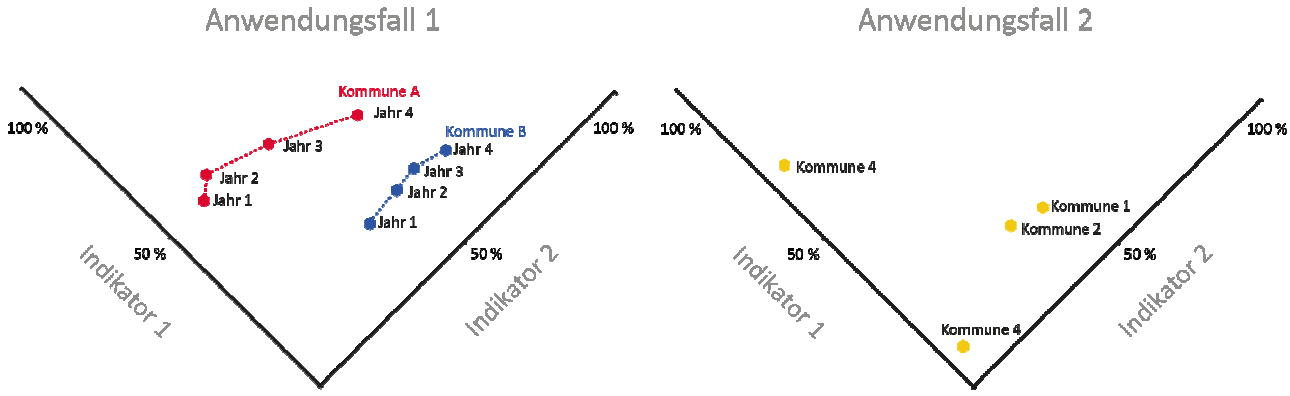

Abbildung 1: Anwendungsfälle einer indikatorbasierten grafischen Auswertung im Analysehilfsmittel

[1] > 5.000 Einwohner

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Der Lösungsansatz sieht eine als Desktop-Applikation angesetzte prototypische Implementierung einer Softwarelösung vor, die auf die durch die Planenden selbstverwaltete Datenbasis zugreift und sie beim (nachvollziehbaren) Ansetzen von Auswertungen der zusammengestellten Daten unterstützt. Für indikatorenbasierten Aspekte in ihren Analysen können die Planenden dabei jeweils die beiden oben beschriebenen Diagrammarten (Entwicklungs- bzw. Benchmarkdiagramm, vgl. Abbildung 1) mit dem Hilfsmittel erstellen. Sowohl als exportierte Bilddateien sowie auch auf dem Bildschirm dynamisch angezeigt, können sie die Diagramme dann in ihren Planungsprozessen weiterverwenden.

3.3 Entwicklungskontext

Die Entwicklung des im Weiteren vorgestellten prototypischen Analysehilfsmittels gliedert sich in zwei Stufen. Eine erste Version wurde in einem abgeschlossenen, vom Bildungsministerium (BMBF) in der Initiative Energieeffiziente Stadt geförderten Begleitforschungsprojekt (vgl. Rexroth & von Both, 2016) entwickelt. Den in einem BMBF-geförderten Wettbewerb teilnehmenden Kommunen diente es dabei beim Vergleich ihrer energetischen Stadtquartierskonzeptionen untereinander (Benchmark). In Abbildung 2 wird in einem Screenshot ein kommunales Benchmark exemplarisch dargestellt, das mit diesem Prototypen „Systemische Information und Analyse für die energieeffiziente Stadt“ (SIASG) erzeugt wurde.

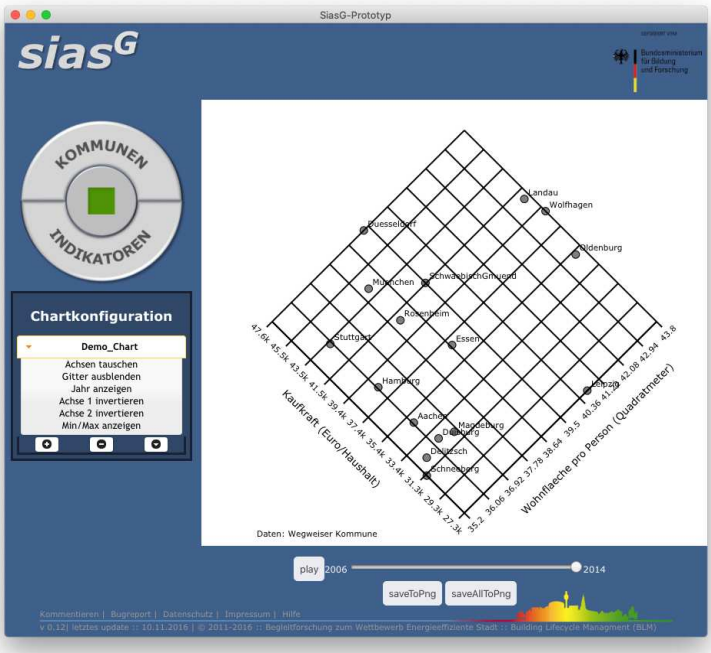

Abbildung 2: Prototyp zur grafischen Auswertung – Systemische Information und Analyse energieeffiziente Stadt (SIASG)

Eine auf dieser ersten Version des Werkzeugs aufbauende Weiterentwicklung des Prototyps „Systemische Analysen für Land und Stadt“ (SALSG) findet derzeit in einem laufenden Verbundprojekt statt, auf dessen Forschungskontext es angepasst wird. Dabei werden die bisher für die teilnehmenden Kommunen hinterlegten Informationen mit Möglichkeiten für die Anwender ersetzt, ihre eigenen Informationen in dem Werkzeug bearbeiten zu können.

4 UMSETZUNG

4.1 Technische Grundlagen und Methoden

4.1.1 Datengrundlage

Als Grundlage des Werzeugs dienen Daten mit Zeitreihen an soziodemografischen Indikatoren und weiteren Informtionen die jährlich im kommunalen Umfeld erhoben werden. Gerade mittelgroßen und kleinen Kommunen, für die eine Datenerhebung zu kostenaufwändig ist, bietet die Bertelsmann Stiftung mit dem Wegweiser Kommune (vgl. Bertelsmann Stiftung, 2019) unentgeltlich eine jährlich fortgeschriebene, umfängliche Datenbezugsquelle zu Informationen über die Kommunen in Deutschland.

Die Daten werden in Form einer Webseite zur Verfügung gestellt, in der sie strukturiert nach Kommunen bzw. Indikatoren in Zeitreihen angezeigt werden können. Darüber hinaus gibt es bereits erste Auswertungen in Form von vergleichbaren Kommunen-Steckbriefen oder kommunale Berichte zu größeren Kommunen. Ein einheitliches Dossierformat ermöglicht bezüglich der einbezogenen Indikatoren dabei einen Vergleich unter den verschiedenen Kommunen.

Um beispielsweise die soziale Lage einer bestimmten Kommune angezeigt zu bekommen, ermöglicht die Benutzerfläche des Wegweisers Kommune in drei Schritten die Auswahl geeigneter Indikatoren: Im ersten Schritt wird die Kommune bestimmt. Anschließend stehen mehrere Hauptthemen zur Verfügung. Unter dem Hautpthema „Ist-Zustand“ wird ein Analysethema wie beispielsweise „Soziale Lage“ ausgewählt. Der letzte Schritt ermöglicht es von einem Jahr bis hin zu allen erfassten Jahren den Zeitraum festzulegen. Alle in diesem Thema zusammengestellten Indikatoren werden im Hauptbereich aufgelistet und können auch einzeln dargestellt werden. In einer ersten Spalte mit dem Indikatorbezeichner können genauere Erhebungsinformationen eingesehen werden, gemäß dem gewählten Zeitraum schliessen daran für jedes Jahr weitere Spalten mit den entsprechenden Werten an. Bei einem einzelnen selektierten Indikator sind neben der tabellarischen Listung zudem einfache Auswertungen abrufbar, wie seine Entwicklung in der Zeitreihe. Bezugnehmend zum kommunalen Benchmark des im Beitrag vorgestellten Hilfsmittels (vgl. Kap. 3.2), können bis zu 10 weitere Vergleichskommunen ausgewählt werden. Dabei werden jeweils die Spalten zu den jährlichen Werten annotiert mit dem Kommunennamen aufgeführt.

Alle durch diese Schritte ausgewählten Datensätze zu einer Kommune können zur eigenen (nicht kommerziellen) Weiterverwertung in einem Tabellendokument exportiert werden. Dabei wird wie in der Oberfläche dargestellt in der ersten Spalte der Indikatorbezeichner aufgeführt und in den weiteren Spalten dann jeweils dazu ein entsprechender Jaheswert.

4.1.2 Technologiewahl und technische Aspekte

Herausforderungen bei der Prototypentwicklung lagen in einer plattformunabhängigen Gestaltung der Desktopanwendung sowie einer Wahrung der Erweiterbarkeit bzw. Migrationsmöglichkeit in eine Web-Applikation. Durch Gestaltung der Architektur nach dem Entwurfsmuster Model View Controller (MVC) zur Gestaltung von skalierbaren Benutzerschnittstellen, konnten diese technischen Zielstellungen im Prototyp umgesetzt werden. Die Umsetzung der Benutzeroberfläche in HTML basiert hierzu auf frei verfügbaren Modulen und Bibliotheken, die spätere Migration des Prototyps in eine serverbasierte Web-Anwendung erlauben. Das Open Source Framework AngularJS mit den darin veranlagten Komponenten zum Umsetzen des MVC-Entwurfsmusters ermöglichte es die Javascript-basierten Nutzerinteraktionen im Rahmen von HTML zielgerecht zu Implementierten. Zur Umsetzung dieser auch in einem herkömmlichen Webbrowser bezüglich Skalierbarkeit in eine Webanwendung bedienbare Programmlogik als plattformunabhängige Desktopanwendung wurde die Open-Source Bibliothek von Electron verwendet. Sie baut auf der plattformunabhängigen Browserkomponente Chromium auf und bedient sich daher des Rendering-Engine zur Darstellung der in HTML und CSS designten Oberfläche auf dem Bildschirm. Zudem nutzt Electron die in der JavaScript-Laufzeitumgebung (V8) laufende Implementierung von der umfänglichen Komponenten-Bibliothek Node.js. Letztere bietet eine Vielzahl an offenen Javascript Komponenten, auch bezüglich Interaktionen mit (lokalem) Betriebssystem und dient verschiedenen Bestandteilen der Software als Grundlage, beispielsweise der Abwicklung von Dateisystemzugriffen, oder dem Zusammenspiel von Datenmodell und Ansichten.

4.2 Beschreibung des Werkzeugs und seiner Anwendung

4.2.1 Datenkonfiguration (Nutzerdatenaufbereitung für den Anwendungskontext)

Das Werkzeug wird „leer“ ausgeliefert, d.h. im Prototyp sind keine eigenen kommunalen Daten enthalten. Die Nutzer müssen die aus offen verfügbaren Datenquellen beschafften bzw. (selbsterfassten) Datensätze selber in eine vorgesehene Ordnerstruktur auf ihrem Betriebssystem einpflegen. Vor dem ersten Start der Anwendung werden hierfür Datensätze des Wegweiser Kommune Informationssystems der Bertelsmann Stiftung unverändert heruntergeladen oder an deren Struktur angelehnt eigene Datensätze erzeugt. Dabei ist es wichtig alle Zeitreihen der Indikatoren jeweils in einem Tabellendokument pro Kommune abzulegen und die gleiche Inhaltsstruktur (vgl. Abbildung 4) beizubehalten.

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Eine übersichtliche Beschreibung der verschiedenen Stränge zur Datenaufbereitung, damit die Daten im Prototyp verwendet werden können, ist in den untenstehenden in BPMN abgebildeten Prozess (siehe Abbildung 3) dargestellt. Standardmäßig können die vorhandenen Datensätze des Wegweisers heruntergeladen und direkt verwendet werden. Dabei können die Nutzer jeweils einzeln bzw. gebündelt zu den Hauptthemen die Datensätze zu einer Kommune beziehen und in einem Tabellendokument die für ihre Analysen bedeutsamen Indikatoren zusammenführen. Darüberhinaus kann in einem ergänzenden Datenaufbereitungsstrang dieses kommunenspezifische Dokument um weitere, selbsterhobene bzw. aus anderen Datenbezugsquellen bezogene Indikatoren sowie entsprechende Jahreswerte erweitert werden. Prinzipiell können auch eigene Datenblätter zu Gebietskörperschaften neu angelegt werden, wie beispielsweise zu einer Kommune, weitere Stadtteile mit detaillierteren oder der Kreis bzw. die Region mit gemittelten Indikatorenwerten.

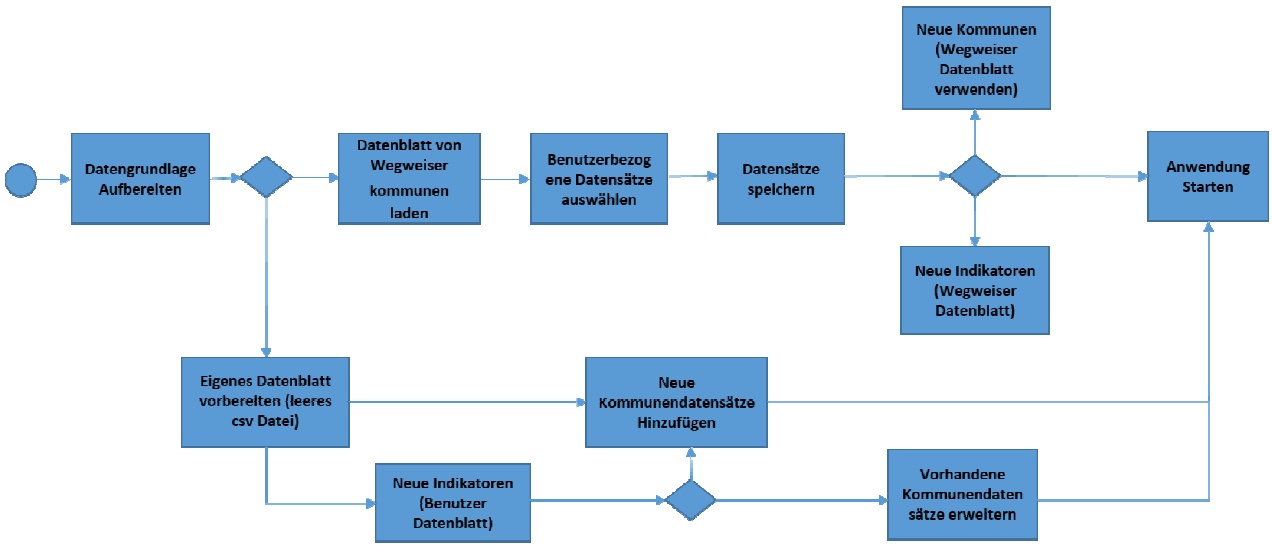

Abbildung 3: Prozessbeschreibung zur Datenaufbereitung der Kommunen

In Abbildung 4 wird ein Beispiel eines Tabellendokuments dargestellt, in dem auszugsweise Indikatoren des Wegweiser Haupthemas Demographischer Wandel sowie zwei eigene (rot markierte) Musterindikatoren die obligatorische inhaltliche Struktur der einzelnen Datensätze veranschaulichen. Neben dem dargestellten Hinzufügen neuer Indikatoren können auch nur Jahreswerte für bereits vorhandene Indikatoren eingepflegt werden.

A1 | Wegweiser Kommune

	A	B	C	D
1	Wegweiser Kommune			
2	Demographischer Wandel			
3				
4	Indikatoren	Aachen2011	Aachen2012	Aachen2013
5	Bevoelkerung (Anzahl)	238.665	240.086	241.683
6	Zuzuege (je 1.000 Ew.)	66,9	69,9	74,1
7	Fortzuege (je 1.000 Ew.)	64,7	66,6	68,5
8	Wanderungssaldo (je 1.000 Ew.)	2,2	3,3	5,6
9	MUSTERINDIKATOR 1	100	101	102
10	MUSTERINDIKATOR 2	100	101	102

Abbildung 4: Auszug einer (benutzerspezifisch angepassten) CSV-Datei der Bertelsmann Daten zu Aachen

Alle Daten die jeweils für eine Gebietseinheit auf die sich die beinhaltenen Indikatoren beziehen in einem eigenen Tabellendokument angelegt sind können von dem Prototyp berückichtigt werden. Damit bedeutungsvolle interkommunale Benchmarks bzw. Vergleiche zu lokalen Situationen in der Software aufbereitet werden können ist beim Aufbau der eigenen Datenbasis auf das Vorhandensein der gleichen Indikatoren respektive der gleichen Jahreswerte in den einzelnen Tabellendokumenten der gegenüberzustellenden Gebietseinheiten zu achten.

Alle benutzerspezifischen Daten werden generell auf dem Computer im Benutzerverzeichnis in einem Ordner „Data“ als Comma-Separated-Values (CSV) Tabellendokumente abgelegt bzw. erstellt und bearbeitet. Gemäß folgender Namenskonvention werden dabei die einzelnen Dokumente für das Einlesen in den Prototyp bezeichnet, damit aus den bedeutungsvollen Dateinamen die Metadaten zu den beinhalteten Datensätzen interpretiert werden können. Der Dateiname wird hierbei jeweils mit einem Unterstrich („_“)

getrennt zusammengestellt aus dem Namen der Gebietseinheit (Kommune usw.) optional gefolgt einer Spezifizierung der Daten, beispielsweise zum Anzeigen der Quelle und abschliessend ergänzt mit dem Zeitraum in Form der Jahre(sspanne) der beinhaltenen Indikatorenwerte. Eine Bezeichnung des Beispieldatensatzes der Kommune Achen mit Indikatorenwerten zwischen 2011 und 2013 könnte somit „Aachen_Musterdaten_2006-2018.CSV“ lauten. Mittels zwei entsprechender Musterdateien werden die für eine bedeutungsvolle Anwendung des Prototyps zumindest benötigten Daten für den Nutzer veranschaulicht. Darin sind jeweils zwei Indikatoren mit jeweils zwei verschiedenen Jahreswerten als Muster angelegt, die den Umfang benötigter Daten darstellen, damit alle designierten Programmfunktionen angewendet werden können.

4.2.2 Konzepte zur Benutzerführung

Vor der Beschreibung der einzelnen Ansichten und darin angesiedelten Nutzerinteraktionen werden im Folgenden die Grundkonzepte der Bedienoberfläche des Prototyps erläutert. Die Benutzeroberfläche ist dabei, wie in Abbildung 5 abgebildet, in drei Funktionsbereiche gegliedert:

(1) Das „Steuerrad“ (links oben) aktiviert die Zugriffe auf die Teilfunktionen der Anwendung. Diese werden im Hauptfenster angezeigt.

(2) Das Verwaltungsfenster (links unten) ermöglicht es, kontextbezogene Einstellungen zu treffen oder diese zu verwalten.

(3) Das Hauptfenster (rechts) zeigt die aktuelle Teilfunktion an, beispielsweise die anpassbaren Konfigurationseinstellungen vom Benutzer zur Kommunen- bzw. Indikatorenauswahl, oder die Ergebnisse/Animation des Benchmarkingergebnisses.

Zur Gewährleistung aller erforderlichen (auf einander aufbauenden) Konfigurationen – Projekt auswählen, Kommune(n) auswählen, Indikatoren auswählen – bevor den Anwenderinnen die Anzeige eines entsprechenden Ergebnisses ermöglicht wird, ist erst nach dem erfolgreichen Durchlauf der einzelnen Einstellungen in den Detailkonfigurationsansichten das zentrale Steuerrad-Element mittels Abspielsymbol gekenzeichnet und zur Navigation in die Ergebnisansicht freigeschalten. Wenn bereits entsprechende „vorkonfigurierte“ Projekte vorhandenen sind kann über dieses zentrale Element auch „abgekürzt“ in einen darin konfigurierten Analysefall gesprungen werden (vgl. Kap. 4.2.3).

Abbildung 5: Oberflächeneinteilung und Steuerungselemente

4.2.3 Projektverwaltung (Start- und Projektansicht)

Beim Starten des Prototyps wird im Hauptfenster eine Willkommens-Meldung angezeigt (Abbildung 3) und der Benutzer befindet sich damit bereits in der Projektverwaltungsansicht In dieser Ansicht wird im Verwaltungsfenster eine Liste alle verfügbaren Projekte (vgl. Abbildung 3) angezeigt. Ein Musterprojekt ist standardmäßig bereits angelegt (vgl. Musterdaten in Kap. 4.2.1). In der Projektliste kann ein Projekt zur Bearbeitung ausgewählt werden und wird als aktuelle Selektion hervorgehoben (fett und orange unterlegt) in der Liste dargestellt. Durch die unterhalb des Fensters befindlichen Schaltflächen können Projekte angelegt, dupliziert und umbenannt, oder auch gelöscht werden. Neben dem Bezeichner können einem Projekt in

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dieser Ansicht eine Beschreibung zugeordnet werden. Zu Austausch- bzw. Archivierungszwecken können die Projekte in die Liste ex- bzw. importiert werden, dazu werden die Projektmetadaten zusammen mit der Datenbasis in einer komprimierten Datei verpackt.

Vor der Auswahl eines Projektes sind die Schaltflächen des Steuerrades nicht freigeschalten (ausgegraut). Bestimmt durch den Stand der Detailkonfigurationen in einem selektierten Projekt werden dann die Steuerad-Elemente freigeschalten. Dabei beinhaltene Konfigurationsmöglichkeiten (im Projekt gespeicherte Einstellungen sowohl in der Kommunen- als auch der Indikatorkonfiguration; vgl. Kap. 4.2.4 bzw. Kap. 4.2.5), die wiederum den Konfigurationsstand des selektierten Projekts bestimmen können jeweils einem der folgenden drei Fälle zugeordnet werden:

(a) Es existiert jeweils nur eine Einstellung zu der Kommunen- sowie zu der Indikatorauswahl, daher kann über das zentrale Steuerrad-Element direkt zur Ergebnisansicht mit der aus der Kombination der beiden Einstellung erstellten Analysegrafik navigiert werden.

(b) Es existieren drei oder mehr gespeicherte Einstellungen, dabei jeweils mindestens eine Einstellung zu der Kommunen- sowie zu der Indikatorauswahl, durch Betätigen des zentralen Steuerrad-Elements werden in einem Kontextmenu alle möglichen Kombination der beiden Einstellungsmöglichkeiten zur Navigation in eine entsprechende Ergebnisansicht präsentiert.

(c) Existiert keine Einstellung oder nur einseitig – entweder in der Kommunen- oder der Indikatorkonfigurtion – dann ist das zentrale Steuerrad-Element nicht navigierbar (ausgegraut) und es müssen zunächst die Detailkonfigurationen druchgeführt bzw. vervollständigt werden.

Wenn beispielsweise ein (neuangelegtes) unvollständig konfiguriertes Projekt in der Projektliste selektiert wird (vgl. Fall 3) kann ein Analyseergebnnis erst angezeigt werden, wenn die erforderlichen Einstellungen zur Auswahl von mindestens einer Kommune (vgl. Kap. 4.2.4) sowie von mindestens zwei Indikatoren (vgl. Kap. 4.2.5) über die entsprechend freigeschaltenen Schaltflächen des zentralen Steuerrads. Prinzipiell kann dabei beliebig zwischen allen drei Konfigurationeansichten des Prototyps gewechselt werden, alle darin jeweils gemachten Änderungen sind direkt wirksam und entsprechend geänderte Projekte bzw. Einstellungen lokal abgespeichert.

4.2.4 Auswahl der Kommune(n) (Kommunenkonfigurationsansicht)

Durch das Betätigen der Schaltfläche „Kommunen“ wechseln die Anwender in die Kommunenkonfiguration, diese Ansicht wird durch das (gelb) hervorgehobene Steuerrad-Element angezeigt (vgl. Abbildung 6).

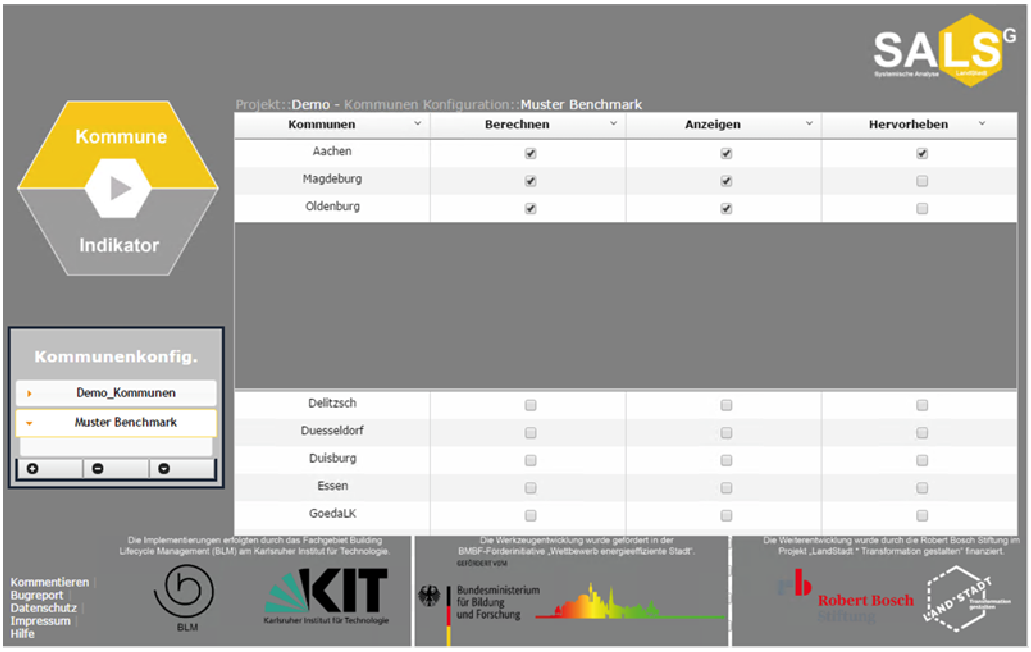

Abbildung 6: Auszug aus der Kommunenansicht

Sind im selektierten Projekt bereits Einstellungen, wie beispielsweise eine Auswahl von zwei zu vergleichenden Kommunen, in der Konfiguration abgelegt, werden diese im Verwaltungsfenster gelistet und

können direkt als ein erster Teil der Konfiguration einer intendierten Auswertung selektiert werden. Mit der Selektion einer Kommuneneinstellung in der Auswahlliste, ist sie bezüglich einer aktuell zu konfigurierenden Auswertungsgrafik aktiviert, d.h. wenn bereits eine Einstellung in der Indikatorkonfiguration aktiviert wurde (vgl. Kap. 4.2.5) kann direkt über das nun freigeschaltene Steuerrad-Element in die Ergebnisansicht gewechselt werden. Durch die weiteren Schaltflächen + und – unterhalb der Auswahlliste können neue Einstellungen hinzugefügt bzw. Selektierte gelöscht werden. Im Hauptfeld der Konfigurationsansicht werden für jede in der Auswahlliste selektierte Einstellung rechts alle in den Datensätzen verfügbaren Kommunen gelistet, die vom Anwender zusammengestellt werden können. Die eigene Zusammenstellung wird dabei in der oberen Hälfte der Listung (Abbildung 6) angezeigt. Neben einer Checkbox „Berechnen“ zum Hinzufügen in die Zusammenstellung, sind jeder Kommune weitere Checkboxen bezüglich ihrer grafischen Darstellung in der Auswertungsgrafik zugeordnet. So können die Werte Kommune generell über die Checkbox „Anzeigen“ ein und ausgeblendet werden oder gegenüber anderen Werten mit der Checkbox „Hervorheben“ farblich markiert werden. Eine Mehrfachauswahl ermöglicht den Anwendern eine individuelle Gestaltung der in der Einstellung zusammengestellten Kommunen für die grafische Auswertung.

4.2.5 Auswahl der Indikatoren (Indikatorkonfigurationsansicht)

Durch das Betätigen der Schaltfläche „Indikatoren“ wechseln die Anwender in die Indikatorenkonfiguration, durch das (gelb) hervorgehobene Steuerrad-Element wird dieser Wechsel den Anwendern angezeigt (vgl. Abbildung 7). Analog zur Kommunenkonfiguration werden gegebenfalls im selektierten Projekt bereits vorhandene Einstellungen, in denen jeweils zwei Indikatoren zusammengestellt abgelegt wurden, im Verwaltungsfenster gelistet und können direkt als ein zweiter Teil der Konfiguration einer intendierten Auswertung selektiert werden.

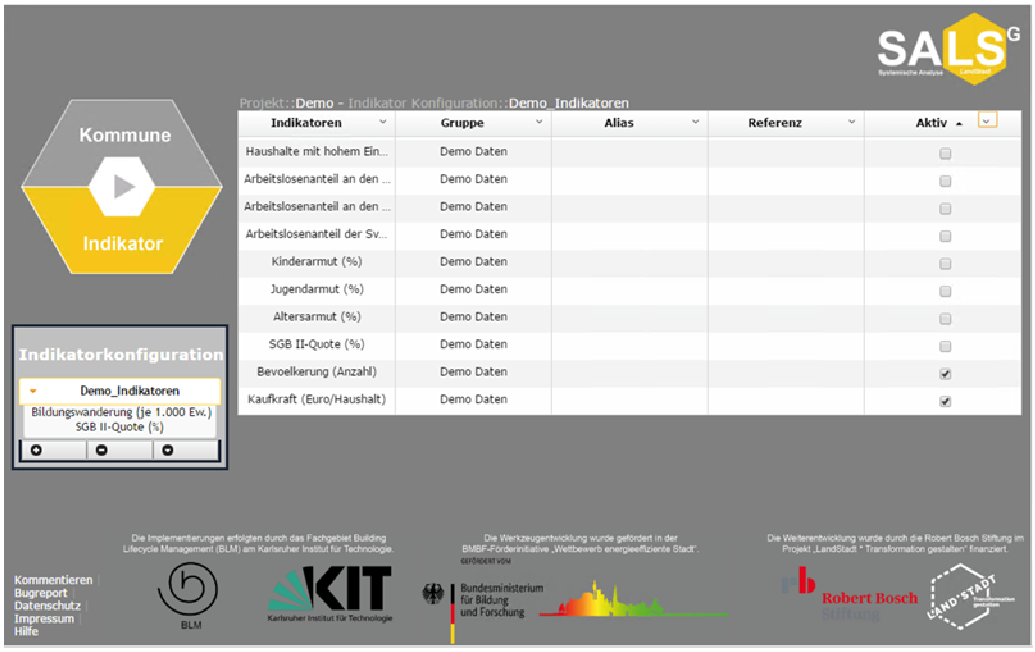

Abbildung 7: Auszug aus der Indikatorenansicht

Somit kann bei gegebener aktiver Einstellung in der Kommunenkonfiguration mit der Selektionen einer Indikatoreneinstellung in der Auswahlliste direkt über das nun freigeschaltene Steuerrad-Element in die Ergebnisansicht (vgl. Kap. 0) gewechselt werden. Zum Erstellen bzw. Entfernen von Einstellungen stehen entsprechende Schaltflächen unterhalb der Auswahlliste bereit. Zur jeweils selektierten Einstellung werden im Hauptfenster tabellarisch alle in den Datensätzen vorhandenen Indikatoren angezeigt. Für die Auswertung sind vom Anwender darin dann zwei Indikatoren zusammenzustellen, in dem die entsprechende Checkbox „Aktiv“ angehakt und somit in der Einstellung abgelegt wird.

4.2.6 Auswertung und Ergebnisse anzeigen (Chartansicht)

Wenn eine Auswertung vollständig durch das Aktivieren sowohl einer Kommunen- wie auch einer Indikatoreneinstellung in den Konfigurationsansichten konfiguriert ist, wird die zentrale Schaltfläche im

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Steuerrad freigeschalten und als „Abspiel“ Symbol dargestellt (vgl. Abbildung 7). Darüber kann in den Ergebnisansicht (vgl. Abbildung 8) gewechselt werden. Im Hautbereich wird das um 45 Grad gedrehte Diagramm angezeigt, bei dem jeweils ein Indikator die X-Achse und einem Indikator die Y-Achse zugewiesen ist. Die Darstellung kann durch verschiedene Anzeigeoptionen im Verwaltungsfenster justiert werden. Generell kann dabei zwischen den beiden Ansichtsmodi eines Eintwicklungs- bzw. Benchmarkdiagramms (vgl. Kap. 3.2) ausgewählt werden. Zudem können beispielsweise die dargestellten Indikatorenwerte im Diagramm invertiert werden, wobei die hohen Werte zum Achsenschnittpunkt hin ausgerichtet werden. Äquivalent zu den Einstellungen in den Konfigurationsansichten können für ein konfiguriertes Auswertungsdiagram jeweils zusammengestellte Ansichtsoptionen in verschiedenen Einstellungen zur Darstellung des Charts angelegt, gelöscht, umbenannt bzw. ex- und importiert werden.

Während die ganze Zeitreihe im Entwicklungmodus im Chart angezeigt wird, können im Benchmarkmodus mittels eines Schiebereglers unterhalb des Diagramms die einzelnen Jahreswerte im Diagramm dargestellt werden. Darüber hinaus ermöglicht eine Schaltfläche „play“ ein dynamisches Benchmark zu vergleichender Kommunen, in dem die einzelnen Jahreswerte nacheinander dadurch in einer Animation abgespielt werden können. In einen nach dem Projekt benannten Ordner im Nutzerverzeichnis können sowohl alle Einzelgrafiken der Animation wie auch jede einzeln navigierte Diagrammansicht als Bilddatei im PNG Format gespeichert werden.

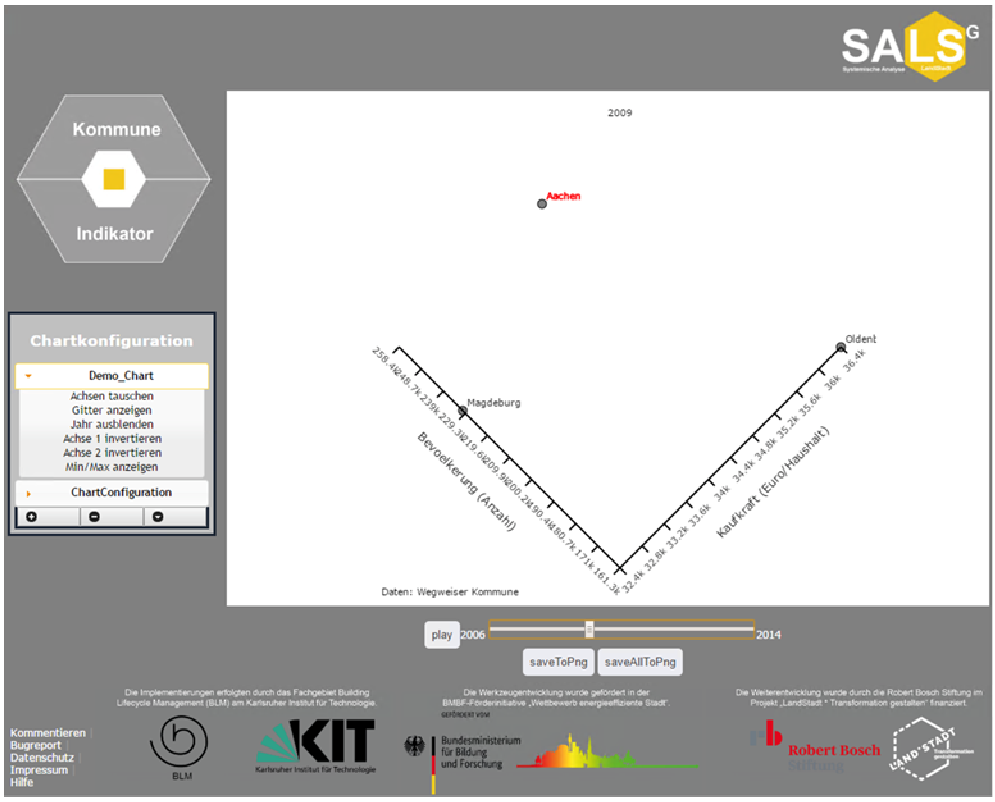

Abbildung 8: Auszug aus der Analyseansicht

5 ZUSAMMENFASSUNG

Im Beitrag wird ein einfach zu bedienendes IT-gestütztes Hilfsmittel vorgestellt, das Kommunen unterstützen soll sich an den offen verfügbaren Datenquellen beim Analysieren ihrer lokalen Situation bedienen zu können. Im Rahmen von zwei Forschungsprojekten wurde eine prototypische plattformunabhängige Software entwickelt und frei zur Verfügung gestellt, mit der sich die Anwender auf Basis ihrer selbstverwalteten Datensätze eigene Auswertungsdiagramme für ihre Kontextanalysen zusammenstellen können. Neben dem Aufbereiten von jeweils zwei in Beziehung gesetzen Indikatoren entlang der vorhandenen Jahreswerte zur Verdeutlichung einer Entwicklung, können auch unter Hinzunahme der Werte weiterer Kommune interkommunale Vergleiche angestellt werden. Indem diese jeweils für die Jahreswerte in einer Sequenz abgespielt werden können wird zudem ein „dynamisches“ Benchmark durch das Werkzeug

ermöglicht. Für Weiterverwendung in der Planung können alle erzeugten Diagramme als Bilddateien exportiert werden.

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🏆 *reviewed paper*

Analysing and Evaluating Gender+ Specific Requirements in Urban Space to Support Urban Planning

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1 ABSTRACT

The research project called Smart Through Gender+ aims to support a gender+ appropriate urban planning and investigates on how new GIS based spatial planning tools can assist analysing the available data. In this context, gender groups are not only determined by sex, but by further factors which are considered to shape a person's urban routines.[1] Those groups are referred to as gender+ groups. For the case study area of Linz, a medium sized city in Austria, data from different sources like official statistics (Statistics Austria), Open Government Data (OGD), OpenStreetMap (OSM), Foursquare and TomTom have been evaluated. The focus is on data about infrastructure, services and facilities that are crucial for daily routines and the everyday life patterns of certain gender+ groups. The analysis is centred upon the principle residence of the citizens. This data is used to correlate supply and demand, deficits and potentials.

Based on the "city for all" approach, different gender+ groups and their specific spatial demands were identified in the course of the research project. This paper demonstrates the creation of gender+ specific supply and demand maps. For increased readability and comparability, a unique key performance indicator (KPI) was developed, which evaluates the appropriateness of the urban space to the needs of a specific gender+ group. This KPI set is a combination of spatial, infrastructural and demographic features, the classification is based on median values.

The resulting maps 1) express the current situation highlighting especially areas where the current infrastructure offer, and the available functions and facilities show need for improvement and 2) expel areas which possess the potential for an increased demand due to an already existing infrastructure for a specific gender+ group. Generally speaking, the resulting maps facilitate planning decisions within given spatial circumstances, which might range from easily adjustable services to fixed, immovable infrastructure.

The paper further discusses the different data sources and analysis methods, as well as the workflow of creating the maps of the current situation. The data basis as well as generalisation and simplification – both in terms of map creation and formation of gender+ groups – is critically reviewed. It finally concludes with the potential involvement of the demand and supply maps to display and validate future demographic development scenarios, as well as to support accompanying urban planning decisions. Decisively based on open data the developed tool shall be applicable to further Austrian cities, providing planners with a first overview of hotspot areas concerning gender+ appropriate design of a given city.

Keywords: Demographic Change, GIS Analyses, Urban planning tools, Open Data, Gender appropriate urban planning

2 INTRODUCTION

Cities are facing a fast change in their population, their needs and thus the requirements and demands. Social change processes and the global trend towards urbanization, as well as the current migration pressures on European cities are increasingly posing a major challenge to respond to the processes of change in urban planning. Although gender issues are considered important in some cities, they are often disregarded in planning practice due to the many other issues and the time and money spent on spatial research (especially in smaller and medium-sized cities). Cities always have been areas wherein different user groups, males, females, young and old, as well as different ethnic groups lived – and all of whom have different needs for urban functions. The current trend of migration even increases the requirement to cope with the different demands of citizens and to understand, which infrastructure and functions of a city have to be provided at which location. In this context, gender groups are not only determined by sex, but by further factors which are considered to shape a person's urban routines. Those groups are referred to as gender+ groups in this paper.

[1] such as age, household size, employment and country of origin

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Furthermore, the role of urban planning and urban planners in shaping cities and regions changes increasingly as new data sources allow a more detailed insight in the spatial distribution of functions and forms of cities. Since the 1970s, an increasing consideration of gender-specific aspects in planning theory and practice has become apparent (Damyanovic and Zibell 2013). Since the gender mainstreaming strategy was anchored in the Amsterdam Treaty, there has also been an increased implementation of this strategy and thus of gender-specific aspects in urban planning. Some cities e.g. Berlin, Vienna have published guidelines on the integration of gender issues in urban planning and development (Stadt Wien, 2013). Only four of the 12 bigger cities in Austria refer to the gender mainstreaming strategy, use gender-disaggregated data or point out the different demands of women and men (Reinwald et al., 2016).

Digital tools for the analysis of socio-spatial structures and for the simulation of measures and their effects are increasingly used in urban planning. These tools though lack the integration of gender and group-specific aspects. Gender-sensitive urban planning is, as one of the basic principles, dependent on gender-specific disaggregated data.

3 SMTG+ PROJECT AND CASE STUDY LINZ

The project "SmartThroughGender+" (SMTG+) develops solutions for this, it investigates on how new GIS based spatial planning tools can assist analysing the available data. Traditional planning tools, such as local development concepts, have difficulty coping with the rapid changes and aligning goals and measures with long review periods. "SmartThroughGender+" aims in integrating gender+ aspects into a toolset to support urban planning. The overall objective of the project is a Proof of Concept if this toolset consisting of (quantitative) digital analysis and simulation tools as well as (qualitative) instruments from urban and landscape planning, taking into account gender+ specific requirements, enables to support gender+ sensitive urban planning. Thus, on the basis of a case study in the city of Linz (Austria), it examines based on commonly available data if and how indicators and characteristics can be developed to enable a (partially standardized) "rapid assessment" of social and spatial structures while taking the gender+ approach into account. SMTG+ develops quantitative tools on different spatial resolutions. One is developed at the overall level and a cell resolution of 250m*250m for the entire city to investigate “hot spots”, which possess an above average demand for gender+ sensitive urban planning. This quantitative tool is based on statistical data from the national statistic agency (Statistic Austria) and Open Government Data (OGD) and sources like OpenStreetMap (OSM), Foursquare and TomTom. The tool is implemented as a web application using R-Shiny. For a district, which was chosen based on the results of a GIS analysis and stakeholder judgement, a quantitative tool on the level of building blocks will be developed using Rhinoceros3D/Grasshopper and a parametric modelling concept. In order to validate, test and clarify the results at the overall level, a qualitative analysis is carried out at district level in which participatory statements are examined and proposals for measures are worked out (combination bottom-up and top-down). This qualitative analysis will also be combined on district level with the quantitative parametric design tool later. The project lasts till Mai 2021, thus in this paper we will focus on the already developed method for the GIS analyses at the overall (entire city) level and the first results and findings of the implementation into an interactive web application.

4 DATA SOURCES AND EVALUATION OF USE

In order to be able to carry out quantitative analyses at overall (entire city) level, different data sources were examined. The focus is on commonly available data to easily transfer the methodology to other cities. A good availability and standardised form of the data sets is essential for the automated processing and analysis of the data. In addition to the availability of the data covering a wide area, the relevance of the data and the implementation of updates is an essential requirement. Data sets which show the development in cities over a period of several years prove to be particularly helpful. In the presented project, demographic data and location data on selected uses were used for the analyses.

For the demographic information on the population the data of the national statistical agency (Statistics Austria) were used in a cell resolution of 250m*250m for the calculations. Here there is a wide range of different categories (family, household, population structure, ...), which represent the population structure on a grid available throughout Austria. In the analysis presented, data on age, gender, ethnicity, household size and marital status are examined. This information is available as bundled packages and can be purchased commercially on individually selected regions. The principle residence is used for the evaluation of

population distribution and accessibility of the daily infrastructure. The availability of everyday facilities close to the workplace is therefore not represented. The data source Statistics Austria has proved to be very suitable according to the demographic data for the application in the project and the transfer of the tool to other Austrian cities.

Location data was used to check the availability and accessibility of daily local supply. The following data sources were tested for their usability: TomTom, OpenStreetMap [OSM] and Open Government Data [OGD]. Location data is available in different geometrical forms [points, polygons] and therefore the usability of data depends on the usage. The supply of daily infrastructure (e.g. shops, education, social infrastructure) can be expressed geographically by points of interest [POI]. However, the sufficient supply of green spaces requires the outlines (polygons, areas) to include the size of the parks in the calculation.

For the analysis of points of interest, comparisons were made between different data sources. The different classification schemes within the data sets form a challenge for counting and comparing characteristics (Hochmair and Zielstra 2013). For the project the TomTom data was bought as points (POIs) data set and the road network as lines for the overall city level. The POIs are available for the overall city of Linz in 2018 with 5571 points and in 2019 with 5667 points. The structure of the data is organized by PACKNAME, in by LABELNAME and by SUBNAME as a clear description of the point information. By applying filters, selected uses from POIs can be included in the evaluation. This means the data is described in the first level (Package) Eating & Drinking, in the second level (Labelname) Café or Pub which is on the third level (Subname) differentiated in Café, Coffee Shop, Pub or Empty.

PACKNAME	LABELNAME	SUBNAME	COUNT
Eating & Drinking	Café or Pub	Café	46
Eating & Drinking	Café or Pub	Coffee Shop	3
Eating & Drinking	Café or Pub	Pub	20
Eating & Drinking	Café or Pub	Empty	40

Table 1: Example on Structure of TomTom data

It was determined that not all POIs contain information in the SUBNAME, this affects that filtering POIs in the third level can cause a loss of data (POI). The percentage distribution of POIs on the PACKAGES also shows that the focus is on business (34.3%) and shopping (31.3%). The necessary basic health care is represented by 10.3% of the POIs and the food & drink category by 9.8%.

The advantage of the open source dataset of OpenStreetMap [OSM] is, a worldwide availability of data. However, the data is created by a user community in a different level of detail and is not validated by the providing company like TomTom. Hence the inclusion of this OSM POIs in the analyses can be beneficial in some applications.

The amount of pharmacies in Linz can be well compared among the different data sources. The lower Figure 1 shows the distribution of pharmacies in Open Government Data, OpenStreetMap and TomTom of the currently available datasets.

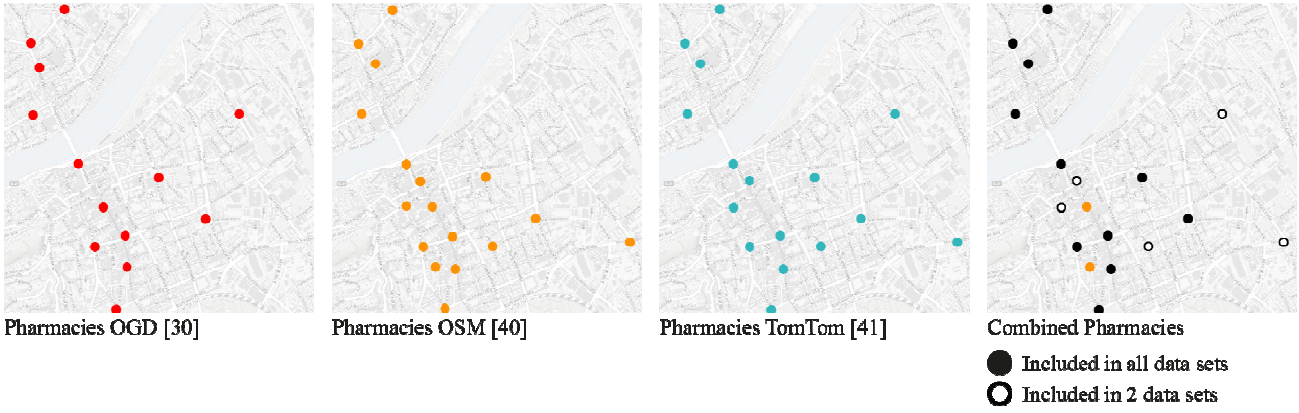

Fig. 1: Distribution of Pharmacies [POI] in Linz – Open Government Data, OpenStreetMap & TomTom © AIT

A comparison of the data sets showed that not only the location of the point data varies, but also the number of POIs in the urban area. For the general accessibility in a 250m raster the geographically exact location on

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a few meters variance is negligible. However, the completeness of the data sets is an essential quality criterion. This insight raises the need for validation of the data within the research project which as a necessary step for a representative statement of the analyses. A detailed documentation of the processing and integration steps must be done in order to enable an optimized work when transferring the method.

The analysis of the polygons (e.g. green areas and open spaces) was based on the official zoning data by Open Government Data [OGD]. The dataset contains the polygons by function and therefore provides information about the area coverage of urban green areas for the population. For the calculation of the supply of open spaces, not only the distance but also the size, type and quality of the open spaces are relevant.

5 GENDER+ SPECIFIC SUPPLY AND DEMAND

The main idea is to combine the demand based on the spatial distribution of the different gender+ groups, with their needs regarding infrastructure as well as green and open spaces distribution. This means a combination of three factors so-called scores. A demographic score, an infrastructure score and a spatial score (green and open space score). All together -the combination of three single scores- was integrated to the so-called gender+ score, a unique key performance indicator (KPI) to investigate how the demand and supply matches Figure 2.

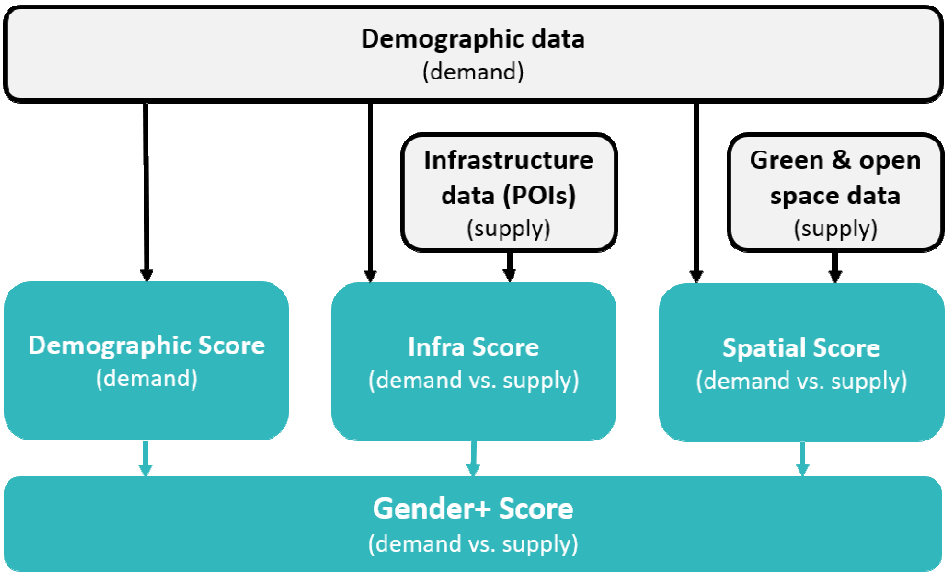

Fig. 2: Gender+ score schemata © AIT

First step to analyse gender+ specific supply and demand was to create the gender+ specific groups. This was established based on gender experience from the projects, desktop research and the available data. The following table shows the chosen gender+ groups for the analysis at the overall city level.

Gender+ Group Name	Sub-groups	Comments
Unemployed	male, female	Source: Statistik Austria
Persons 70+	male, female	Source: Statistik Austria
Childrens 0-9	male, female	Source: Statistik Austria, age groups available in 5-year steps (0-4, 5-9, 10-14, 15-19,…)
Non-German mother tongue	male, female	Source: Statistik Austria
One-parent families	parent-male, parent-female	Source: Statistik Austria
Households with more than 5 persons	-	Source: Statistik Austria,
Single households	-	Source: Statistik Austria, no male or females are available

Table 2: Investigated Gender+ groups

All these groups have their own set of requirements to fulfil their needs regarding all day infrastructure, mobility, security, health, leisure equipment etc. Which does not mean that there are no common needs for all, like open spaces or food shops, but with different weights in their daily life.

The second step was to explore these different needs for the gender+ groups regarding infrastructure and green and open space distribution. This step included searching for available spatial data to derive the single scores. The third step was to develop methods to derive the single scores and to combine them into a so-called Gender+ Score.

In this paper we focus exemplarily on one important group and show how this was done, namely for the gender+ group children females 0-9 years. The demographic data from statistic shows individual numbers of children which were classified into three quantiles visualized with lower case letters of “a”, “b”, “c”, as can be seen in Figure 3.

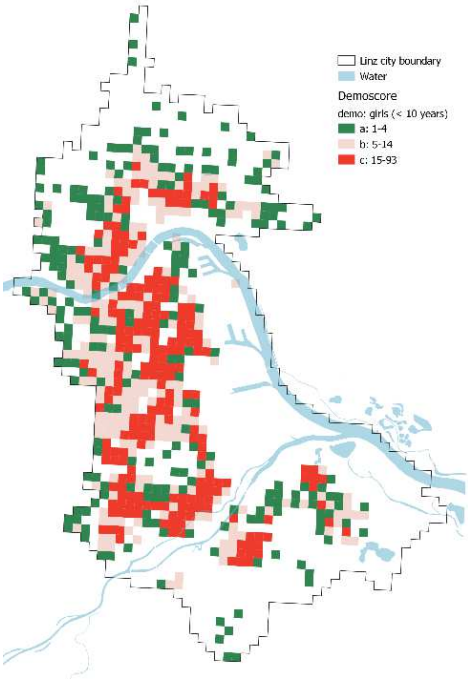

Fig. 3: Demographic score gender+ group female children 0-9 years © AIT

Regarding the infrastructure score a list of factors was found as important to be in close distance to the demand of the specific gender+ group. We used data from several sources mainly TomTom and OGD to calculate Euclidian distance maps to the individual factors called Points of Interests (POIs). First results have shown that due to the difference in the spatial distribution of some of the factors weights have to be used not to create biased maps. The following table shows the list of POIs as well as default weight factors chosen, to create the map depicted in Figure 5.

POI category	**weight factor**
Hort	0.7
Youth centre	0.3
Playground	0.8
Kindergarten	1
Park	0.8
Day sursery	0.5
Library	0.2
Music school	0.5
School	1

Table 3: Gender+ specific POIs and default weight factors, ©AIT

Similar as it was done for the demographic score where we categorised the euclidian distances to combined weighted infrastructure into three classes using quantiles. This time we used upper case letters “A”, “B”, “C”. The following Figure 4 shows the resulting possible combinations of the demographic and infra scores.

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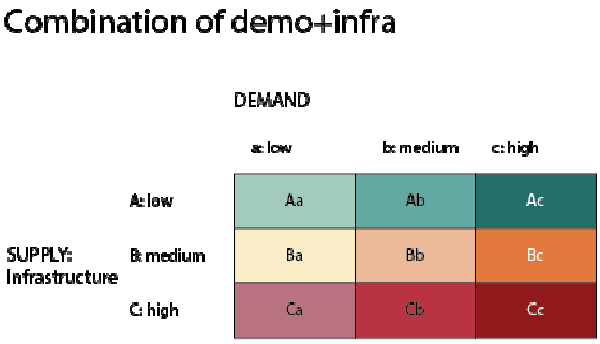

Fig. 4: Possible combinations of demographic and infrastructure score classes © AIT

This allows to understand for each class it's cause, e.g., "Ca" as low demand (few girls living in the given cell) and high supply of the relevant social infrastructure, as can be seen in Figure 5.

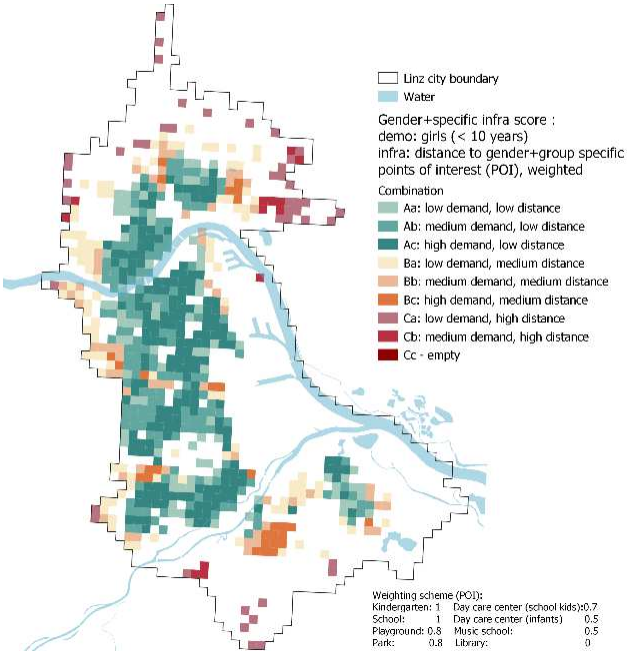

Fig. 5: Gender+ specific INFRASCORE (female children 0-9 years) © AIT

For the gender+ group childrens 0-9 also a spatial score (green and open space score) was calculated distinguishing between different sizes of green spaces. The categories were classified according to their size. For each category a distance was defined as the maximal acceptable distance based on expert judgement and former studies. The following table shows the chosen size and default maximal acceptable distance for the green space categories.

Green space category	**Size**	**Maximal acceptable distances**
Neighbourhood	<1 ha	250m
Residential area	1-3 ha	500m
District: small greenery	3-10 ha	1,000m
District: big greenery	10-50 ha	1,500m
City region	>50 ha	6,000m

Table 4: Gender+ specific POIs and default weight factors, (Wien and Magistratsabteilung 18 2015)

The calculated spatial score is thus a combination of the different green space categories and therefore a well supplied location would be one if all categories are reachable within the maximal acceptable distances. The first analyses showed that a simple counting does not achieve an informative result as for example the big green space in the case study area was accessible within all locations (250m*250m) raster cells in Linz. And furthermore, if for example a green space of 40ha would be in a distance of 1,750m it would be accounted as

not acceptable (>1500m), but 250m is only a minor deviation compared to 1500m. Taking the same transgression into account for the smallest green space, the neighbourhood category, this green space would be twice as far away as it is aimed for. To avoid this a method has been developed named inaccessibility transgression. This method calculates for each green space category the percentage of inaccessibility compared to the maximal acceptable distance. Only transgressions are taken into account. If the closest green space of the given category is within the maximum acceptable distance, the percentage will be 0. The following Figure 6 shows a schematic representation of this method.

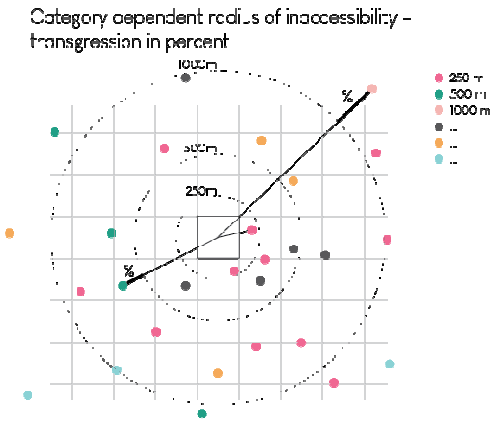

Fig. 6: Inaccessibility transgression © AIT

The calculated inaccessibility transgression was classified in the same way as the demo and infra scores using quantiles into three classes. To combine the demographic score with the spatial score the following combinations were used (Figure 7).

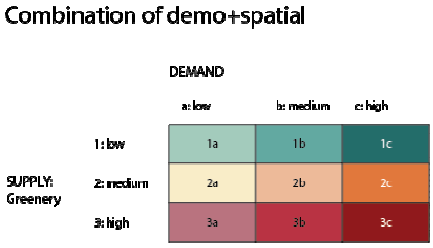

Fig.7: Possible combinations of demo and spatial score classes © AIT

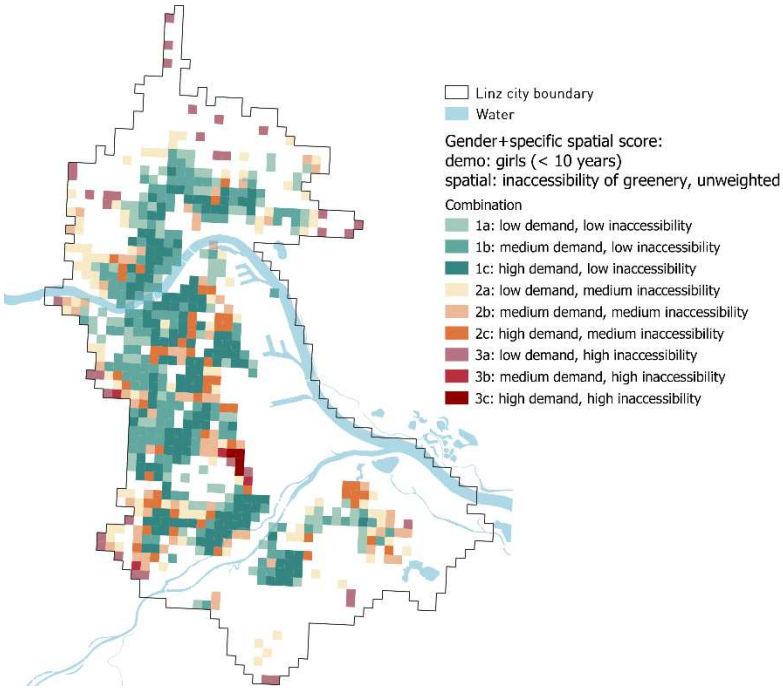

Fig. 8: Gender+ specific SPATIAL SCORE (female children 0-9 years) © AIT

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The gender+ specific spatial score in Figure 7 shows areas with high demand and low inaccessibility, meaning well supplied areas but also with a high demand and thus bear no high potential to increase the specific gender+ group there. The map also enables to find areas currently not appropriately supplied with access to the green infrastructure (classes “3c”and “3b”) as well as areas with a high potential for further increase of gender+ specific demand (i.e. in this case more females 0-9 year).

Last but not least, the above described scores have been combined to the Gender+ Score. The combination of the three criteria would give 27 different gender+ score classes, which would result in a very complex map (Figure 9 left). To simplify the visualisation and identify the “hot spots” we concentrated on the extreme values (Figure 9 middle). An additional category “0” was introduced as an indicator for areas with currently no demand (no specific gender+ population). This means the demand category exists of 4 categories “a”, “b”, “c“, “0”. So, the final possible combinations are 12 (Figure 9 right).

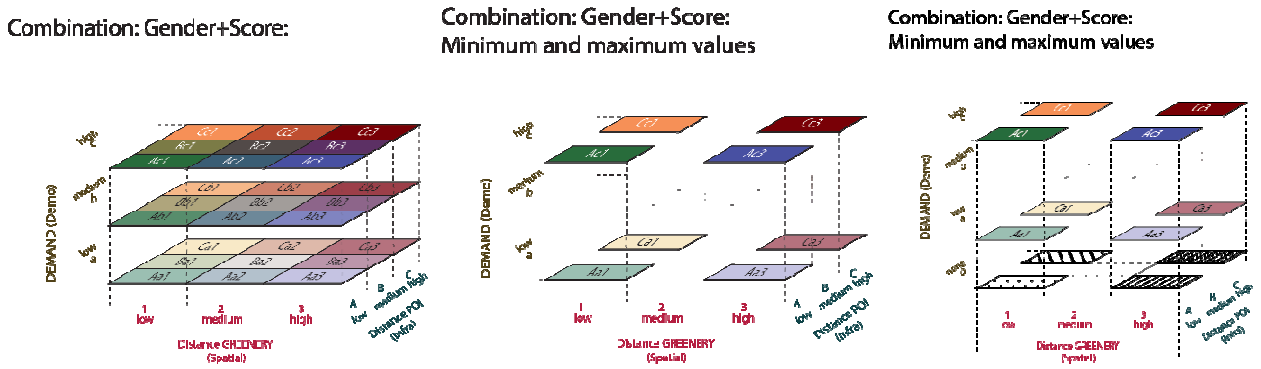

Fig. 9: Possible combinations GENDER+ SCORE (female children 0-9 years) © AIT

For the above chosen default values of the POI weights for the infrastructure score (Table 3) and green space types and maximal acceptable distances (Table 4) the following specific gender+ score map was calculated. This map (Figure 10) contains a lot of information depicting areas where demand and supply match “Ac1” (dark green), areas where a low demand but high supply indicate that a demand increase is easy to manage “Aa1” (light green). The same map can be used to find areas where new demand (females < 10yr) would find the infrastructure and green space they need “A01” (doted areas), and on the other hand areas where the current situation for these gender+ group seems to be very bad “C03”.

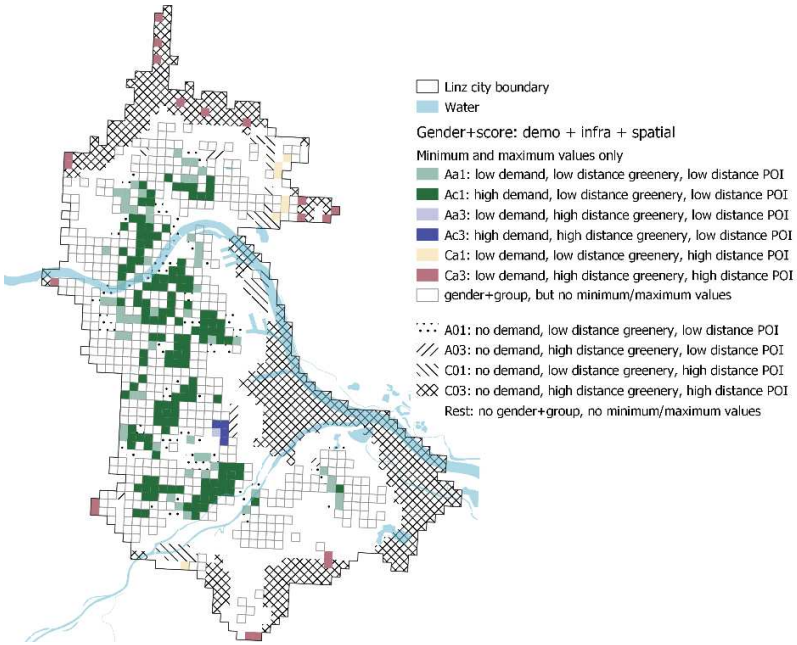

Fig. 10: Possible combinations GENDER+ SCORE (female children 0-9 years) © AIT

6 DEVELOPMENT OF A DECISSION SUPPORT PLANNING TOOL

The section 5 demonstrates that it is a high effort and a complex procedure to create these demand and supply maps and furthermore some parameters influence the results significantly as the weight and green

space sizes etc. Additonaly, it is very difficult to define the "correct" values which shall be used. The aim of SMTG+ is to show as a proof of concept that an interactive simulations tool could help in several aspects. Firstly to reduce the effort to create this kind of maps, and secondly, to use them together with local experts from the city in co-creation workshops. The idea is to develop a decission support planning tool, which can perform the same or at least in a very similar way as GIS analysis tools and create the above discussed maps. As a first concept, we developed a web based application which uses the spatial data analysis capacity of R (Muenchow n.d.), (Lovelace et al., n.d.). To create the interactive web application Shiny was used, an R package that enables to build interactive web apps with less effort straight from R (R-Studio n.d.; Chang et al. 2017; Gebetsroither-Geringer, Stollnberger, and Peters-Anders 2018). The development of the interactive web application showed that the GIS analysis can be performed using R. The user interface (sliders in Figure 11 right image) enables to interactively choose the weights for the infrastructure (Table 3). The calculation of a new map needs less than half a minute using a standard notebook. This is a huge improvement compared to calculating all the necessary steps one by one in a starndard GIS program as QGIS.

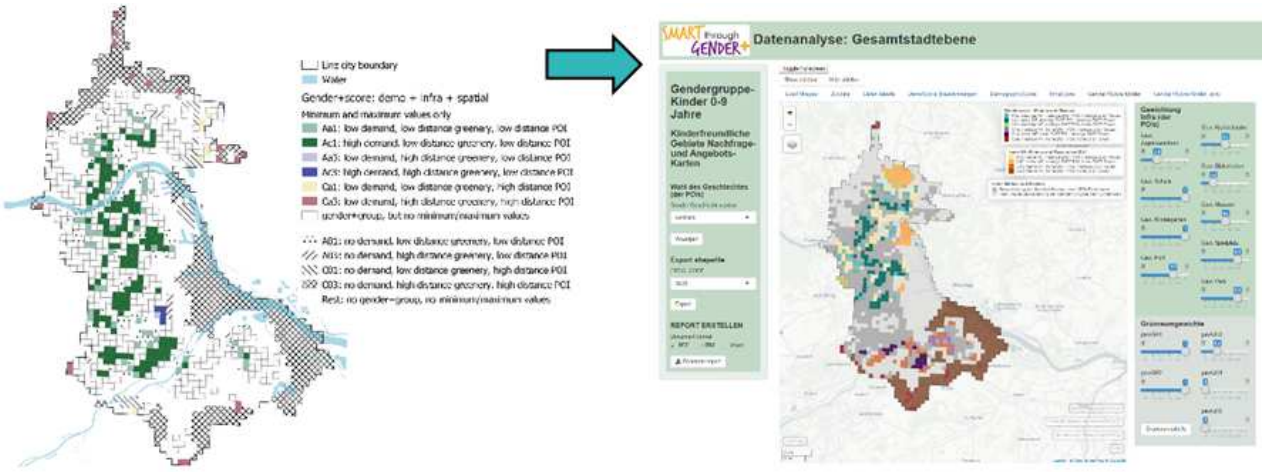

Fig. 11: Interactive web application - implementation of the Gender+ SCORE (female children 0-9 years) with R-Shiny © AIT

Furthermore, the developed application shows the single score maps at the same time, and zooming synchronously shows details on all maps.

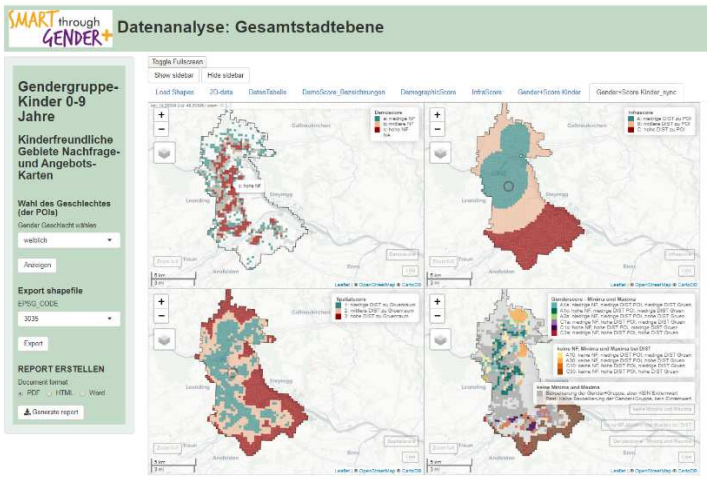

Fig. 12: Single synced maps - implementation of the Gender+ SCORE (female children 0-9 years) with R-Shiny © AIT

7 RESULTS DISCUSSION AND OUTLOOK

The result of the presented methodology is a proof of concept of a web application for the quantitative evaluation of the current situation regarding gender+ specific demand and supply on the overall (entire city) level. The dynamic evaluation and change of input data sets enables a flexible working mode, intended for planners in practice. This high flexibility is important, since it should be possible to create and evaluate different results depending on the input parameters as the weights, or discussed green space sizes. Furthermore, driven by the need to update the analysis with newer or more accurate data sets. This enables to

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monitor the changes easily e.g., every 5 years with demand data from the statistic or new supply data from different sources. The application for other cities within Austria is possible without major adjustments by using standardized data sets. The application to other European cities is also considered possible through the use of open source data. While the development of a userfriendly web-application is considered as a possible next step in the future, it is this not covered by the project Smart Through Gender+ and its proof of concept analysis.

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🏆 *reviewed paper*

Analysis in Selected European Smart City Districts regarding Ageing Population

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1 ABSTRACT

Urban regions are changing at all levels. Technological and demographic change poses major challenges for urban planning and regional development. Evaluation from the report "Europe's demographic future" from 2017, prepared by the Berlin Institute for Population and Development, illustrates the demographic development of the population 65+ by 2050. According to this, an increase of up to 55% of the population over 65 in Europe is forecast by 2050. Independence and the associated opportunity for a self-determined, autonomous life in old age is the wish of the aging population and is often accompanied by a changed form of living. But how can this predicted increasing demand and the associated range of infrastructure and services be implemented and managed in urban areas? In order to identify the parameters and necessary framework conditions that influence the development of an age-friendly, smart city district, this paper deals with the comparison of seven European smart city districts and their offers in relation to their aging population, for autonomy and flexibility also in old age. Modern forms of housing, shared flats, mixed concepts of senior and students, where the collective is lived, are reality. Flexibility of use plays an important role here. Common spaces, accessibility at all levels, good public transport connections and an environment with the best infrastructure are indicators of self-determination even in old age. A case study of seven selected European Smart City districts focusing on "Living in old age" will be analysed and evaluated here. The selected European Smart City districts: „Malmö BO01“, „Stockholm - Hammarby Sjöstad“, „Vienna Seestadt Aspern“, „Hamburg – HafenCity“, „Helsinki – Kalasatama“, „ Helsinki – Jätkäsaari „ and „Copenhagen – Nordhavn”. Here, the ratio of offers for older people to registered residents +65 is analysed and compared: „Vienna Seestadt Aspern“, with 6.348 inhabitants and a population density of 2.645 inhabitants per km², has 2.39% inhabitants in the category +65, despite multiple offers, although various assemblies on the construction site D13 „Aspern Die Seestadt Wiens“ advertise with a focus on communal living. „Hamburg HafenCity“, with an average age of 35,7 years and a population density of 1.893 inhabitants per km², has a population +65 of 9,2%. The percentage of one-person households is 37,6%. Here, intergenerational communal housing solutions can benefit from one another and form synergies. Another positive aspect in this district is the medical infrastructure, which with 13 established medical facilities, including a pharmacy, forms a good basis for an independent life in old age. The infrastructure and the necessary services are available in many districts. Society is currently undergoing a rethink, and the population is also willing to accept these social offers. The percentage of the resident population +65 is still manageable in Smart City districts, but the result is that they are still relatively young. However, the population will change in the future and in 2050 there will be more old people than young people, even those currently under 65 will follow the demographic change with the desire to age autonomously and independently.

Keywords: ageing population, Smart City districts, autonomous, flexibility, districts

2 INTRODUCTION

Smart City is the challenge of the new generation of the city. Digitalization is driving social change. The analysed target group 65+, too, is discovering the digital world and its numerous possibilities to make life easier in old age, more and more for itself. In the future, it will be easier for older people to live in their own homes for as long as possible and to participate in social life in a self-determined way. Although older people attach great importance to self-determination, people often have to make themselves dependent against their will. The older people get, the more time they spend in their home. With this reduced radius, the demands on the apartment also changes and the need for comfort and security increases. My thesis on this is: Old people prefer to live autonomously and longer in a Smart City District than in rural areas, because they can manage their everyday life there independently and therefore do not have to seek outside help from a nursing home. Accessibility, networking in old age and an appropriate infrastructure in the immediate vicinity are considered important factors for senior living. There are now many alternative forms of living, such as intergenerational living for seniors and students. Alternative concepts are the future here. Today's best agers

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do not want to live in the home, but rather self-determined in associations that offer a social life. Therefore, the following part deals with the analysis of seven European Smart City Districts in relation to the population living in them, their percentage 65+ and the offer for independent living in old age per district.

3 SMART CITY

The term Smart City is the development of future-oriented urban planning programmes and strategies, in the form of creative networking, as well as innovative integration of different areas of a city. Its intelligent structure and the associated infrastructure overcome the urban challenges of the city and operate 24 hours a day, seven days a week. There are various interpretations and interpretations worldwide. Innovative smart city concepts include technical, social, economic and ecological developments. It offers its residents an energy-efficient and low-emission city with a high quality of life and minimal resource consumption.[1] The use of information and communication technologies, which promise a change in cities as systems and as a society, can only lead to smart city development in combination with other factors. In order to bring about this change in living conditions, smartness must be thought through in terms of innovative ability, ecological sustainability and quality of life. Participative processes of participation and the integration of social aspects of urban society are essential here, because smart cities are committed to sustainable and integrated urban development at all levels in order to improve living conditions in cities.[2]

4 DEMOGRAPHIC CHANGE

Demographic change is changing European society. The world's lowest birth rate contrasts with increased life expectancy. Demographic change is increasing, with the increase in single households and increased mobility, an increasing number of people in need of care. Due to this demographic development, the aging population and its holistic area of life, from economy to architecture, is being brought into focus, because in our affluent society you not only live longer, you also age more slowly. The reasons for higher life expectancy are growing prosperity, advances in medicine, hygiene and health care, and accident prevention.[3]

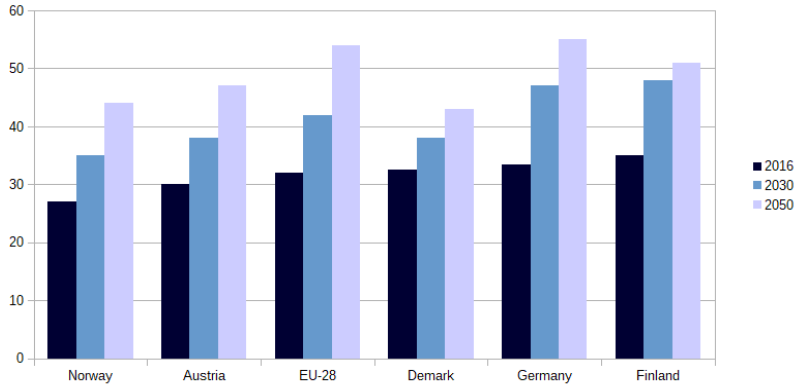

Fig. 1 Europe's demographic future - Percentage over 65 years old

The graphic illustrates the evaluation from the report "Europe's demographic future" from 2017, prepared by the Berlin Institute for Population and Development. In this study, the demographic development of the population 65+ is forecast by 2050. According to this, by 2030 more than 40% of the population in Europe will be over 65 years old. In 2050, an increase of over 65-year-olds in Europe's population is forecast with an average of up to 55%. This share of the population is expected to be 44% in Norway and Denmark in 2050, 49% in Austria and Finland and 55% in Germany. The calendar age will lose more and more meaning, because the population has two age values, so to speak. A value based on the year of birth and one based on actual skills and behaviour. One of the greatest challenges of the future will be to keep the aging population, economically and socially, efficient.[4]

[1] Lobsiger 2015, 13 -14.
[2] Bundesinstitut für Bau-, Stadt- und Raumforschung 2017, 12.
[3] Hergott 2012, 8-11.
[4] Hergott 2012, 10-11.

5 LIVING IN OLD AGE

Participation is a social phenomenon based on relationships with other people. It is an important factor in physical self-determination and medical health. This aspect also has a high impact, in the areas of housing and social integration, in relation to the satisfaction of the residents of a neighbourhood. It is also an important indicator in the case of supportive digitalization in order to be able to lead a certain lifestyle, because older people want actively designed leisure time in order to maintain physical and mental fitness as well as social contacts. The technical assistance systems are in a process of constant further development and are becoming increasingly important. These systems are used in nursing to support older people and those in need of care, as they allow them to stay in their own home for longer. The desire to be able to live autonomously in your own apartment for as long as possible often goes hand in hand with a change in living arrangements.[5]

5.1 Living in a district

Independent living in a familiar environment can be best achieved in a district even in old age, through participation and mutual help. A district is a social space and describes the individual radius of action, the extent of which is variable, and promotes quality of life. The radius of action is a dynamic process and is made up of the available offers and individual skills in everyday life. To do this, one is faced with the question of what skills are required to use the available offer. The radius of action can be expanded by the social space offered in a quarter, in the form of one's own apartment and the regularly used public space. Activities and interactions of everyday life take place here. The advancing digitalisation is already having an impact on networking in the district. In this context, older people have a local connection and digitalization in the district can become a concrete problem solver in everyday life. Neighbourhoods and social-spatial networking at the district level are essential in order to receive help when needed, because support from the surrounding area improves living together, reduces the need for help and increases the quality of life.[6]

5.2 Survey Target group

In order to better understand the target group 65+, a survey of 63 people aged 65+ was carried out in Austria and Germany. 34% of those questioned form the 65-69 year olds. 70-74 year olds are 33%. The age groups 75-79 and 80-84 each make up 14%. The age group 90 - 94 make up 5%. For this purpose, questions were asked in the area of digitalization, infrastructure and mobility, in terms of habit and relevance, and the following findings were obtained: Basic tenor: The older population 65+ is afraid of change. 67% find nursing robots as not necessary and 5% find nursing robots as very important. The emergency bracelet, on the other hand, was rated as very important by 81%. Many do not have a PC, but a smartphone. Whats App is used by 62% and the mobile phone by 86% every day. 76% have never used Facebook. The target group rarely orders online but goes shopping regularly. 33% go shopping daily and 57% weekly. 67% have never ordered anything online. Small-scale infrastructures and businesses must be preserved! Public space is of great importance for 66%. Barrier-free accessibility as a human right. 95% find that public spaces should ne barrier-free. Short distances are particularly important. 62% of the respondents walk up to 2 km on foot. Short distances to medical aid are very important for 76%. 66% find short routes to shopping very important and 34% find short routes to green spaces very important. Social infrastructure in the neighbourhood is important. Networking in the neighbourhood has a significant impact on housing satisfaction and is an important quality feature. Neighbourhood relationships were rated as particularly important by 71%. It is important to be used. 86% find it very important to be needed.

[5] Naujoks u.a. 2017, 9-10.
[6] Naujoks u.a. 2017, 15.

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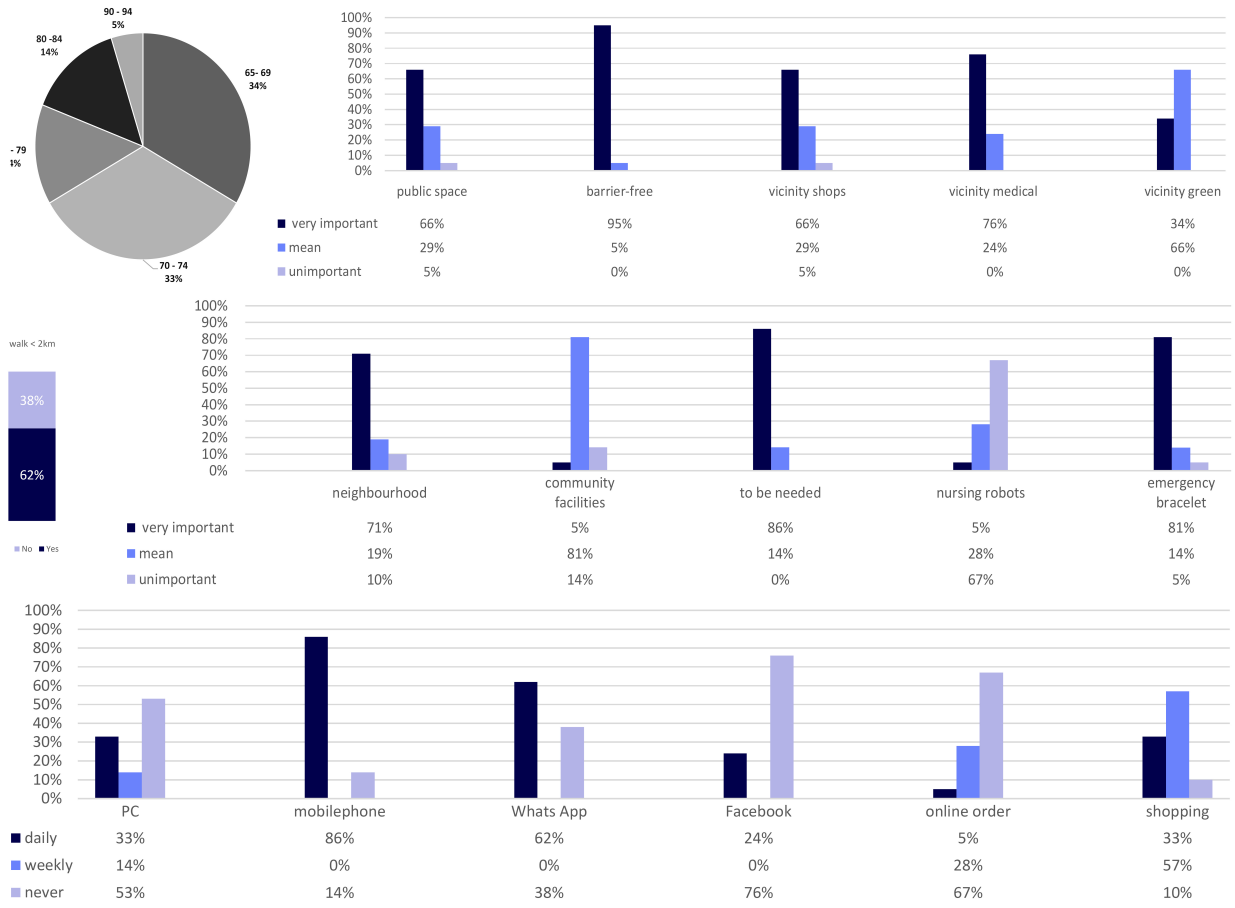

Fig. 2: Core data of the respondent's target group 65 + as a diagram

6 ANALYSED SMART CITY DISTRICTS

6.1 Smart City districts

In old age, one's own home is the centre of life. However, many apartments are not suitable for the elderly. That is why many older people, at age 65+, are considering changing their living situation. Parameters for selecting the new living situation are not only aspects of accessibility in the form of levels and thresholds, but also short distances and social aspects, such as a good neighbourhood network. That's why some move to a smart city district. A case study of seven selected European Smart City neighbourhoods focusing on "Living in old age" will be analysed and evaluated here. The selected European Smart City districts: "Malmö BO01", "Stockholm - Hammarby Sjöstad", "Vienna - Aspern", "Hamburg - HafenCity", "Helsinki - Kalasatama", " Helsinki - Jätkäsaari " and „Copenhagen – Nordhavn". The districts were selected based on "Mapping Smart Cities in the EU"[7] and in the Smart City publication "Technical Tours Smart Cities 2014-2018".[8] All seven considered Smart City districts were selected according to the indicators of sustainability and innovative strength in the area of urban and district development and considered and defined as a Smart City project based on an already implemented project.

	population	0 - 64	>65	%	ha
Malmö - BO01/ Västra Hamnen	10203	8945	1258	12,33	175
Stockholm - Hammarby Sjöstad	18902	16564	2338	12,36	110
Vienna - Seestadt Aspern	6.348	6196	152	2,39	240
Hamburg - HafenCity	4.592	4168	42–4	9,20	157
Helsinki - Kalasatama	2910	2559	351	12,06	175
Helsinki - Jätkäsaari	6901	6432	478	6,92	68,5
Copenhagen - Nordhavn	2896	2781	115	4,00	55,4

Table 1: The selected European Smart City districts. (population 65+, population and district size)

[7] Cave u.a. 2014, 180-198.
[8] BMVIT 2020, 19-20.

6.1.1 Malmö - BO01/ Västra Hamnen

The project start of Bo01 - Västra Hamnen in Malmö was in 2001, through the Bo01 architectural exhibition. Since then, an internationally known example of sustainable urban development has established itself here. The Bo01 quarter is Sweden's first climate-neutral district. Malmö - BO01 / Västra Hamnen, has a very high number of the considered target group 65+ with 12.3%. The population of the district is 10203, of which 1258 are 65+. The population density is 5830 people per km².[9] Pedestrian zones, room sequences of different sizes, wind-protected inner streets and extensive urban spaces refer to the human scale. Västra Hamnen, as a residential and office town, has eight kilometres of shoreline with swimming areas, green areas and beach promenades with many beautiful parks. Pedestrians and bicycles have priority, so bus stops have been set up within a radius of 300 m from the residential buildings. High priority is given to public space as a lifeline and meeting point. The Västra Hamnen project pursues the goal of an urban district that covers all areas of life around the focus of diverse living and training. The mix focuses on affordable social sustainability. MKB Senior Accommodation is a house in Västra Hamnen for people aged 55 and over, it offers regular activities for residents and cafes for the elderly living there. Attendo Västra Varvsgatan senior accommodation also offers 53 apartments on three floors with a courtyard, terraces and balconies.

6.1.2 Stockholm - Hammarby sjöstad

Hammarby sjöstad on the southern outskirts of Stockholm, has 12.4% of the considered target group 65+. The population of the district is 18902 people. 2338 of them are 65+. The population density is 17,184 people per km².[10] Hammarby Sjöstad was planned for a balanced mix of rental and condominiums. The district's rainwater is collected and the waste is transported through an underground suction system. The focus is on public transport, in the form of light rail, bus and ferry, as well as bicycle and foot traffic. The green space concept provides 25m² of free space per apartment. All green areas are interconnected. Stockholm pays strict attention to standardized dimensions and materials in the area of barrier-free accessibility, such as the inclination of the streets, non-slip materials or the lowering of the curb. The ground floor zone of the building offers space for shops and public services such as a health centre. Hammarby sjöstad has its own apartments for customers aged 55 and over, which must also be sold to them. Homes for older people who need medical care are called Seniorgården. There are gyms for seniors and regular senior meetings in a cafe. In addition, a caretaker service for small-scale repairs in everyday life is offered throughout the city of Stockholm for seniors.

6.1.3 Vienna – Seestadt Aspern

The Seesatdt Aspern master plan places great emphasis on public space in the context of smart development processes, participation and inclusion. The Urban Lakeside is young because more than half of the urban residents are between 19 and 39 years old. At 2.4%, Seesatdt Aspern currently has a small number of the target group 65+ considered. The population of the district is 6,348. 152 of these residents are 65+. The population density is 2,645 people per km².[11] An important point in the design of public spaces is accessibility. Thus, for example, all sidewalks are made in sufficient width and angle. The assemblies in Seestadt Aspern are very concerned about a mixed life. "MISCHA" offers communal living in response to demographic developments. In addition to „MISCHA“, there is also a dormitory for senior citizens. "Yella Yella" works with overarching concepts such as childcare for neighbours. "LiSA" - nine living spaces for older people who want to live in a community and are interested in integrating into a home community. "Gesiba" - offers 36 manageable apartments especially for seniors. "House of Life" is a cross-generational, barrier-free housing project that relies on neighbourhood help. There is good public transport links by bus and subway. A high-quality open space - with more than 30 business locations, as well as pharmacies, doctors, banks is located directly at the „Seepark“.

6.1.4 Hamburg - HafenCity

The HafenCity has an average age of 35.7 years and, at 9.2%, has a relatively high number of the target group 65+ considered. The population of the district is 4,592, of which 424 are 65+. The population density

[9] City of Malmö - Business and External Relations Department (31.12.2018).
[10] Stockholms Stad - Business and External Relations Department (31.12.2018).
[11] Bundesanstalt Statistik Österreich (01.01.2019).

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is 5830 people per km².[12] The future-proof urban structure of HafenCity shows a delicate, inclusive mix of uses from social infrastructure, such as work, living and educational and leisure facilities with a large public ground floor zone. Accessibility and social meeting places as well as networks and associations are intended to strengthen participation here. The proportion of single-person households is 37.6%. Here, cross-generational municipal living solutions can benefit from each other and create synergies. Another positive aspect in this district is the medical infrastructure, which, with 13 established medical facilities, including a pharmacy, forms a good basis for independent living in old age. The area division in HafenCity is 24% traffic areas, 31% building floor areas and 25% public open spaces, here a distinction is made between "green open spaces" and "blue open spaces". 41 accessible senior apartments have been rented by the „Martha Foundation“, in the middle of HafenCity with a view of the harbour, since summer 2009 with a common room and additional services such as emergency calls and caretaker services.

6.1.5 Helsinki - Kalasatama

Kalasatama is Helsinki's Smart City model area and, at 12.1%, has a very high number of the target group 65+ considered. The population of the district is 2910, of which 351 are 65+. The population density is 1663 people per km².[13] The water edge with the promenade is 5 km long and the metro station is 7 minutes from the centre. There are common rooms and rooms for temporary use in the buildings. The offer in public space consists of social infrastructure such as a health centre. The focus is on foot and bike connections. A large number of the street blocks consist of different residential buildings, which are arranged around a collectively used courtyard. Special forms of living such as senior citizens' communities are also offered here. Kotisatama is a barrier-free low-energy house with condominiums for 85 residents 48+ and offers senior citizens a new type of living facility, which is partly based on the collective help of neighbours. There are also common rooms such as a sauna and roof terrace with a garden, workshop and kitchen. “Kalasatama is an innovation laboratory, so every third inhabitant has already participated in a survey.

6.1.6 Helsinki - Jätkäsaari

Helsinki - Jätkäsaari has 6.9% of the target group 65+ considered. The district has 6901 residents, 478 of whom are 65+. The population density is 5949 people per km².[14] The blocks of flats in the area are usually 7-8 stories high and there are large and sheltered courtyards between the blocks. Jätkäsaari as a test site for intelligent mobility solutions, is a district that is characterized by a variety of wide services, shops, a park with a total area of 2.4 hectares, a dense tram network and well-developed bicycle and pedestrian paths. City Village CO-10 is a startup for sustainable development. The “generation block” is a developed concept for multi-generation residential construction. The concept unites people of all ages and offers a variety of urban living options.

6.1.7 Copenhagen - Nordhavn

Copenhagen - Nordhavn has 4% of the target group 65+ considered. The population of the district is 2,896, of whom 115 are 65+. The population density is 5830 people per km².[15] Nordhavn is planned as a green district on many levels. Water is the subject of the redesign of the port area. The concept of public space and urban planning is under the water, above the water and on the water. Temporary projects increase activity in the port area. The area is 600m from the Nordhavn train station. The prioritization is based on cycling. There is even a bicycle highway for this. The district consists of a mixed use of public and private facilities for a lively, varied district and active ground floor zones. HOLO operates autonomous buses for senior citizens in the district. The development plan is designed with a special focus on public spaces. The district consists of small residential units for singles, the elderly and medium-sized houses.

6.2 District advertising strategy

A Smart City district has many advantages for “living in old age”. In order to transport them and attract the 65+ target group, these advantages, such as vicinity to shops and green, networking, and collective living solutions must also be advertised and illustrated accordingly. For this, the respective official Smart City

[12] Hamburger Melderegister Statistikamt Nord (31.12.2018).
[13] Statistics Finland - Tilastokeskus (31.12.2018).
[14] Statistics Finland - Tilastokeskus (31.12.2018).
[15] Københavns Kommune (01.01.2019).

district homepage was analysed. Unfortunately, the analysed Smart City districts "Malmö BO01", "Stockholm - Hammarby Sjöstad", "Vienna – Seesatdt Aspern", "Hamburg - HafenCity", "Helsinki - Kalasatama", " Helsinki - Jätkäsaari " and „Copenhagen – Nordhavn" apply rarely or not the 65+ target group. The following table shows the evaluation of all SC district pages with the rating key 0-3.

Smart City district	mobility	energy	65 +	family	leisure	business	
Malmö - BO01/ Västra Hamnen	0	1	1	3	3	1	www.vhamnen.com
Stockholm - Hammarby Sjöstad	2	3	1	2	0	0	www.hammarbysjostad20.se/?lang=en
Vienna - Seestadt Aspern	1	0	1	3	2	3	www.aspern-seestadt.at
Hamburg - HafenCity	2	0	1	2	2	1	www.hafencity.com
Helsinki - Kalasatama	2	0	1	1	1	1	www.uuttahelsinkia.fi/fi/kalasatama
Helsinki - Jätkäsaari	2	0	0	1	2	1	www.uuttahelsinkia.fi/fi/jatkasaari
Copenhagen -Nordhavn	3	1	1	2	3	1	www.byoghavn.dk/nordhavn/

Table 2: district advertising strategy (0 = not advertised, 1 = minimally advertised, 2 = advertised, 3 = heavily advertised)

7 CONCLUSION

Smart City districts are still very young districts, which is why it can be concluded that the population in the districts will change due to increasing demographic change. The key words are integration and networking. It is about social networks, barriers and participation of the residents through active involvement. Smart city districts are good places to age autonomously, as the results of the target group surveyed reflect (Fig. 2: Core data of the respondent's target group 65 +). It can be derived from the survey that the desires of the aging population go hand in hand with the advantages offered by a Smart City district. Smart City districts would meet the demands of the aging population of interaction and self-determination. The percentage of the resident population 65+ is between 2% and 12% in the analysed Smart City districts. In the EU, the population of the 65+ group had already been just over 30% in 2016 (Fig. 1 Europe's demographic future). Thus, the population 65+ in the analysed Smart City districts is 18% to 28% lower than the European average of 2016 and thus strongly underrepresented. It can be concluded from the analysis that there are differences in the implementation and theming of the seven Smart City districts analysed in relation to the aging population. In order to be able to analyse these measures and focal points in depth in the analysed Smart City districts, a field study would be necessary to take up the feeling of the residents and the real offer for the participation of older people in the district. Even if these analysed districts, as the evaluations of the advertising strategy (Table 2) make visible, currently rarely advertise with qualities for living in old age, the age of the population in the district will change in the future.

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Application of Gaode OPEN API in the Fire-Fighting Facility Planning Evaluation

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1 ABSTRACT

In recent years, big data has been extensively applied in urban planning and design area. However, its wider application is constrained by the data acquisition approach. Accordingly, many efforts have been made to accurately find and solve urban problems by mining legal open source internet data, which gradually becomes a hot topic among urban researchers. In this context, this study applies the Gaode OPEN API in the urban real-time traffic circle construction and fire-fighting facility planning evaluation taking Nanjing as example. First, a batch processing model is established on the basis of Gaode OPEN API, including automatic acquisition of real-time traffic data in the study area and extraction of average vehicle speed of all the roads during specified time period. It found that speed involves division of the whole Nanjing City into several characteristic zones. Then, a case study is conducted to construct the urban real-time traffic circle through python language and Arcgis software based on existing fire-fighting facilities. In the end, through a subsequent evaluation, it is found that the existing fire-fighting facility planning has a stark regional difference between urban central area and suburban area, which shows a low coverage rate of 22% and 39% for respond time of 6min and 8min respectively. This study provides an integrated approach for acquisition and processing of Gaode data, mining of its space-time features, and application in the planning evaluation practice. This approach demonstrates the advantages of streaming features and distributed processing of big data, effectively utilizes the real-time characteristics of big data in the emergency facility planning, and is expected to broaden ideas for data acquisition.

Keywords: Gaode OPEN API, fire-fighting facility planning evalation, Nanjing, China, real-time traffic circle

2 BACKGROUND

In recent years, the growing number of public emergency causes great losses to society. Especially for emergency events like fire disaster, require rescue workers get to the scene with least delay possible and take action immediately. Low treatment efficiency could turn general emergencies into serious public incidents or major catastrophic accidents. Additionally, the growth of urban traffic volume and vehicle out-driving ratio which results from the improvement of urbanization process and socioeconomic status, brings serious traffic congestion. Consequently, the commuting time of fire fighting trucks gets delayed, so that the emergency respond time is affected. Traditional emergency facility siting is static and determined, which is calculated on the basis of existing road network and specified vehicle speed. However, the traditional analogy method is considered to be unconvincing and imprecise since its neglects on the influence of the actual traffic capacity on commuting time. Therefore, it is believed that real-time big data could help making more accurate evaluation of fire station service quality and efficiency, which contributes to sophisticated emergency facility siting: making sure the emergency service could arrive at designated position within required time so as to ensure the safety of life, property and urban operation. Based on the above, this article tries to analyze the real-time traffic data of Gaode API, establish real-time traffic circle by Python and Arcgis. Taking fire station in Nanjing as example, following the logic of “intelligent extraction of real-time traffic data – establishment of real-time traffic circle – evaluation of fire station planning”, this article explores the flow characteristic of big data and the application of distributed processing in urban planning practice, in order to provide reference and basis for similar study and project. Moreover, this essay will help EU countries where the inspire regulations are responsible for obligatory generation of huge amounts of free open governmental datasets.

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3 INTELLIGENT EXTRACTION AND PROCESSING OF TRAFFIC BIG DATA BASED ON OPEN API

3.1 Introduction of Gaode OPEN API

Big data has became growing important in urban study area during the past few years. Due to the restriction of data acquisition, the research value of OPEN API (application programmers interface, the interface code that makes internet connection between two websites or databases) on big data acquisition, technology broaden and urban ecosystem receives increasing attention. Gaode open platform is the leading LBS service provider in China, which possesses advanced data fusion technique and massive data handling capacity. In the meantime, it also provides development kits both on the web terminal and mobile terminal to the public. Developers achieve functions including map display, map labeling, position search through recall development kits or API interface. API open the gate of open resource data for data demanders in internet and big data ear. The existing web service includes geocoding & inverse geocoding, route planning, POI search, input tip, batch request interface, administrative region enquiry, static map, IP positioning, coordinate transformation, weather query, road extraction, traffic situation, etc. According to the ten billion level daily average location requests and related actions, it is convincing that the data acquired from Gaode open platform could reflect the population flow, regional heat, behavioral preference and traffic characteristic in real world effectively.

Traffic situation is one category of the HTTP interface, which responds traffic inquiry according to the input content. Massive original data with spatial position and time scale could be achieved from Gaode open platform through data acquisition from a database which is established on floating car data and travel data of over seven hundred million users, and covers 40 cities including Nanjing. Before using, it is essential to apply for a Gaode API account and key. Then, traffic situation data can be achieved for designated rectangle, roundness or roadway (it is confirmed by test that the maximum side length of rectangle is 0.6 longitude/latitude degree). Besides, there is daily restriction for total volume and utilization frequency. There are detailed technical specifications for data acquisition with spatial information through Open API wed interface both in China and other country. Some studies have introduced APIs of online map developers such as Google Map or Baidu Map to estimate travel time[1-3], recently Zhou et al. [4] and Xi et al. [5] use online map API to obtain data on the dynamic population distribution and variation in transit time due to different transportation modes. In this way, researchers can make use of the dynamically updated transport network data and the routing rules maintained by map developers to obtain a reliable estimation of travel time. In the previous prediction of travel distance, Euclidean distance is often used to represent the spatial connection between geographical entities[6-7], and some researches also calculate the transportation cost by dividing the grid[8-9]. The road network distance[10-11] can be used to build a complete network, but it often takes a lot of time to carry out topology analysis, integrity check and manual correction. Besides, the existing handling method are tedious in general. Moreover, there is few detailed description for acquiring traffic situation of designated area by merging units and automatic data collection in different time scale.

This study proposes to extract real-time traffic data using a Gaode Open API-based streaming processing method(Fig.1). Given the rectangular-shaped data extraction scope, this study first divides the urban area into several rectangular units according to their longitudes and latitudes, and then extracts the original traffic information of each unit through the traffic data acquisition program, which is subsequently archived in the database. After that, units are merged to form the actual regional road network, followed by pre-processing of the original data and linking them with the effective road condition information. Meanwhile, timers are set for multiple periods of multiple consecutive days to automatically acquire the road condition data, which are then intelligently processed in batch. In this case, urban traffic data within a specified time range are successfully acquired, and the processed information table can be automatically matched to the urban road network for related processing and time-space analysis. The presented approach fully considers flow characteristics of the Gaode data, which is a branch of open source big data, and achieves higher efficiency than the currently used more complicated manual traffic data crawling method.

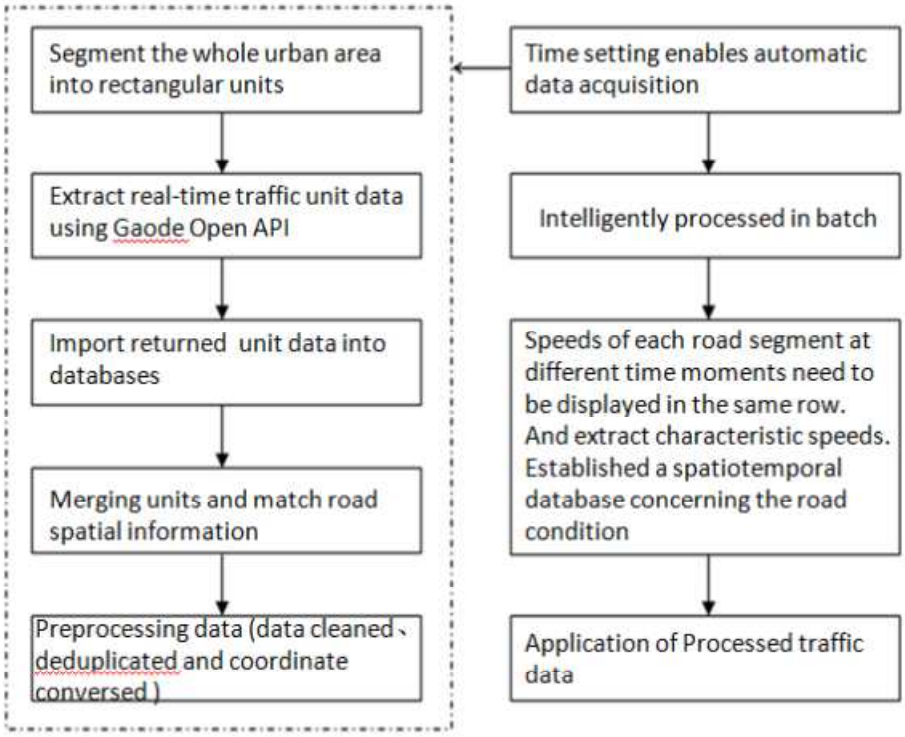

Fig. 1: Gaode Open API-based automatic processing method.

3.2 Intelligent traffic data extraction

3.2.1 Request diameter settings

Both data acquisition and processing are implemented using the Python language. The obtained data includes the real-time traffic speed and congestion status of the Nanjing City provided by Gaode Map, with a time range from May 28, 2019 to June 10, 2019 and a data acquisition spacing of 1 hour. Request parameters for traffic situation data acquisition in the rectangular units are input through the web service traffic situation API, including user permission identification, query road level, return data format, callback function, longitude and latitude coordinate pairs of top-left and top-right vertices of the rectangle unit to be queried (Table 1). The maximum distance in the rectangular unit to be queried should not exceed 10 km. Accordingly, the whole urban area of the Nanjing City is segmented into 230 rectangular units (0.06°by 0.06° for each unit). Before this, the latitude and longitude coordinates of top-left and top-right vertices of each unit need to be converted to Gaode coordinates from WGS84 counterparts(Fig.3 and Fig.4).

3.2.2 Data format analysis

Returned data objects include the result status value, the request status, the request status code, and the traffic situation information. Specifically, the traffic situation information includes road condition overview, road condition evaluation, and road information, and the road information includes road name, road condition, direction description, driving direction, speed, sign code for a certain road segment, and road coordinate set. Critical information such as road name, road segment code, road status, road speed and road point coordinate set is obtained and archived, accompanied by recording of the real-time acquisition time. Each rectangular unit contains several roads, and a certain road with its specific name consists of several road segments. In order to avoid repeated acquisition of road segments across units, this study assigns global codes (Row_ID) to road segments in a certain order during the data archiving. In this case, the overall road traffic situation is stored in the road condition information table, while the spatial point coordinate set is stored in the spatial point table. Data in both tables are linked to the corresponding Row_ID. In order to facilitate recognition of Chinese road names, input parameters and output data encoding of the interface are unified as UTF-8. The sracpying function is defined to loop through coordinates of top-left and top-right vertices of each rectangular unit, accompanied by data acquisition in order.

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Parameter	Meaning	The rule description
key	user permission identification	users applies for the Web service API type KEY on the Gaode Map website
level	road level	specify the meaning of the following values for the road class: 1：highway 2：expressway 3：auxiliary-road of the expressway 4：main road 5：other road 6：anonymous road
output	format type of returned data	optional type：JSON,XML
callback	callback function	The callback value is the name of the user-defined function, which is valid only if output=JSON
rectangle	a rectangular area is queried	top-left and top-right vertices of each rectangular unit; The diagonal of the rectangle shall not exceed 10 km

Table 1: Request parameters through the web service traffic situation API

Name		Meaning	The rule description
Rdstatus		result status value	0：request failed；1：request suceed
trafficinfo	Rdname	road name	
	RdOrgin	original of the road segment's name	
	RdDest	destination of the road segment's name	
	Rdstatus	road condition	0：unknown 1：clear 2：slowdown 3：congest
	Rdspeed	speed	
	RdPx;RdPy	road coordinate set	format：x1,y1;x2,y2

Table 2: Return parameters through the web service traffic situation API

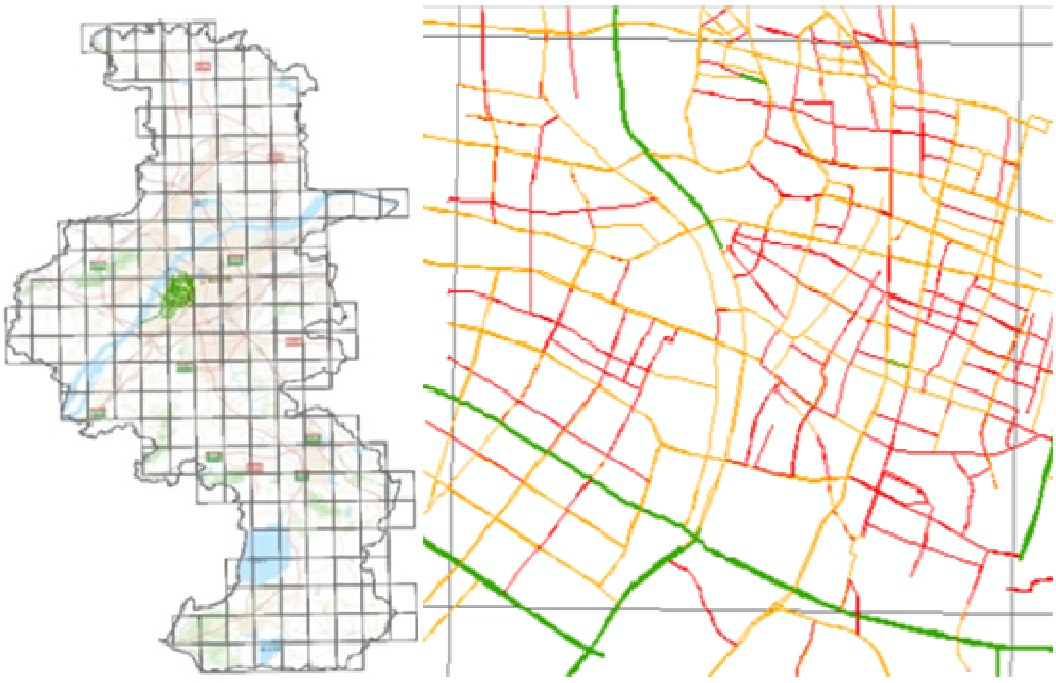

Fig. 3: Schematic diagram of the segmentation unit segmented units(left); Fig.4.Schematic diagram of the independent units(right)

3.2.3 Data cleaning and deduplication

In order to enhance accuracy and clarity of traffic information, data in the tables are processed using the Pandas library of Python, including merging of all units at the same time, deduplication of overlapping road segments after merging, and conversion of the coordinate system. All the merging processes are implemented while calling the sracpying function. After data of all units are obtained, the drop_duplicates function is called to delete the duplicate objects through filtering road names and road segment codes.

3.2.4 Batch data spatialization

Cleaned traffic data are implemented with coordinate conversion to the same coordinate system as the digital map. In this way, the information that is simply stored in the data table is spatialized. During data processing, the primary key pairs for regional traffic Shapefile files at different time moments, consisting of globally coded Row_ID, road name, and road segment code, are converted into hash values. In other words, the primary key pairs are converted into non-Chinese-character primary keys. These hash values are used as associated values to combine road condition characteristics of the same road at different time moments, resulting in spatial polyline objects with attributes such as hash values, road congestionstates, transit speeds, and time of data acquisition. Each Row_ID corresponds to a road polygon object and several latitude and longitude point pairs. In this context, the roads can have data concerning both spatial attributes and road conditions.

3.2.5 Timer setting

Above procedures are shown in the left part of Figure X. In order to obtain real-time traffic data for multiple days in Nanjing City, these procedures need to be repeated multiple times. Using automated means to ensure continuous operation can reduce a lot of manpower and improve data acquisition accuracy. Accordingly, a main_funtion function is defined to comprehensively package abovementioned procedures including user request sending, data acquisition, and data processing. Meanwhile, a timer is set using the threading library of Python. Specifically, the function is automatically run at intervals of 1 hour (3600 seconds) for 14 consecutive days, which enables automatic data acquisition, data pre-processing, and storage of the road condition data in readable shapefile format.

3.2.6 Establishment and use of spatiotemporal road condition database

Eventually, a spatiotemporal database concerning the road condition of Nanjing City is established, which consists of multiple shapfile files that document spatial road conditions at each hour (e.g. 7:00, 8:00, etc.) and one table that includes congestion and speed record of each road segment at all hours. In general, speeds of each road segmental different time moments need to be displayed in the same row. After transpositions of rows and columns, there should be theoretically a total of 336 (14 days * 24 hours) columns of speed features, which are excessively too many. It has been previously demonstrated that there are certain rules for residents' urban travel behavior, and thus there must be a lot of redundancy in road speed data for multiple periods of many days. Accordingly, the characteristic speeds related to the research purpose are extracted through principal component analysis to reduce speed data dimensionality of each road segment at all time moments. And characteristic speeds that are of interests are taken as the representative speeds of the road segment.

3.3 Modeling approaches of real-time traffic circle

On ArcGIS platform, running topology processes including intersection interruption, interface connection in the shapfile-format road network document, then a grid data set could be established as the real-time traffic circle model. Based on the real-time traffic circle model of Nanjing city, taking the location of emergency station as start point, and transit time as impedance, this study works out the coverage of emergency service within specified time. Thus, the real-time traffic circle could be evaluated by the road length and cover area with its scope. Through multi-plan trial and amendment, it could be suggested that stations with overlapped coverage area should be abolished or relocated, or new station should be built in the shadow area. Overall, this study helps optimizing the layout of emergency infrastructure. Specifically, it aims at reducing the overlapped coverage area of different stations, and improving the coverage rate especially in high risk regions.

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The nature of real-time traffic model is to seek the service area of any position using Network Analyst which is a extended module of ArcGIS. As a matter of fact, it is a route solution program based on Dijkstra which is considered as a classical algorithm that solve the unisource shortest path finding in weighted graph. In order to find the shortest path from the initial position s to the target position d, this study originate a meeting point set S of which the shortest path to s is calculated by Dijkstra algorithm. Afterwards, meeting point with shortest estimated value would be searched repeatedly and be added to the set S. Meanwhile, the shortest estimated value of those adjacent points not included in the set S are being updated continuously. The algorithm will be executed until all expected meeting points get added to the set S. This study use the model as a refined stimulation that reflects the emergency response of related facilities in the research area, so as to lay the foundation of service area division. Basically, a traffic network model consists of road segment and road junction. Road segment is the edge feature of road network, which is expressed as segmental arc in ARC/INFO. Its attributes include normal average vehicle speed, average congestion speed, transit time, road length, etc. Road junctions is expressed as nodes in ARC/INFO, associated with the turn table, it could stimulate real-time road condition including waiting time during red light, no straight through, no left turn, elevated through, etc.

The steps are as follows: construct the road network framework with every road segment as an edge; set turn attribute, intersection attribute to establish connectivity; assign the value of length, vehicle speed and transit time to the road network according to the element attribute list. Finally, a feature dataset of all meeting points is generated. The existing road network is derived from Gaode open platform, and calculated with real-time average transit speed. Meanwhile, the planning road network is taken from “Overall urban planning of Nanjing” to the sub-arterial road level in principle, and partially access road if necessary. Vehicle speed using in the calculation is extracted from the real-time data considering different directions.

4 THE APPLICATION OF API BASED REAL-TIME TRAFFIC CIRCLE MODEL IN THE EVALUATION OF FIRE STATION LAYOUT

4.1 Gaode open API based real-time traffic status analysis in Nanjing

The vehicle speed extracted from Gaode API model is based on real-time traffic status, which is affected by holidays and festivals, fatal traffic accident and rush hour. Considering that emergency facility study more focus on the stable traffic connection and transit time between the facility and demand point, it is essential to evaluate the variability and stability of the transit time extracted from Gaode API model at different time. Therefore, this study acquires the two-week vehicle speed data from 28th, May, 2019 to 10th, June, 2019 as sample, and obtains the hourly average vehicle speed after data analysis. Compared the vehicle speed data of the two week, it can be seen from the covariance calculation result that the two average speed curves are highly matched, with a correlation coefficient of 0.973 (Figure.5). It confirms that the data is representative.

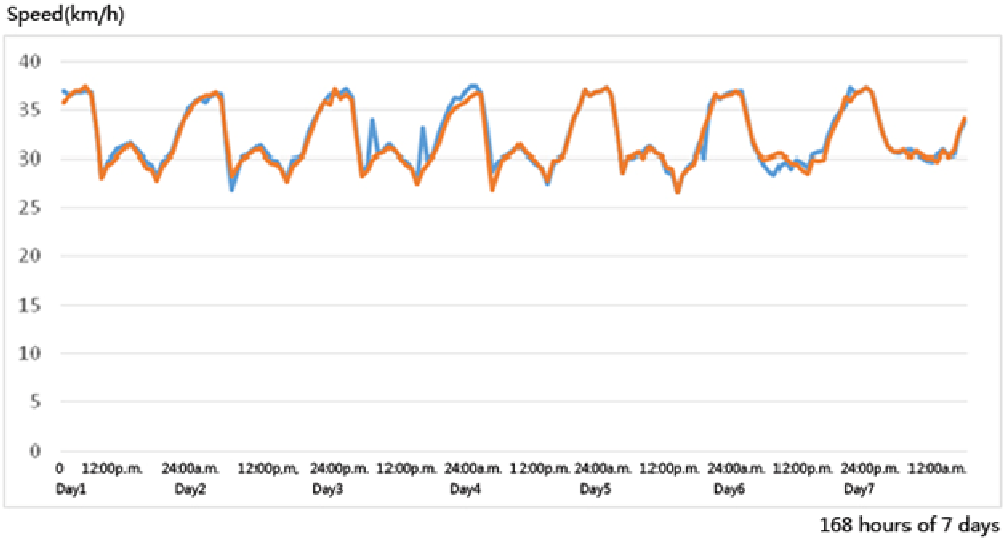

Figure 5: Comparison of average speeds (May 28 - June 10, 2019)

4.2 The space-time characteristics of road network during traffic congestion in Nanjing urban region

According to the Web API data, road condition spatial information has two characteristics: congested condition and driving speed. Taking the data from 28th, May, 2019 to 10th, June, 2019 as sample, the study carries on the statistics. The congested condition is divided into three level according to the congestion delay index1: clear (congestion delay index equal or less than 1.5), slowdown (congestion delay index between 1.5 and 1.8) and congested (congestion delay index equal or greater than 1.8). The statistics of all urban road data in Nanjing shows that the speed range of "clear" condition is [20, 120 km/h] with Eigen value of 35 km/h; the speed range of "slowdown" condition is [10, 50 km/h] with Eigen value of 20 km/h; the speed range of "congested" condition is [5, 25 km/h] with Eigen value of 10 km/h. It is calculated that the daily congestion delay index in Nanjing is 1.55 with the average vehicle speed of 28.29km/h. And for rush hours, the congestion delay index reaches 1.81 with the average vehicle speed drops to 24.21 km/h. The calculation result above can be corroborated with data from the official report of traffic management department. Thus it can be seen that traffic congestion has been a chronic disease of Nanjing city.

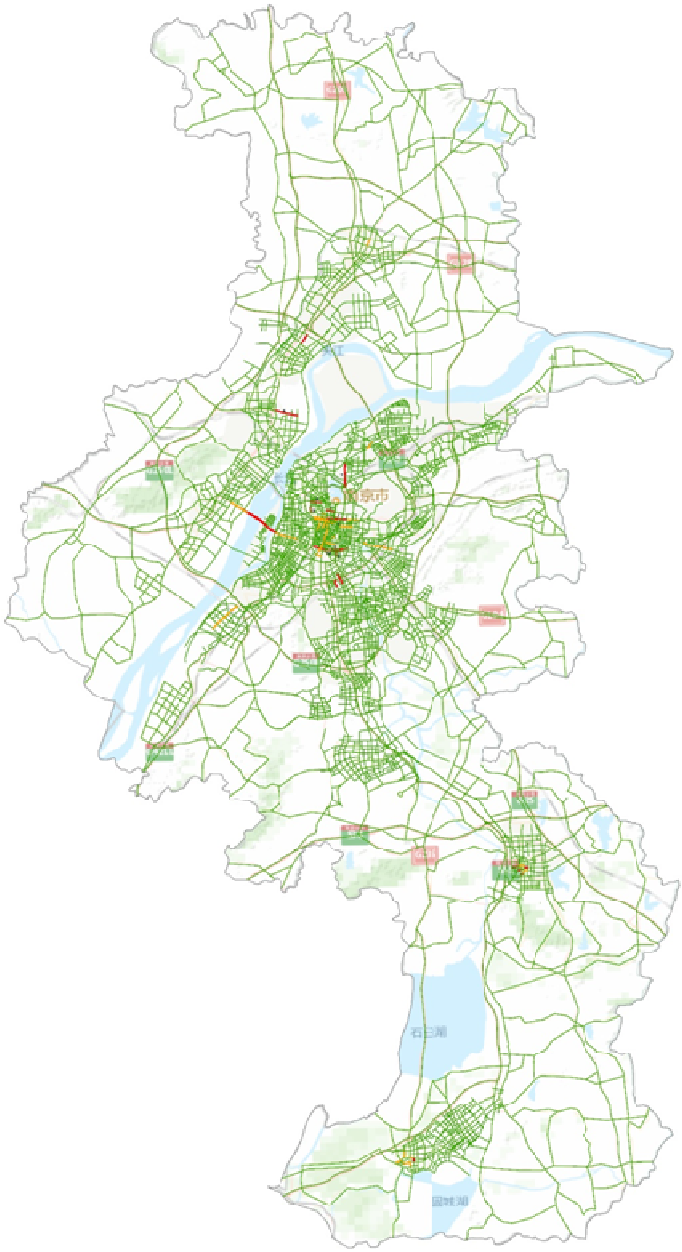

Figure 6: Road value of Nanjing City

The visualization result indicates that it is evidently more congested in Nanjing central urban area than in surrounding rural area. Specific to the district level, and focusing on the morning and evening rush hours. It suggests that Qinhuai District is the most congested area. Attributed to the traffic congestion, Qinhuai city

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dwellers spend twice as long travelling time compared with that in free flow condition. The congested condition is gradually improved from the center to the edge. According to the distribution characteristics of the two-week data, this study defines the road segment with average vehicle speed equal or less than 20 km/h as congested segment, the road segment with average vehicle speed between 21to 35 km/h as slowdown segment, and the road segment with average vehicle speed equal or over 36 km/h as clear segment. Taking a statistics of average vehicle speed on the 11 administrative districts of Nanjing respectively, it can be found that in the coral area of Nanjing central urban area including Qinhuai, Gulou, Xuanwu, Jianye district and their conterminous area, there is a continuous peaking traffic situation emerges in non-late-night hours while there are still a few road segments display slowdown situation during late night. In another word, within the coral area mentioned above and its 5 km extended scope, the traffic situation could be described as widespread “slowdown” with partially “clear”.

To be specific, the first circle with the core location facing outward: from Xuanwu District to Qixia district, Qinhuai district to Yuhuadai district, Qinhuai district to Jiangning district, and Jianye to Pukou district, all have major input and output roads bearing a large amount of transit traffic, causing time-division congestion. Similiarly, Hexi district is characterized with slow traffic as well, especially Hengshan Road, Fuchunjiang East Street and Yurun Street. Above all, Yuhuatai district has more prominent congestion. For transition area: The junction of Qixia and Xuanwu district starts from Hongshan Road, reaches Keyan Road in the north, and reaches Huadian East Road in the west, which is the characteristic congested area of the whole city. For surburb area: Lishui district, Liuhe district and Gaochun district shows that most of the road are unblocked with a small part of the central urban streets and main transit roads has more prominent congestion.

Through the two-week traffic data, 24 full-time data are automatically obtained every day. The average speed of the road is calculated and the congested road section is evaluated by the extreme value and average value of the road speed (Figure.6). In addition to the unknown state of the road, the original data is formatted to the effective road, and the average data availability reaches 89.8%. Considering that the traffic speed is limited by the road grade, the road with low traffic speed cannot be simply classified as congested state, so this paper retains two dimensions of average speed and congested state for comprehensive analysis. According to the analysis, the overall traffic situation shows the commuting characteristics of a single center in the city, spread to the transition area and many small centers in the suburb area; the characteristic congested sections in each jurisdiction are obvious; and the congested periods are also obvious (Figure 7).

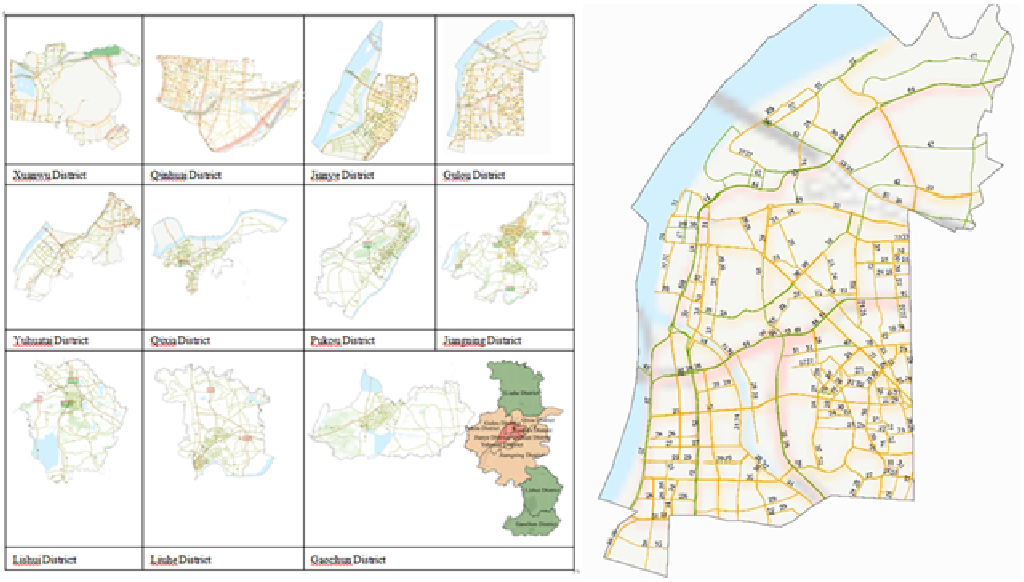

Figure 7: Average speed diagram of different districts (Top line for central area; the middle line for transition area; the end line for suburb area, the figure on the right is an example of a map of the Qinhuai region)

Urban real-time circles model integrate the two dimensions of time and space, which generally refer to the space range that can be reached within a certain time from the central location. In addition, it is a direct reflection of the ability of the transportation infrastructure to guide, support and secure urban and regional development [12]. The traffic circle can be used to assess the spatial scope of facilities and services.

Traditional traffic circle measurement methods are often carried out by simulating the speed of traffic [13-15]. However, it lacks the measurement of people's actual decision on behaviors and congestion in different parts of the city in real situation, thus it cannot mirror the influencing factors in real traffic congestion. Besides, there is no better way to quantify and extract those factors for explanation. In light of this, the article combines the real-time traffic conditions provided by the Gaode API, and applies Python and Arcgis software to extract and construct the real-time traffic circle. In other words, it divides the vehicle circle based on the speed of each road acquired from the Internet's open data to evaluate the coverage of the current service facilities.

4.2.1 Determination of evaluation index system

The traffic circle generated by the real-time traffic conditions can run through the entire process in the practice of emergency facilities planning. this study divides it into three stages: assessment of service scope of current facilities, mid-term location selection model to assist decision-making, and later facility optimization and verification. This article focuses on the application in the first stage. Namely, it divides the travel circle based on the speed of each road acquired from the Internet's open data to evaluate the coverage of the current service facilities. After extracting the current vehicle speed of each road in Nanjing, accurate real-time traffic circle analysis on the current facilities could be performed, corresponding to the arrival time of various emergency facilities, and choose different times to analyze the current traffic circle. In accordance with different levels in prevention, control and service requirements of fire stations, real-time circles including 2-4-6-8mins are set for comprehensive analysisc(Figure.8). Taking the linear coverage of fire stations as an example, the analysis of the current coverage of fire stations in the city of the actual road network speed reveals that, based on the area of the city, the overall service area coverage of fire stations is 16%. There are many blind areas in the Nanjing city, of which the core of the main urban area covers a continuous range, the surrounding jurisdictions mainly cover the central urban area. The lack of stations has become the main cause of large blind areas. Within 8 minutes, the maximum distance that can be visited by each fire station is 12435 meters, the minimum distance is 1085 meters, and the average service distance is 5125 meters. Besides, the service distance of the main urban area is smaller than the surrounding jurisdictions. The coverage of the 8-minute station almost coincides with the high-risk area, but there is still a large gap to meet the national regulatory requirements of "the fire brigade shall reach its descending edge within 5 minutes after receiving an active command". It shows a low coverage rate of 22% and 39% for respond time of 6min and 8min respectively.

4.2.2 Evaluation of current fire service coverage characteristics

The fire stations are rather independent and the 2-min fire service scale does not overlap. In the central urban area with high road density, service scope is distributed in plane shape, radiating from every fire station along the road network. While in the rural area with low road density, service scope is distributed in line with the shape of narrow belt, and the length-width ratio is pretty unbalanced. Vehicle traffic speed and road network density are the primary influencing factors, so that the 2-min fire service can cover 100% of the high fire risk area. The 4-min fire service scale are found partially overlapped. In the remote urban areas with high traffic speed, the patches become more diffuse, and the CONTAG rises. In the main urban area with high site density, the patches are even more diffuse, but connectivity increases which begins to show continuous characteristics. Thus in 4 minutes, the service scope is influenced by the road network density, the station density and the traffic speed, in which the impact of the traffic speed continues to increase. Compared with 4-min service scope, 6-min service scope is partially overlapped in remote urban area if more stations set and road network density offered. In the middle and north of Hexi, in the border area of Xuanwu, Gulou, Jianye and Qinhuai, and those 5km range, fire service is fully covered. The layout of road density is still narrow as a belt. Namely in 6 minutes, station density is the primary factor, while the influence of road density is reduced by traffic speed. In 8 minutes, except that Gaochun and Lishui are too far away from other fire stations and little stations in southern Jiangning, the service coverage shows connectivity between and inside jurisdictions, but far behind the demand of high fire risk area. The blindness would clearly reflect that high traffic speed cannot make up for the lack of fire station. In other words, unless the full travel time of fire fighting truck increases by a large span rather than 2-min staged rise (eg. 15 mins), the current fire service blind area cannot be effectively filled. In order to reduce the influence of traffic speed, the density of fire station plays a vital role (Fig.9.and Table 3).

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District	Service area (km²)	District area (km²)	Ratio (%)	average service distance (m)
Xuanwu	38.8457	74.44539408	52.18%	4028.082
Qinhuai	41.53912	48.43016978	85.77%	4044.878
Jianye	47.29169	81.10873799	58.31%	4981.331
Gulou	37.85746	53.04622712	71.37%	3032.16
Yuhuatai	63.94336	128.3607192	49.82%	5366.33
Qixia	87.12422	391.8374808	22.23%	4215.387
Pukou	161.1523	905.7031179	17.79%	5068.42
Jiangning	171.8731	1564.25834	10.99%	6482.437
Lishui	56.50106	1065.229347	5.30%	7176.875
Liuhe	361.5921	1472.001506	24.56%	6225.208
Gaochun	47.72451	788.9013365	6.05%	4266.789

Table 3 Service area and average service distance of each district

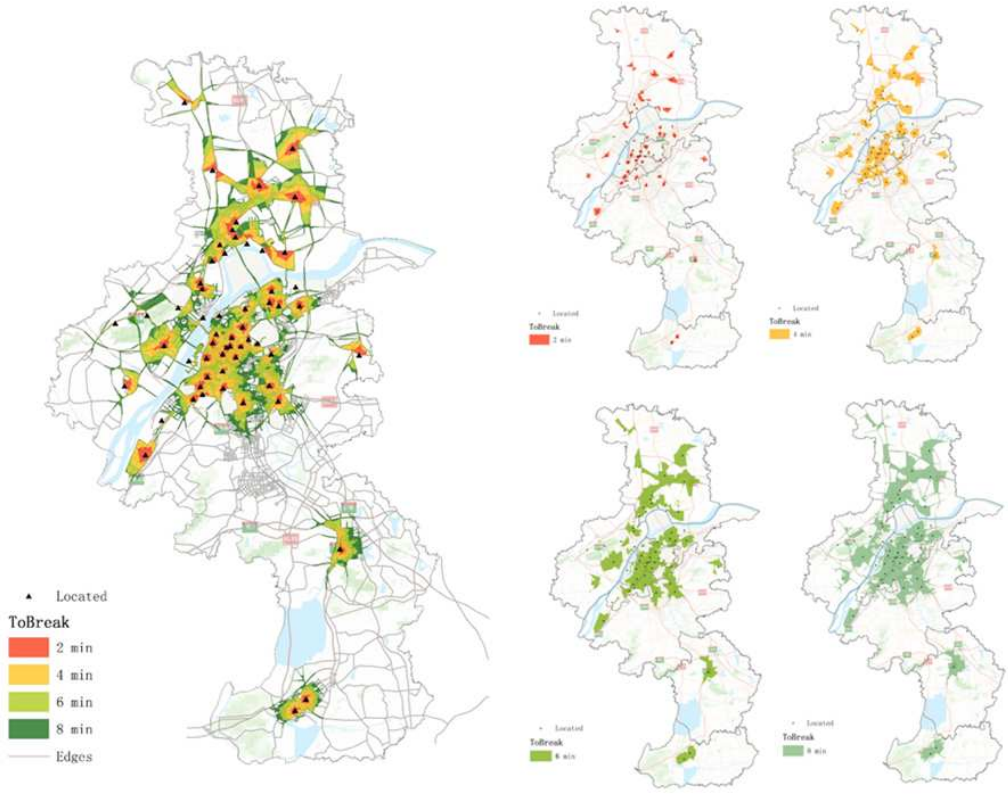

Figure 8: Service area diagram of Nanjing city

5 CONCLUSION

The purpose of this study is to provide a method of automatically acquiring and processing data using internet open data represented by Gaode open platform through the streaming and distributed processing features. This method restores the authenticity of data, and provides a practical method for the application of big data in urban planning discipline. Compared with traditional methods, it is perspective to establish a real-time traffic circle based on Gaode data. Besides, with the help of various government departments, it has been successful implemented into the emergency facility planning of Nanjing city, which helps proving its feasibility in practice. Speaking of the creativity, this study not only makes up the shortage of ignoring traffic condition in traditional emergency facility planning, but also expands thought for similar planning by reviewing the application of traffic circle. However, there are still some imperfections in this paper that need to be further supplemented in the future: firstly, the accuracy of data analysis is on hourly level which could be further divided in to minute level for more details.

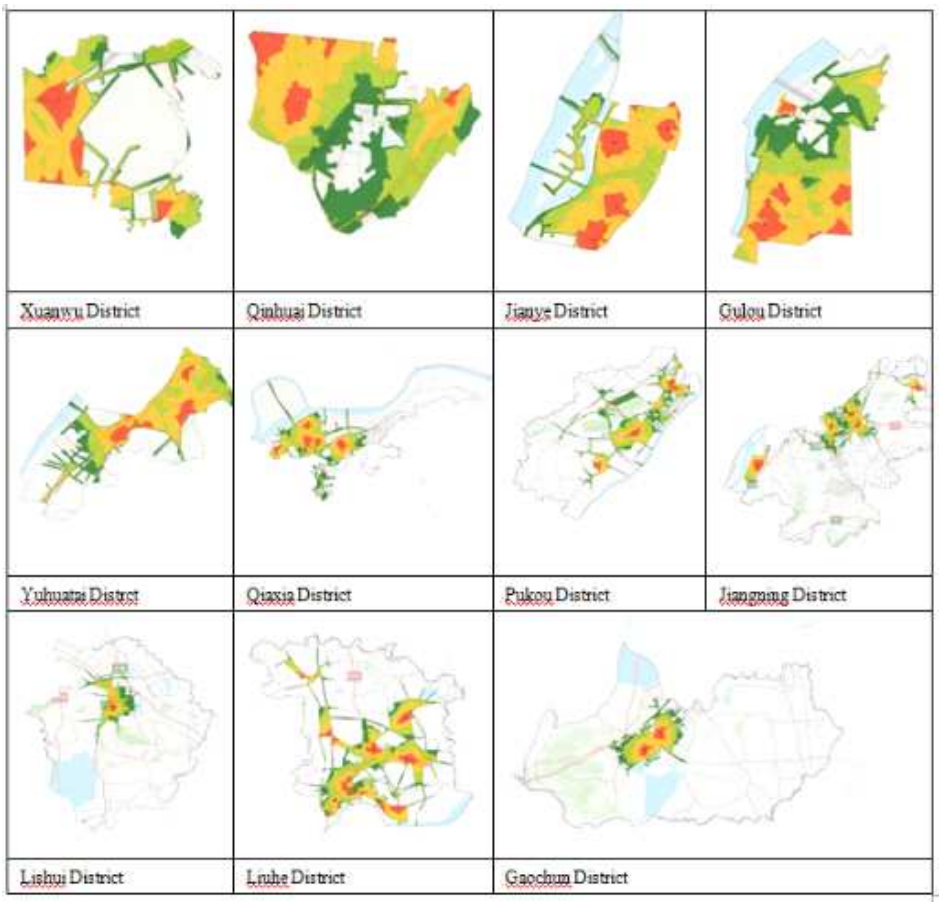

Figure 9: Service area diagram of different districts (Top line for central area; the middle line for transition area; the end line for suburb area)

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Index1 Congestion delay index = travel time/free flow travel time

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🏆 *reviewed paper*

Approaches of Flexible Spatial Planning to Sustainable Cities

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1 ABSTRACT

This paper is a literature review of approaches of flexibility in spatial planning. It is about key elements which provide a flexible spatial planning to sustainable cities.

Spatial planning plays a decisive role in the implementation of sustainable adaptation measures and in ensuring the climate stability of spatial developments. Because urban structures have an impact on energy consumption and pollution, depending on how a building, park or square is designed.

In order to explore this issue, the paper first underscore the current environmental challenges and combines them with current challenges in spatial planning to point out the need of flexible spatial planning; second, explains why flexibility is necessary and which advantages it brings for sustainable city planning; third gives an overview of existing approaches in the literature. Next it provides the key flexibility elements analyzed from literature review. In conclusion the paper presents eight key elements which provides flexibility in spatial planning: Planning rules and norms, Programs and Concepts, Organization, Experiments, Control and Limits, Utilization structures, Spatial Planner and Time.

Keywords: space, cities, sustainability, spatial planning, flexibility

2 CURRENT ENVIRONMENTAL CHALLENGES AND THE IMPACT OF CITIES

Different strategies and concepts developt in countries and regions to set targets to sustainable city planning and designingto meet environmental targets and social needs. Because we do not know exactly what constitutes the environmental challenges and its consequences, it is stressed, that opportunities should be explored which are flexible and adaptive (van Buuren et al. 2013).

The term flexibility in spatial planning is not uniform defined yet. Cattlin (2017) points out that there is a definitional problem of flexibility: “if we lack of a common idea of what flexibility consists of, or who or what can be flexible, or over what kind of timescales we mean spaces to be flexible, we are talking about different things.” (Cattlin 2017, p.1). In literature terms like adaptable, flexible, adjustable, agile, customizable or adapt-flexible are used. For this reason, it is necessary to find out whether the terms are used simultaneously or whether they are different terms with different meanings. Perhaps it is not even necessary to define flexibility uniformly. Because this may contradict the term flexibility per se. However, it makes sense not to talk past each other when it comes to the approach. For this reason, it is assumed that flexibility in spatial planning is “a change in the system and making the possibility of obtaining new conditions, needs, and frameworks” (Ardeshiri et al. 2016, p.83-84). If the definition is transfered to urban development, flexibility for spatial planning must achieve the following: spatial structures must be able to adapt to changing circumstances, new uses and also social requirements.Thus, in a next step, flexibility can also be integrated in the planning of cities.

Figure 1 shows the main current challenges in urban development to sustainability: resource scarcity, environmental pollution, urbanization, sealing and soil compaction. Cities are responsible for 2/3 of the worlds emissions, thereby they account for only three percent of the surface area. But there is a rethinking in society, they are calling for sustainable solutions and products that adapt to viable (King and Trübstein 2019). Social and political pressure bring about change: it is about more sustainable solutions that influence spatial planning and are influenced the other way round by it. These include, for example, electrification in the transport sector, sector coupling, the generation of sustainable energy, emission-free mobility, green areas and, last but not least, the structures of the built city.

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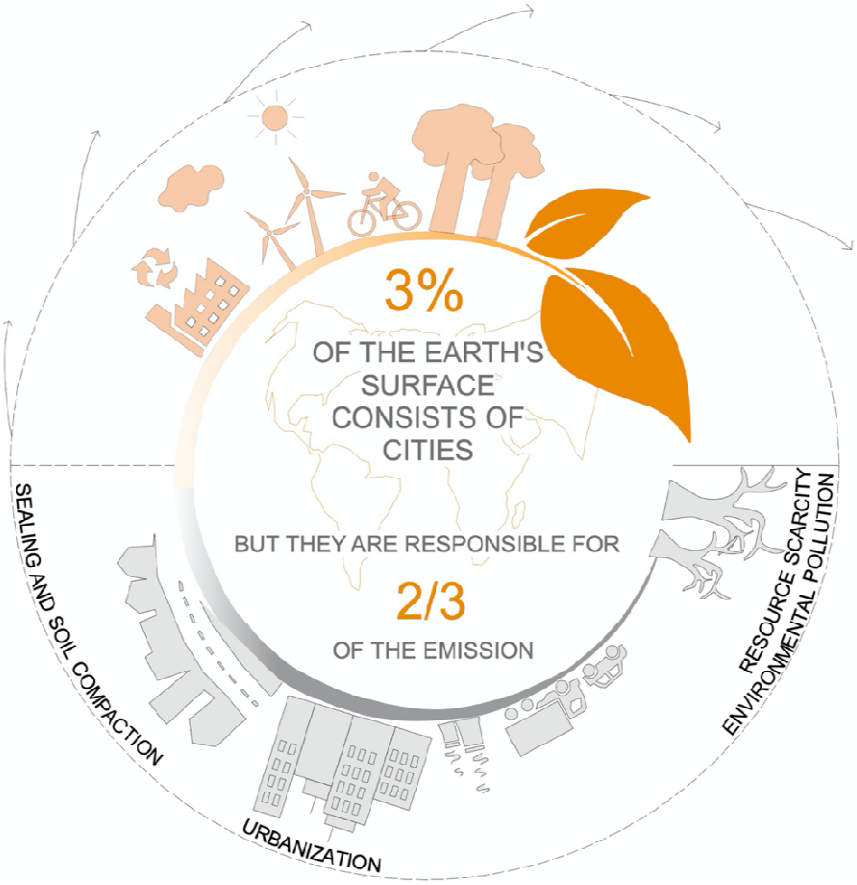

Figure 1 Indicators of climate change and urban development: rethinking in politics and society (own figure according to Stratmann 2019, p.1)

The United Nation recognised the link and interaction between sustainability and cities and therefore developed goals and targets to promote the sustainable development of cities. According to the Sustainable Development Goals (SDGs) one promote Sustainable Cities and Communities (Nr. 11). One of the idicators to achieve this target is the ratio of land consumption rate to population growth rate (United Nations 2020). The goals are not only quantificabile but also qualifiable, because sustainability challenges are different everywhere. It has not only to depend on geographical conditions, but also on social and economic conditions.

3 METHODICAL PROCEDURE AND OBJECTIVES

The aim is to filter out and summarize the key elements for flexibility in spatial planning from literature. In this way a common understanding of the planning approach of flexibility can be created and this can also be understood as a planning tool for the future of sustainable cities.

Designing cities with uncertainty and with gaps of knowledge means to develop innovative approaches (Zandvoort et al. 2019). The current challenges can be met by flexible approaches in spatial planning, as “the use of flexibility in designing projects is becoming increasingly common” (Geltner and Neufville 2012). As well van Buuren et al. (2013) called for an adaptive approach where flexibility is central. Based on these facts, it is necessary to take a closer look at the existing approaches to flexible spatial planning and to compile the most important principles to set an understanding.

New solutions must be found to meet the growing pressure for more sustainable cities. Due to the high decisive influence of spatial planning, the approaches already found in the literature are analysed and linked more closely. In the following, the research design is posed and the methodological approach of the work is explained. As a process-based dynamic planning tool, flexibility creates an adaptable planning basis.

In order to achieve this goal, it is necessary in the first step to understand why the approach requires closer examination. The already presented problem shows that due to the increasing pressure for sustainability in order to survive climate crises etc. and to offer society an adequate living space in cities, new approaches to spatial planning are taken.

Figure 2 schematically shows the procedure of literature research and analysis. First of all, an overview of existing approaches to flexibility in spatial city planning has been provided. To select significant flexibility approaches a national (germany) and international literature review was taken. Next followed by a brief analysis of key elements involved in each approach. After filter out the key elements a connection between the elements and sustainable spatial planning is created. At the end the impacts on sustainable city planning and the inferences are presented.

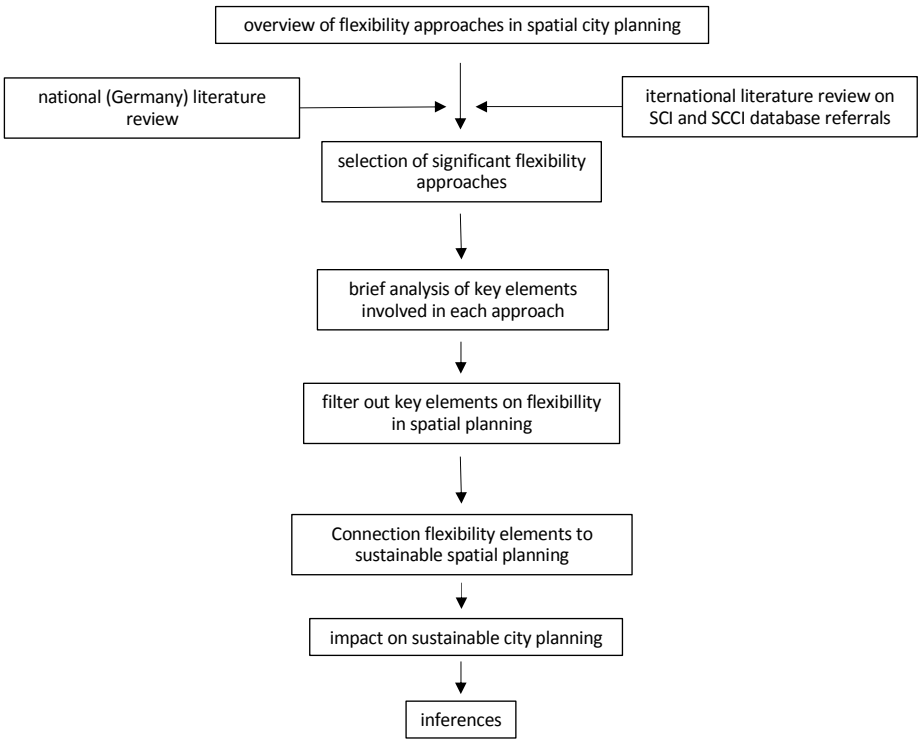

Figure 2 Methodological flow chart

The outline of the paper is: First the paper establishes a connection between current challenges in climate and environmental challenges and current urban development problems. This leads to the conclusion why the approach of flexibility can make a positive contribution to reducing the negative consequences of these challenges. Second, an overview on the methodical procedure on the literature review is given. Next the necessarity and advantages of the approaches of flexibility are explained. Various approaches of flexibility are taken up simultaneously. Next the paper provides the key flexibility elements analyzed from literature review. In conclusion the paper presents the key elements which provides flexibility in spatial planning

4 WHY DEALING WITH FLEXIBILITY IN SPATIAL PLANNING?

Summarizing it is seen that flexibility in spatial planning is justified in order to meet sustainable goals in city planning. There are a lot of different arguments promoting the idea of flexibility. Besides social and economic reasons, the ecological benefits play an important role. Next the advanteges and also critical points are given.

Flexible spatial planning brings diverse chances to urbanism (Costa et al. 2014). Cozzolino summarize arguments of different authors (Alfasi; Buitelaar; Cozzolino; Moroni; Rauws) towards the essential role of flexibility in the city: “if we recognize the essential role of spontaneity and flexibility in the city functioning (i.e., its creative role for innovation, the importance of localized knowledge, the need for perpetual adjustment and improvements of the build environment, and on) we cannot regulate the city in order to obtain or preserve the specific and predetermindes social-spatial configurations as we would or desire” (Cozzolino 2018, p. 16). More flexibility mitigate adverse effects of uncertainty (Zandvoort et al. 2019) and shortcomings of planning (Carr and Dionisio 2017). Because we do not know the future, agile approaches, like flexibility, fits into that we do not know the final result (Aurigi 2016). This brings design for unsheduled uses (Carr and Dionisio 2017). Moreover, it is possible that flexibility reduce resistance against further uses we do not know yet (Carr and Dionisio 2017). Because “adaptive landscape designs are important for heding

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against the negative consequences of long-term commitments" (Zandvoort et al. 2019, p. 21). As well, flexibility supports short-term measures, while keeping options open on the long-term (Zandvoort et al. 2019).

Flexibility offers great opportunities to reduce resource consumption. Because multi usage is possible, less space is needed. Thus, the resource soil can be used sparingly (Geltner and Neufville 2012; Stiftung et al. 2003). For this reason "flexible […] land use represents efficient land use. This also serves to ensure the conservation of resources and sustainability in urban development" (Stratmann 2019, p. 69). Flexibility can reduce natural and unnatural damages (Ardeshiri et al. 2016), e.g. in times of climate change, when it is necessary to design more adaptable and flexible (BBSR 2016). In times of unforeseeable natural events, areas can be used both as public space for societies and as space for e.g. flooding events. By reuseing space and materials a much smaller carbon foodprint is given (Godwin 2018). One of the most commonly used defintion which links flexibility with climate change points out: "the adjustment in natural or human systems in response to actual or expected climatic stimuli or their diem, which moderates harm or exploits benefical opportunities" (IPCC 2007, p.7). Flexible public space contributes to ecological sustainable cities, because it is adaptable for different uses, users and in different times and it consume less ground, because usage can happen in parallel and/or side by side and offers hybrid space organizations (Stratmann 2019).

Likewise, flexibility offers great opportunities in social aspects. Flexibility provides potentials to society and achieves requirements and goals of peoples needs (Ardeshiri et al. 2016). As also mentioned by Ardeshiri et al. "in effect, it should be stressed that flexibility searches for selection arrays against needs" (2016). In view of the ever more rapidly changing demand needs, flexible spatial planning can be combined with faster implementation (King and Trübstein 2019). To put it briefly: flexibility is demand-oriented.

On the one hand there are a lot of reasons to design flexible in spatial planning. But on the other hand there are a few arguments which call the approach into question. Carr and Dionisio explain "that flexible spaces may provoke a greater level of NIMBYism (Not In My Backyard) than convential land uses" (2017, p. 76). As well there is a risk of inferior re-use and less security of planning (Stiftung et al. 2003; Gifford 1994).

5 KEY ELEMENTS OF FLEXIBILITY IN SPATIAL PLANNING

In summary there are some repeated elements in literature which welcome flexibility in spatial planning. For this reason it is assumed that there is a consensus on these elements in literature. Therefore it can be assumed that flexibility depends mainly on the eight elements identified. The identified key elements are: Planning rules and norms, Programs and Concepts, Organization, Experiments, Control and Limits, Utilization strucutres, Spatial Planner and Time.

To find out key elements in flexibility approaches, an analyse was taken. A total of 16 approaches to the issue have been examined more closely. The approaches have been filtered through national (Germany) and international literature research and do not necessarily explicitly include the approach of flexibility but implicitly. Nevertheless, there are already approaches in the literature that have specifically addressed the issue of flexibility. This spectrum of authors and also the way the term is dealt with highlight the key elements of flexibility through its diversity and at the same time uniformity. The analysis has been carried out qualitatively and is not regarded as conclusive. In the end, once the recurring elements have been included, it is possible to determine on a quantitative level which elements have been mentioned particularly frequently. From this it is concluded that the frequently mentioned elements are central elements of flexibility in spatial planning. Below the key elements are listed and discribed in their impacts to flexibility in spatial planning.

Planning rules and norms: Rules ensure that flexibility is reduced quickly and easily and thus takes away the possibility of adapting. For this reason, it is necessary to make the way rules and norms are written and deployed flexible. Rules must be established that allow flexibility in spatial planning. This includes not only the flexibility of the standards among themselves, but also the context of the content. There should be flexibility in the rules of use in spatial planning. Conversely, the space itself should also be able to provide differences in rules. Without enough space for flexibility in planning rules, there is no flexibility in spatial planning. Any regulation should be minimal, for maximum flexibility. (Aliyha and Aulia 2019; Carr and Dionisio 2017; Cozzolino 2018; King and Trübstein 2019; Rauws 2015; Van Buuren et al. 2013)

Programs and Concepts: Traditional urban development plans and concepts have been drawn up without flexibility and are completed in their spatial and functional system. But flexible concepts have to be established which convey the concept and the handling of adaptability and flexibility in spatial planning. The concepts must be flexible so that the plans and measures developed and implemented on them become flexible. Flexibility must be conceptually anchored in order to be applicable. Flexible concepts can help planners to design the future. The aim is to create long-term plans and concepts that can be flexible adapted in short-term. (BMBVBS 2013; Cozzolino 2018; Fainstein et al. 2018; Lotto and Di Morelli Popolo 2015; Rauws 2015; Reicher 2014; Zandvoort 2019; Zikovic et al. 2014)

Organization: The management, institutional context and the planning process itselfs, has to become flexible, summerized to the term organization. To get flexibility in spatial planning, flexibility has to be managed. There has to be a manager, who is responsible for flexibility. The involvement of institutions play a role to establish flexibility in spatial planning. For more flexibility in spatial planning, the institutional design must become more flexible. Institutions must not be rigid, but do welcome flexible participation. If the planning processes do welcome and change to flexibility. (Aurigi 2016; Friedman 1997; Van Buuren et al. 2013)

Experiments: Flexibility can provide spaces that are suitable for experiments and pilot projects. This creates new opportunities and possibilities in urban planning: new solutions can be found through flexible space, which are effective and valuable. There are spaces for new ideas and solutions that can be try out without having to commit to them. Therefore, flexibility is also experimental, apart from the fact that the approach is innovative and experimental in itself. Therefore, flexibility in spatial planning brings spaces for unpredictable, improvised and ephemeral uses. (Carr and Dionisio 2017; Hetzberger 2014; Lewis and Schwindeller 2014; Van Buuren et al. 2013)

Control and Limits: Flexibility is strongly influenced in spatial planning by control and limits. On the one hand, it can be said that the more the city is controlled and planned from above, the less flexibility. On the other hand, it can be said that a lack of control and limits can have a negative influence on flexibility. Therefore the degree of control and limits plays a decisive role in the flexibility of spatial planning. (Cozzolino 2018; Friedman 1997; Lotto and Di Morelli Popolo 2015; Zikovic et al. 2014)

Utilization structures: The current utilization structures are called into question by flexibility. Flexible space and utilization structures must be created multifunctional, but do not claim to be fitted to all uses. The build environment and inventory must be flexible, offering space for other uses and users. Structural elements must be flexible and the utilization structure must be flexible for unsheduled uses. (BMVBS 2013; Carr and Dionisio 2017; Hetzberger 2014; King and Trübstein 2019; Lotto and Di Morelli Popolo 2015)

Spatial Planner: If planners do not fulfil the task of flexible planning, there can not be flexibility in spatial planning. Planners must be more sensitive to needs in order to be able to react more flexible to changes. The way planners understand their task influences flexibility. Relevant suggestions from society should also be sought for this. A flexible space makes it unnecessary for planners to intervene at a later stage. (Carr and Dionisio 2017; Cozzolino 2018; Fainstein et al. 2018; Friedman 1997; Lotto and Di Morelli Popolo 2015; Rauws 2015; Zandvoort 2019)

Time: The time frame of flexibility plays a crucial role, because flexibility creates the possibility to adapt to the physical and social world over time. Because there is always uncertainty about future uses and the requirements change over time. It is therefore important to draw up plans and concepts that are designed for the long term, but can always act in the short term. Changes have to be accepted in different time periods, only then flexibility can succeed. Sufficient space must be left for the time factor, because planning processes can often only be regulated over time. (Cozzolino 2018; Fainstein et al. 2018; Hetzberger 2014; Lewis and Schwindeller 2014; Lotto and Di Morelli Popolo 2015; Rauws 2015; Reicher 2014; Zandvoort 2019)

The combined eight key elements influence the flexibility of spatial planning to varying degrees. The degree of flexibility in spatial planning depends on how many elements are used and the value of these elements accoring to the conditions and case study. How to measure and determine the degree of flexibility on a qualitative and/or quantitative level and whether this is even necessary to achieve the goal of a sustainable city has not yet been considered.

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6 CONCLUSION: FLEXIBILITY TO SUSTAINABLE CITIES

As outline before, the spatial planning approach of flexibility influence the possibility to achieve sustainable cities. Flexibility is called a designing tool to reach sustainable spatial planning. The approach of flexibility is to see as a process which influence spatial planning as much as spatial planning influence flexibility. In conclusion in literature there are different terms of flexibility but in case they usually mean the same circumstance and there are many overlapping requirements and elements for flexible planning in the analyised approaches.

By analysing the key elements of flexibility it is possible to create a common understanding of flexibility in spatial planning. Without the knowledge of the approach of flexibility and its elements it is not possible to establish the approach and create an international understanding. The eight elements illustrate the complexity of the influence of spatial planning on the flexibility of a city. Not only the built, the physical structures (such as the elements Urbanization structures), but also the temporal course, element time, the organization and last but not least one of the strongest elements: the social influence of Spatial Planner. Looking at the elements, it is obvious that they need and influence each other in order to create the goal of flexible and thus sustainable cities. Without the Spatial Planner no new planning rules and norms can be established. Without concepts and plans, Spatial Planner cannot be guided by them. Without the organization, the approach cannot be executed. Without the temporal consideration, no experiments can be conducted, which in turn require control and limits. These relationships can be elaborated further and it becomes very clear that the elements are closely related and interrelated. All together, as well as each one individually, contributes to the planning and design of a sustainable city.

The field of flexibility is large and certainly includes more than the eight elements presented in this paper. Furthermore, it is debatable whether these elements are representative, how far their influence is. Therefore, a closer (also spatial) investigation is needed in further steps.

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🏆 *reviewed paper*

Automatisierte Generierung eines 3D-Baumkatasters am Beispiel des KIT Campus Nord

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1 ABSTRACT

Bei Baumkontrollen werden sogenannte Baumkataster angelegt, in denen Informationen über in einem bestimmten Bereich befindliche Bäume dokumentiert werden. In ihnen wird unter anderem die Gestalt der Bäume durch die Parametern Baumhöhe, Baumkronendurchmesser und Baumkronenumfang beschrieben. Im Rahmen dieses Beitrages wird ein in Python entwickeltes Analyse- und Transformationswerkzeug vorgestellt, welches erlaubt, Baumdaten in unterschiedlicher, strukturierter Form (CSV, XML) einzulesen, tabellarisch darzustellen und zu analysieren. Weiterhin ermöglicht es, aus den Gestalt beschreibenden Daten ein 3D-Modell abzuleiten und dieses im standardisierten Datenformat CityGML unter Verwendung des Vegetation-Moduls als geometrisches 3D Modell mit den vorhandenen Sachdaten zu exportieren.

Keywords: Digitalisierung, CityGML, 3D, Baumkataster, Python

2 EINLEITUNG

Im Rahmen der Verkehrssicherungspflicht ist diejenige Person, die Verfügungsgewalt über ein Grundstück ausübt, dazu verpflichtet sicherzustellen, dass von den auf dem Grundstück befindlichen Bäumen keine Gefahren ausgehen. Daraus resultiert, dass Bäume im öffentlichen Raum in regelmäßigen Kontrollen auf Standsicherheit und Beschädigungen überprüft werden müssen.

Dabei werden sogenannte Baumkataster angelegt, um der Dokumentationspflicht nachzukommen, in denen neben einer Bewertung jedes Baumes auf einem Grundstück dessen genaue Lage sowie Metadaten erfasst werden. Einige dieser Metadaten beschreiben den Baum in seiner Gestalt, z.B. die Baumhöhe, der Stammdurchmesser oder der Baumkronendurchmesser.

Die Daten eines Baumkatasters lassen sich abgesehen von der Dokumentation aber auch noch für andere Einsatzgebiete nutzen. Aus den erfassten Parametern lässt sich die Gestalt der Bäume in parametrisierter Form beschreiben und damit für die Visualisierung oder für Simulationsberechnungen einsetzen. In einer Abschattungsanalyse kann beispielsweiße der Schatten berechnet werden, der von einem Baum auf ein Gebäude geworfen wird. Diese Informationen können für eine Solarpotentialanalyse oder für thermische Gebäudesimulationen genutzt werden. Um solche Berechnungen durchführen zu können ist ein digitales dreidimensionales Modell der Bäume notwendig. Viele Softwarelösungen zum Verwalten solcher Baumkataster unterstützen einen Export dahingehend jedoch nicht. Das am Campus Nord des KIT eingesetzte Programmsystem Arbokat® unterstützt beispielsweiße lediglich einen Export in die Formate CSV, PDF, KML, Shapefile und INGRADAweb, sodass die Entwicklung eines Werkzeuges, welches aus den Baumkatasterdaten dreidimensionale Geometrien ableitet und diese im standardisierten CityGML-Format exportiert, notwendig ist.

3 GRUNDLAGEN

3.1 Baumkataster

Ein Baumkataster ist ein raumbezogenes Verzeichnis, in dem Informationen zu Bäumen innerhalb eines bestimmten Gebietes erfasst sind (Stadt Stuttgart, 2020). Ein solches Gebiet kann zum Beispiel ein einzelnes Grundstück sein, aber auch ein gesamtes Stadtgebiet umfassen. Sie werden zu Dokumentationszwecken regelmäßig stattfindender Baumkontrollen angelegt. Solche Kontrollen müssen regelmäßig von sowohl öffentlichen als auch privaten Grundbesitzern stattfinden, die Verkehr eröffnen oder auf einem Grundstück zulassen. Der Grund hierfür ist, dass ein Baumbesitzer der Verkehrssicherungspflicht nachzukommen muss, die er gegenüber Dritten hat (Wessolly und Erb, 2014). Bei diesen Baumkontrollen wird der Zustand des Baumes erfasst und bewertet, um beispielsweise Sach- und Personenschäden durch baumkrankheitsbedingte Sturmschäden zu vermeiden. Im Jahr 2004 hat die Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e.V. (FLL) erstmals die Anforderungen an Baumkontrollen in den Baumkontrollrichtlinien

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normiert. Diese Baumkontrollrichtlinien der FLL wurden über gerichtliche Urteile dem aktuellen Stand der Technik der Baumkontrolle zugeordnet. Mittlerweile wurden die Baumkontrollrichtlinien überarbeitet, sodass diese seit 2010 in einer neuen, aktualisierten Fassung zur Verfügung stehen (Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e.V., 2010). Während dieser Baumkontrollen werden Daten über die untersuchten Bäume erfasst, wie z.B. der Gesundheitszustand, der Standort, die Höhe, der Stammdurchmesser oder der Baumkronendurchmesser.

Alle während der Baumkontrolle erfassten Daten werden danach zu Dokumentationszwecken im Baumkataster festgehalten. In ihnen werden also neben Daten zum Gesundheitszustand des Baumes und Standortinformationen und auch Daten über die Gestalt des Baumes festgehalten.

Es existieren einige Software-Programme, um die Erstellung und Verwaltung eines digitalen Baumkatasters zu erleichtern. Die am Campus Nord des KIT verwendete Software zur Erstellung und Verwaltung des digitalen Baumkatasters heißt Arbokat® und wird von der Firma iNovaGIS und dem Sachverständigenbüro Peter Klug konzipiert und entwickelt. Dabei werden alle in den Baumkontrollrichtlinien der FLL festgelegten Kriterien berücksichtigt (iNovaGIS, 2016).

3.2 CityGML

Das Datenformat City Geography Markup Language (CityGML) ist das Datenmodell, in das das Baumkataster überführt werden soll. Es ist ein semantisches Datenmodell zum Speichern und Austauschen digitaler dreidimensionaler (3D) Stadtmodelle (Gröger et al. 2012).

Das CityGML-Datenmodell wird seit 2002 von der Special Interest Group 3D (SIG 3D) entwickelt. Die Arbeitsgemeinschaft besteht aus mehr als 70 Firmen, Gemeinden und Forschungseinrichtungen. Ziel ist, ein standardisiertes Datenformat zum Speichern von 3D-Stadtmodellen zu schaffen, um den Austausch von Stadtmodellen zu erleichtern (Kolbe, 2009). Im Jahr 2008 wurde das CityGML-Datenformat (damals in der Version 1.0.0) auch vom Open Geospatial Consirtium als Standard (OGC) anerkannt. Aktuell liegt CityGML in der Version 2.0.0 vor und wird von vielen Städten weltweit (z.B. Berlin, München, Paris, Monaco, Istanbul, Doha) dazu verwendet, 3D-Stadtmodelle bereitzustellen (Gröger et al. 2012).

CityGML verbindet dabei eine geometrische Modellierung von Städten mit einer semantischen Modellierung. Das bedeutet, dass ein Stadtmodell im CityGML-Format sich nicht nur zur Visualisierung einer Stadt eignet, da nicht nur eine geometrische Repräsentation von einzelnen Objekten einer Stadt vorliegt, sondern dabei die einzelnen Objekte auch klassifiziert und aggregiert werden können, sowie mit verschiedenen, das Objekt näher beschreibenden, Attributen versehen werden können. Eine solche semantische Modellierung ermöglicht in Kombination mit der geometrischen Modellierung weitreichende Analysen (Gröger et al. 2012).

Das CityGML-Format ist modular aufgebaut. Es besteht aus dem zwingend erforderlichen Core-Modul sowie aus thematisch gegliederten Erweiterungs-Modulen. Das Core-Modul umfasst alle dem Datenmodell zugrundeliegenden Konzepte und Komponenten, die von jedem der Erweiterungsmodule genutzt werden. Mit den thematisch voneinander abgegrenzten Erweiterungsmodulen findet dann die eigentliche Modellierung der Objekte einer Stadt statt. Das Stadtmodell besteht dann aus der Gesamtheit der einzeln modellierten Objekte. In CityGML 2.0 existieren Erweiterungsmodule für z.B. Gebäude, Brücken und Stadtmöbelierung. Es existiert außerdem ein Modul für Vegetation, welches im Folgenden genauer vorgestellt wird (Gröger et al. 2012).

Unterschieden werden im Vegetation-Modul zwei verschiedene Klassen von Vegetation. Während die Klasse PlantCover dazu verwendet wird, eine größere Ansammlung von Vegetation zu modellieren wie z.B. eine Wiese oder einen Wald, können über die Klasse SolitaryVegetationObject einzelne Vegetations-Objekte beschrieben werden wie z.B. einzelne Bäume, Sträucher oder Büsche. Beide Klassen erben von der abstrakten Klasse _VegetationObject, die wiederum von der abstrakten Klasse _CityObject des Core-Moduls erbt. Abbildung 1 zeigt das UML-Klassendiagramm des CityGML-Vegetation-Moduls.

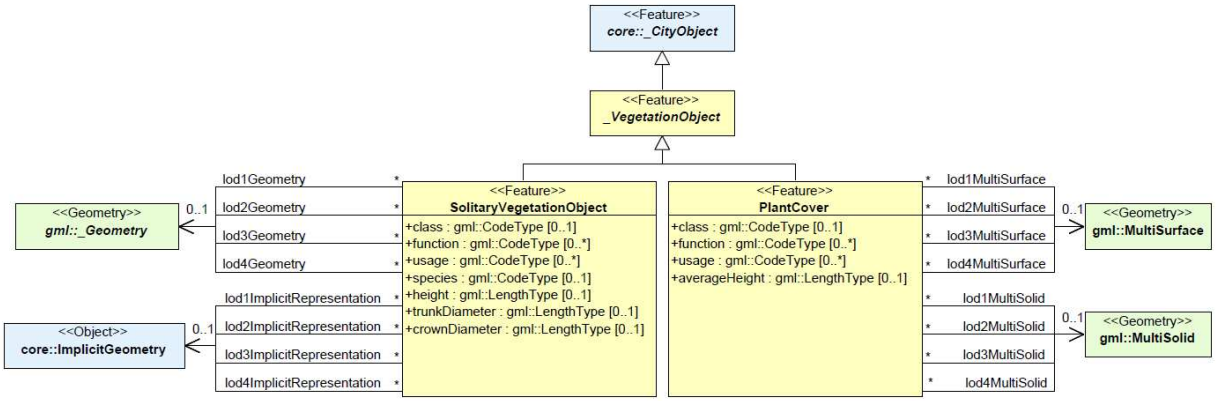

Abbildung 1: UML-Klassendiagramm des CityGML Vegetation-Moduls (Gröger et al. 2012)

Ein Objekt der Klasse PlantCover besitzt die Attribute class, welches die Vegetationsgruppe beschreibt, der das PlantCover-Objekt angehört. Die Attribute function und usage beschreiben den angedachten und tatsächlichen Zweck eines Objektes. Zudem besitzt die Klasse PlantCover das Attribut averageHeight, in dem die durchschnittliche Höhe der Vegetationsgruppe gespeichert wird (Gröger et al. 2012).

Auch ein Objekt der Klasse SolitaryVegetationObject hat die Attribute function und usage, die hier die gleiche Verwendung haben. Das Attribut class wird bei SolitaryVegetationObject jedoch dazu verwendet, um das Vegetations-Object genauer zu klassifizieren (z.B. Baum, Busch, Gras). Ein Objekt der Klasse SolitaryVegetationObject besitzt außerdem das Attribut species, in welchem der botanische Fachname der Spezies (z.B. Abies alba für Weißtanne) als CodeType gespeichert ist. Das bedeutet, dass jeder Baumspezies über eine sogenannte Codelist ein Zahlencode zugeordnet ist, und nur dieser Zahlencode im CityGML-Stadtmodell gespeichert wird (Gröger et al. 2012). Diese Codelist ist in der CityGML-Spezifikation definiert, sodass die verwendeten Codes programmunabhängig interpretiert werden können.

Des Weiteren besitzt die Klasse SolitaryVegetationObject einige Attribute zur parametrisierten Beschreibung der Geometrie. So kann im Attribut height die Höhe des Vegetations-Objektes gespeichert werden, im Attribut trunkDiameter der Durchmesser des Baumstammes (falls das modellierte Objekt ein Baum ist) und im Attribut crownDiameter der Durchmesser der Baumkrone. Alle Attribute der Klassen PlantCover und SolitaryVegetationObject sind jedoch optional und nicht zwingend erforderlich, was auch die Modellierung sehr flexibel macht. So können z.B. mit der Klasse SolitaryVegetationObject Bäume als auch Sträucher und Büsche modellieren, obwohl z.B. das Attribut trunkDiameter bei Büschen nicht sinnvoll einzusetzen ist. Es macht aber auch dann eine thematische Modellierung möglich, wenn nicht alle Attribute eines Vegetation-Objektes erfasst sind oder erfasst werden können. Weiterhin ist es möglich, jedem Objekt der Klasse _CityObject eine beliebige Anzahl frei definierbarer Attribute hinzuzufügen, sogenannte Generic Attributes, um eine thematische Modellierung über Attribute zu ermöglichen die nicht vom Datenmodell vorgesehen sind (Gröger et al. 2012).

Zur Visualisierung der Vegetation sowie zur Durchführung geometrischer Analysen ist es außerdem möglich, jedem Objekt der Klasse PlantCover und SolitaryVegetationObject Geometrien im Level-Of-Detail (LOD) 1 bis LOD4 zuzuweisen (Gröger et al. 2012).

4 ANALYSE

In diesem Kapitel werden zunächst die Ausgangsdaten, die im CSV-Format vorliegen, analysiert. Anschließend wird untersucht, welche Anforderungen an das zu erstellende Softwarewerkzeug gestellt werden

4.1 Baumdaten im CSV-Format

Das am KIT Campus Nord zur Verwaltung eines digitalen Baumkatasters verwendete Programmsystem Arbokat® unterstützt einen Export der Baumdaten in das Datenformat Comma Seperated Values (CSV) (iNovaGIS, o.D.). Dabei handelt es sich um eine Textdatei zur Speicherung strukturierter Daten, die sich aufgrund der Einfachheit des Datenformats leicht automatisiert verarbeiten lässt.

Die von Arbokat® generierte CSV-Datei enthält alle im Baumkataster gespeicherten Bäume. Jede Zeile der Datei enthält dabei die Informationen für je einen Baum. Innerhalb einer Zeile stehen, durch Semikolons

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voneinander getrennt, verschiedene Attribute, die den Baum näher in seinem Standort, seiner Gestalt und seinem Gesundheitszustand beschreiben. Um die einzelnen Baumattribute interpretieren zu können stehen in der ersten Zeile der CSV-Datei die Namen der Attribute. Für die Erstellung eines dreidimensionalen Baumkatasters sowohl als geometrisches als auch als parametrisiertes Modell im CityGML-Format sind dabei die folgenden Informationen wichtig, die in der CSV-Datei gespeichert sind:

- Genaue Position des Baumes: Rechts- und Hochwert im Referenzsystem Gauß-Krüger-Zone-3
- Lateinischer Name der Baumart
- Gestalt des Baumes: Baumhöhe, Baumkronendurchmesser, Stammumfang

Auffällig ist, dass den Bäumen in der CSV-Datei keine ID zugewiesen ist, über die ein Baum identifiziert werden könnte. Es existiert lediglich eine Baumnummer, die jedoch mehrfach vergeben wurde. Allerdings ist jedem Baum ein Bereich zugewiesen ist, in dem er steht und bei näherer Betrachtung fällt auf, dass die Baumnummer innerhalb eines Bereiches eindeutig ist. Somit ist es möglich, einen Baum anhand einer Kombination aus Bereichsnummer und Baumnummer eindeutig im gesamten Datensatz zu identifizieren.

4.2 Anforderungen an das Programm

Im Allgemeinen soll das in Python geschriebene Programm Baumdaten verschiedener Datenformate einlesen und verarbeiten können. Die Daten sollen analysiert, validiert und aus ihnen ein parametrisches als auch geometrisches Baummodell generiert werden können. Dieses soll im CityGML-Format exportiert werden können. Diese allgemeinen Anforderungen, die im Folgenden konkretisiert werden, legen die Rahmenbedingungen für die Entwicklung des Programms fest.

- Einlesen der Baumdaten: Das Programm soll Baumdaten in zweierlei Datenformaten einlesen und verarbeiten können. Es soll Baumdaten im CSV- als auch im XML-Format einlesen, verarbeiten und interpretieren können. Dabei soll eine gewisse Flexibilität beim Einlesen der Daten hinsichtlich ihrer Modellierung im jeweiligen Datenformat möglich sein.
- Graphische Benutzeroberfläche: Das Programm soll zur vereinfachten Bedienbarkeit über eine graphische Benutzeroberfläche verfügen. In ihr sollen die eingelesenen Baumdaten tabellarisch angezeigt werden, damit der Benutzer sich einen Überblick über den Datensatz verschaffen kann. Über die Benutzeroberfläche sollen alle Funktionen des Programms aufgerufen werden können.
- Analyse der Daten: Die eingelesenen Daten sollen analysiert werden können, damit der Benutzer sich einen Überblick über die Qualität der Daten schaffen kann. Die Daten sollen sowohl nach ihrer ID als auch nach ihrer Position auf Duplikate überprüft werden können. Weiterhin soll eine Validierung der Gestalt beschreibenden Parameter der Bäume stattfinden.
- Ableitung einer Referenzhöhe: Da in Baumkatastern häufig keine Referenzhöhen zu den Bäumen gespeichert sind, diese aber für weitere Analysen wichtig ist, soll es eine Möglichkeit geben, für jeden Baum im Datensatz eine Referenzhöhe aus einem DGM abzuleiten. Diese soll in der Datenstruktur gespeichert und bei der Weiterverarbeitung der Daten zu berücksichtigt werden.
- Export in das CityGML-Datenformat: Das Programm soll die Möglichkeit bieten, das Baumkataster im standardisierten, semantischen Datenformat CityGML unter Verwendung des Vegetation-Moduls zu exportieren. Dabei soll ein parametrisiertes als auch ein geometrisches Modell des Baumes erstellt und exportiert werden.

5 KONZEPT UND IMPLEMENTIERUNG

In diesem Kapitel soll zunächst das theoritische Konzept, auf welches das Softwarewerkzeug aufbaut, vorgestellt werden. Im Anschluss wird kurz auf die technische Umsetzung dieses Konzeptes eingegangen.

5.1 Konzept

Den Ablauf des entwickelten Programmes zeigt in schematischer Darstellung der Programmablaufplan in Abbildung 2. Es ist möglich, sowohl CSV- als auch XML-Dateien zu interpretieren und in eine räumliche Datenbank, die als interne Datenstruktur fungiert, zu überführen. Von dort aus werden die Daten in der GUI angezeigt, können analysiert, mit Höheninformationen angereichert und ins CityGML-Format exportiert werden.

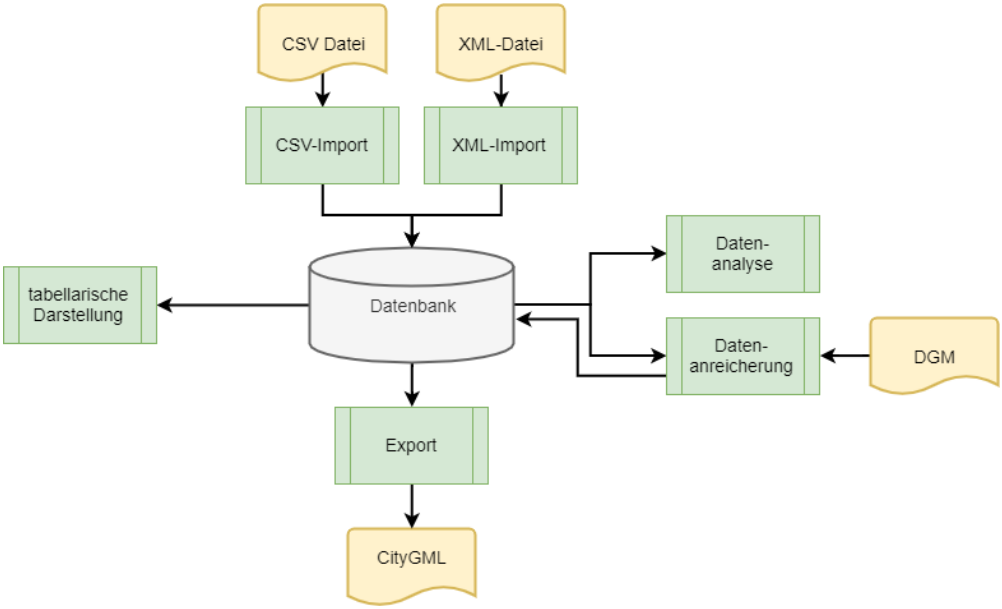

Abbildung 2: Programmablaufplan (eigene Darstellung)

Während der tabellarischen Anzeige der Daten hat der Benutzer die Möglichkeit, die Reihenfolge der Tabellenspalten anzupassen sowie einzelne Tabellenspalten ein- und auszublenden. Weiterhin hat er die Möglichkeit, die Spaltenwerte auf- und absteigend zu sortieren, um so einen besseren Überblick über die Daten erhalten zu können.

Während der Datenanalyse ist es möglich, die Daten auf zweierlei Arten auf Duplikate zu untersuchen. Einerseits wird dazu die ID des Datensatzes untersucht, wobei ein Duplikat potentiell dann vorliegt, wenn eine ID mehrmals im Datensatz vergeben wurde. Andererseits ist es möglich, den Datensatz auf Duplikate zu untersuchen, indem die Position eines Baumes betrachtet wird. Ist der Abstand zweier Bäume des Datensatzes geringer als ein zuvor vom Benutzer eingestellter Schwellwert, handelt es sich potentiell um ein Duplikat. Werden Duplikate festgestellt hat der Benutzer die Möglichkeit, die Duplikate von einem späteren Export ins CityGML-Datenformat auszuschließen.

Eine weitere Analysemöglichkeit der Daten ist die Validierung der Gestalt beschreibenden Baumparameter (Baumhöhe, Stammdurchmesser, Baumkronendurchmesser). Dafür sind verschiedene Kriterien implementiert, anhand der die Validität der Parameter geprüft werden kann. Bäume werden als ungültig eingestuft, wenn folgende Kriterien verletzt werden:

- Es existiert ein Wert für Baumhöhe, Stammdurchmesser und Baumkronendurchmesser
- Die Werte für Baumhöhe, Stammdurchmesser und Baumkronendurchmesser sind größer als null
- Der Stammdurchmesser ist größer als der Baumkronendurchmesser
- Der Baumkronendurchmesser ist größer als die Baumhöhe
- Der Stammdurchmesser ist größer als die Baumhöhe

Für jeden als invalide eingestuften Baum wird dem Nutzer anschließend in einer kurzen Meldung auf der Benutzeroberfläche die ID des ungültigen Baumes ausgegeben, sowie eine kurze Erklärung, warum diese invalide ist. Beim späteren Export der Daten ins CityGML-Datenformat werden die als invalide eingestuften Bäume zwar als parametrisiertes Modell exportiert, jedoch nicht als geometrisches, da für sie kein geometrisches Modell erzeugt werden kann.

Bei der Datenanreicherung ist es möglich, die vorhandenen Baumdaten mit weiteren Informationen anzureichern, um die vorhandenen Daten entweder um weitere Informationen zu erweitern oder um vorhandene Informationen zu verbessern. Es ist dabei möglich, eine Referenzhöhe für jeden Baum aus einem digitalen Geländemodell (DGM) abzuleiten oder eine einheitliche Referenzhöhe für jeden Baum festzulegen, falls dem Nutzer kein DGM vorliegt (was aber nur in flachen Gebieten sinnvoll sein kann).

Zur Ableitung der Referenzhöhe wird in einem ersten Schritt das digitale Geländemodell in die räumliche Datenbank importiert. Jeder Höhenreferenzpunkt des DGMs entspricht dabei einer Zeile einer neu

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angelegten Tabelle. Diese Tabelle hat die Lage des Höhenreferenzpunktes als 2D-Geometrie gespeichert, die Höhe als numerisches Attribut. In einem zweiten Schritt wird zunächst für jeden Baum untersucht, ob er innerhalb der konvexen Hülle aller Referenzpunkte liegt. Ist das nicht der Fall, kann zu diesem Baum keine Referenzhöhe aus diesem DGM abgeleitet werden, da zur Position des Baumes keine Höheninformationen im DGM vorliegen und keine Extrapolation der Höhe erfolgen soll. Liegt der Baum aber innerhalb der Konvexen Hülle, werden die vier Höhenreferenzpunkte, die dem Baum am nächsten liegen, extrahiert. Zwischen ihnen wird anschließend mit der Inverse-Distance-Weighting-Methode interpoliert, um die Referenzhöhe des Baumes zu bestimmen. Dabei handelt es sich um eine gewichtete Mittelwertbildung, wobei räumlich näher liegende Datenwerte stärker gewichtet werden als weiter entfernte Datenwerte (Bill, 2016)

Beim Export des Baumkatasters in das CityGML-Format wird jeder Baum, der im Baumkataster vorhanden ist, als SolitaryVegetationObject ins Stadtmodell exportiert. Dabei wird einerseits ein parametrisiertes Baummodell erstellt und exportiert. Der Nutzer trifft dazu vor dem Export eine Zuordnung über die GUI, in welcher er die Baumattribute des programminternen Datenmodells in der Datenbank den Attributen der CityGML-Klasse SolitaryVegetationObject zuordnet. Andererseits wird auch ein geometrisches Baummodell erstellt und exportiert, das aus den Gestalt beschreibenden Baumparametern errechnet wird. Der Nutzer hat dabei die Möglichkeit, den verschiedenen LODs unterschiedliche geometrische Baummodelle zuzuweisen. Diese geometrischen Baummodelle unterscheiden sich erheblich in ihrer Komplexität. Je nach Komplexität der Geometrie wird dabei nach Laub- oder Nadelbaum differenziert und unterschiedliche Geometrien generiert. Alle möglichen Arten der Baumgeometriemodelle, die der Nutzer den LODs zuweisen kann, sind im Folgenden nach aufsteigender Geometriekomplexität geordnet aufgelistet:

- Linie (Abbildung 3a): Es wird an der Position jedes Baumes eine senkrecht im Raum stehende Linie generiert. Der Anfangspunkt der Linie liegt dabei auf Höhe der Erdoberfläche, der Endpunkt auf Höhe der Baumhöhe über der Erdoberfläche.
- Zylinder (Abbildung 3b): Es wird an der Position jedes Baumes ein senkrecht auf Höhe der Erdoberfläche stehender Zylinder generiert. Die Höhe des Zylinders entspricht dabei der Höhe des Baumes, der Durchmesser des Zylinders entspricht dem Durchmesser der Baumkrone.
- (texturiertes) Rechteck (Abbildung 3c): Ein (texturiertes) Rechteck im Raum wird auf Höhe der Erdoberfläche an der Position jedes Baumes generiert. Die Höhe des Rechtecks entspricht der Höhe des Baumes, die Breite entspricht dem Baumkronendurchmesser. Auf Wunsch des Nutzers können pro Baum mehrere, sich in der Mitte überkreuzende Rechtecke generiert werden, um die Sichtbarkeit auf das Baummodell aus verschiedenen Blickwinkeln zu ermöglichen.
- Kontur beschreibende Polygone (Abbildung 3d): Es werden Polygone generiert, die die Kontur des Baumes beschreiben. Diese Polygone überkreuzen sich in der Mitte, um die Sichtbarkeit auf das Baummodell aus verschiedenen Blickwinkeln zu ermöglichen.
- Stark vereinfachte Baumgeometrie (Abbildung 3e): Zur Repräsentation des Baumstammes wird ein Quader generiert. Länge und Breite dieses Quaders entsprechen dem Stammdurchmesser. Für die Baumkrone eines Laubbaumes wird ein Würfel oberhalb des Quaders generiert, für Nadelbäume eine vierseitige Pyramide. Sowohl bei Quader als auch bei Pyramide entsprechen deren Längen und Breiten dem Baumkronendurchmesser. Die Summe der Höhen von Quader und Würfel bzw. Quader und Pyramide entspricht der Höhe des Baumes.
- Vereinfachte Baumgeometrie (Abbildung 3f): Zur Repräsentation des Baumstammes wird ein Zylinder auf Höhe der Erdoberfläche generiert. Dessen Durchmesser entspricht dem Stammdurchmesser. Für die Baumkrone eines Laubbaumes wird eine Kugel, für Nadelbäume ein Kegel oberhalb des Zylinders generiert. Kugeldurchmesser bzw. Kegelgrundflächendurchmesser entsprechen dem Baumkronenradius. Die Summe von Zylinderhöhe und Kugeldurchmesser bzw. Kegelhöhe entspricht der Baumhöhe.

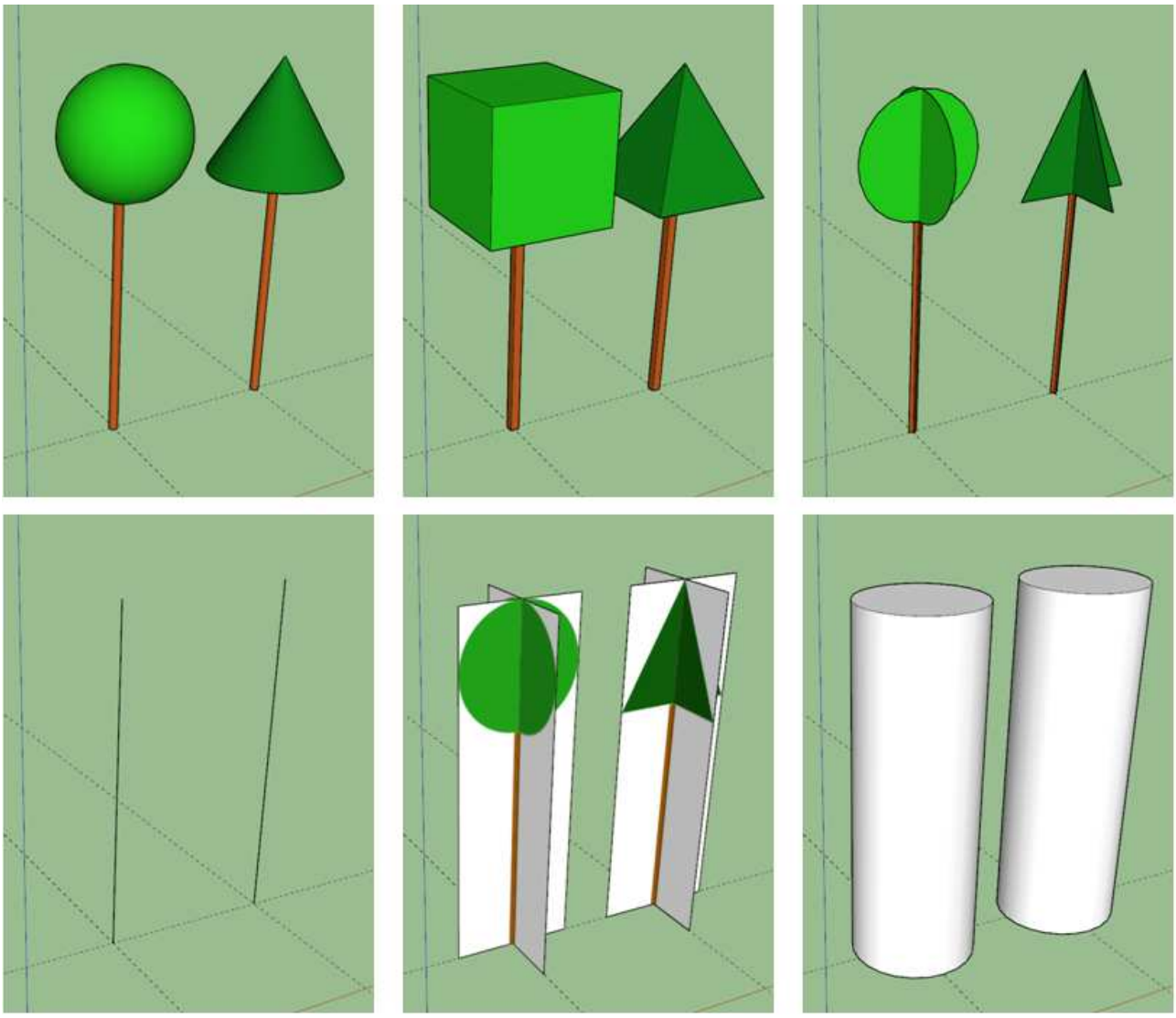

Abbildung 3a-f: Die zu erzeugenden Geometrien in den verschiedenen Detaillierungsgraden für Laub- und Nadelbäume (eigene Darstellungen)

Da das von CityGML verwendete Geometriemodell nur ebene und keine gekrümmten Flächen zulässt (Gröger et al. 2012), müssen Kugel-, Zylinder- und Kegeloberflächen durch Kombination von Polygonen angenähert werden. Der Benutzer kann dabei die Genauigkeit dieser Annäherung bestimmen, wobei die Komplexität der Geometrien mit steigender Annäherungsgenauigkeit ebenfalls zunimmt, da zu einer Steigerung der Genauigkeit die Anzahl der Flächen zunimmt.

5.2 Implementierung

In diesem Abschnitt wird kurz dargelegt, wie das zuvor vorgestellte Konzept technisch umgesetzt wird. Zur Implementierung des hier vorgestellten Programmes wird die Programmiersprache Python der Version 3 verwendet.

Als Datenbank, die zur Verwaltung des internen Datenmodells genutzt wird, kommt SQLite zum Einsatz. Bei SQLite handelt es sich um ein frei verfügbares SQL-Datenbanksystem, und hat den Vorteil, dass keine Serverarchitektur benötigt wird sondern die komplette Datenbank als seine Datei auf der Festplatte gespeichert ist (SQLite, 2020a). Unterstützung für SQLite-Datenbanken ist direkt in die Python-Standardbibliothek implementiert (Python Software Foundation, 2020), somit sind keine zusätzlichen Softwarebibliotheken nötig, um SQLite-Funktionalität in einem Python-Programm nutzen zu können. In dieser Anwendung verwendet SQLite zusätzlich die Erweiterung SpatiaLite, eine quelloffene Programmbibliothek, die SQLite um Funktionalitäten einer räumlichen Datenbank erweitert (Furieri, 2020).

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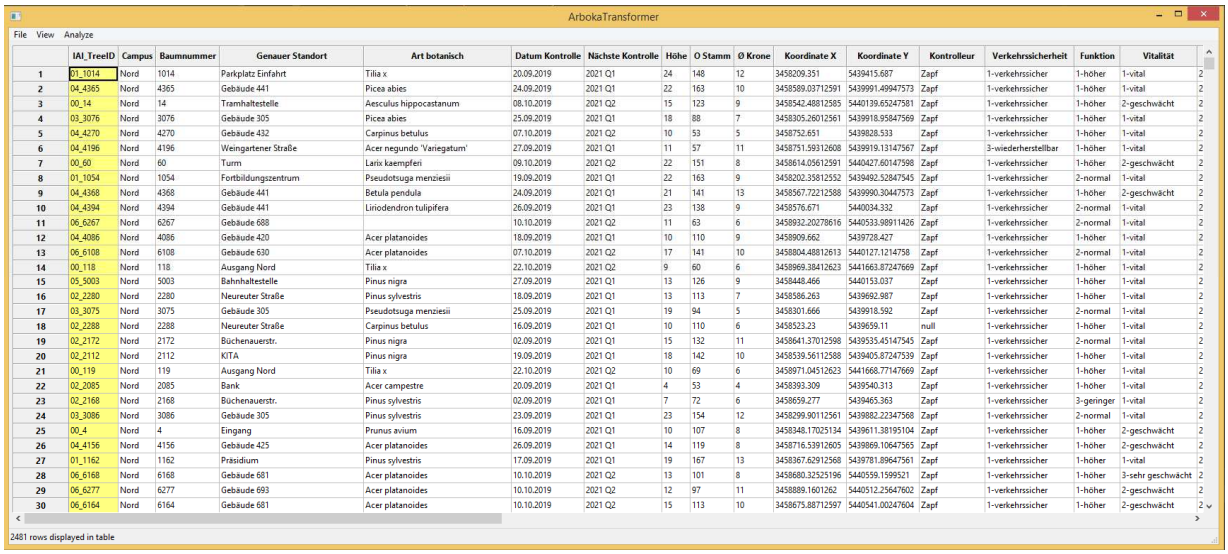
Die graphische Benutzeroberfläche wird mit der Bibliothek wxPython realisiert. Der Programmcode für eine Standardbenutzeroberfläche wird dazu mit dem Programm wxFormBuilder automatisiert generiert. Diese Standardbenutzeroberfläche wird dann durch eigenen Code ergänzt und angepasst.

Da die im Baumkataster vergebenen Baumnummern lediglich innerhalb eines Bereiches eindeutig sind, ist es möglich, eine ID aus einer Kombination der Bereichsnummer und der Baumnummer zu generieren. Dem Nutzer wird also beim Import der Daten die Möglichkeit gegeben, zwei Spalten auszuwählen, die dann miteinander durch einen Unterstrich verbunden werden. Hat ein Baum in Bereich 04 beispielsweiße die Baumnummer 4394, wird daraus die ID 04_4394 generiert. Diese ID wird in einer neuen Spalte IAI_TreeID in der Datenbank gespeichert. Da bei der weiteren Benutzung des Programmes häufig auf einzelne Bäume in der Datenbank zugegriffen werden muss, wird aus Gründen der Effizienz ein Index für die Spalte IAI_TreeID generiert.

Für den Fall, dass in den eingelesenen Daten keine ID vorhanden ist, ist es außerdem möglich, die von SQLite automatisiert generierte ROWID als ID zu verwenden. Es handelt sich dabei um eine Integer-Zahl, die automatisiert von SQLite vergeben wird, über die jede Zeile in einer Datenbanktabelle angesprochen werden kann (SQLite, 2020b).

Im Datenansichtsfenster des Programms werden nach dem Einleseprozess die Daten aller Bäume tabellarisch angezeigt, wie Abbildung 4 zeigt. Vom Programm automatisiert generierte Spalten (wie z.B. die der ID) werden dabei mit gelber Farbe hinterlegt um dem Nutzer anzuzeigen, dass diese Spalte nicht dem Baumkataster entstammt.



	IAI_TreeID	Campus	Baumnummer	Genauer Standort	Art botanisch	Datum Kontrolle	Nächste Kontrolle	Höhe	O Stamm	Ø Krone	Koordinate X	Koordinate Y	Kontrolleur	Verkehrssicherheit	Funktion	Vitalität	
1	01_1014	Nord	1014	Parkplatz Einfahrt	Tilia x	20.09.2019	2021 Q1	24	148	12	3458209.351	5439415.687	Zapf	1-verkehrssicher	1-höher	1-vital	2
2	04_4365	Nord	4365	Gebäude 441	Picea abies	24.09.2019	2021 Q1	22	163	10	3458589.03712591	5439991.49947573	Zapf	1-verkehrssicher	1-höher	1-vital	2
3	00_14	Nord	14	Tramhaltestelle	Aesculus hippocastanum	08.10.2019	2021 Q2	15	123	9	3458542.48812585	5440139.65247581	Zapf	1-verkehrssicher	1-höher	2-geschwächt	2
4	03_3076	Nord	3076	Gebäude 305	Picea abies	25.09.2019	2021 Q1	18	88	7	3458305.26012561	5439918.95847569	Zapf	1-verkehrssicher	1-höher	1-vital	2
5	04_4270	Nord	4270	Gebäude 432	Carpinus betulus	07.10.2019	2021 Q2	10	53	5	3458752.651	5439828.533	Zapf	1-verkehrssicher	1-höher	1-vital	2
6	04_4196	Nord	4196	Weingartener Straße	Acer negundo 'Variegatum'	27.09.2019	2021 Q1	11	57	11	3458751.59312608	5439919.13147567	Zapf	3-wiederherstellbar	1-höher	1-vital	2
7	00_60	Nord	60	Turm	Larix kaempferi	09.10.2019	2021 Q2	22	151	8	3458614.05612591	5440427.60147598	Zapf	1-verkehrssicher	1-höher	2-geschwächt	2
8	01_1054	Nord	1054	Fortbildungszentrum	Pseudotsuga menziesii	19.09.2019	2021 Q1	22	163	9	3458202.35812552	5439492.52847545	Zapf	1-verkehrssicher	2-normal	1-vital	2
9	04_4368	Nord	4368	Gebäude 441	Betula pendula	24.09.2019	2021 Q1	21	141	13	3458567.72212588	5439990.30447573	Zapf	1-verkehrssicher	1-höher	2-geschwächt	2
10	04_4394	Nord	4394	Gebäude 441	Liriodendron tulipifera	26.09.2019	2021 Q1	23	138	9	3458576.671	5440034.332	Zapf	1-verkehrssicher	2-normal	1-vital	2
11	06_6267	Nord	6267	Gebäude 688		10.10.2019	2021 Q2	11	63	6	3458932.20278616	5440533.98911426	Zapf	1-verkehrssicher	2-normal	1-vital	2
12	04_4086	Nord	4086	Gebäude 420	Acer platanoides	18.09.2019	2021 Q1	10	110	9	3458909.662	5439728.427	Zapf	1-verkehrssicher	1-höher	1-vital	2
13	06_6108	Nord	6108	Gebäude 630	Acer platanoides	07.10.2019	2021 Q2	17	141	10	3458804.48812613	5440127.1214758	Zapf	1-verkehrssicher	2-normal	1-vital	2
14	00_118	Nord	118	Ausgang Nord	Tilia x	22.10.2019	2021 Q2	9	60	6	3458969.38412623	5441663.87247669	Zapf	1-verkehrssicher	1-höher	1-vital	2
15	05_5003	Nord	5003	Bahnhaltestelle	Pinus nigra	27.09.2019	2021 Q1	13	126	9	3458448.466	5440153.037	Zapf	1-verkehrssicher	1-höher	1-vital	2
16	02_2280	Nord	2280	Neureuter Straße	Pinus sylvestris	18.09.2019	2021 Q1	13	113	7	3458586.263	5439692.987	Zapf	1-verkehrssicher	1-höher	1-vital	2
17	03_3075	Nord	3075	Gebäude 305	Pseudotsuga menziesii	25.09.2019	2021 Q1	19	94	5	3458301.666	5439918.592	Zapf	1-verkehrssicher	2-normal	1-vital	2
18	02_2288	Nord	2288	Neureuter Straße	Carpinus betulus	16.09.2019	2021 Q1	10	110	6	3458523.23	5439659.11	null	1-verkehrssicher	1-höher	1-vital	2
19	02_2172	Nord	2172	Büchenauerstr.	Pinus nigra	02.09.2019	2021 Q1	15	132	11	3458641.37012598	5439535.45147545	Zapf	1-verkehrssicher	2-normal	1-vital	2
20	02_2112	Nord	2112	KITA	Pinus nigra	19.09.2019	2021 Q1	18	142	10	3458539.56112588	5439405.87247539	Zapf	1-verkehrssicher	1-höher	1-vital	2
21	00_119	Nord	119	Ausgang Nord	Tilia x	22.10.2019	2021 Q2	10	69	6	3458971.04512623	5441668.77147669	Zapf	1-verkehrssicher	1-höher	1-vital	2
22	02_2085	Nord	2085	Bank	Acer campestre	20.09.2019	2021 Q1	4	53	4	3458393.309	5439540.313	Zapf	1-verkehrssicher	1-höher	1-vital	2
23	02_2168	Nord	2168	Büchenauerstr.	Pinus sylvestris	02.09.2019	2021 Q1	7	72	6	3458659.277	5439465.363	Zapf	1-verkehrssicher	3-geringer	1-vital	2
24	03_3086	Nord	3086	Gebäude 305	Pinus sylvestris	23.09.2019	2021 Q1	23	154	12	3458299.90112561	5439882.22347568	Zapf	1-verkehrssicher	2-normal	1-vital	2
25	00_4	Nord	4	Eingang	Prunus avium	16.09.2019	2021 Q1	10	107	8	3458348.17025134	5439611.38195104	Zapf	1-verkehrssicher	1-höher	2-geschwächt	2
26	04_4156	Nord	4156	Gebäude 425	Acer platanoides	26.09.2019	2021 Q1	14	119	8	3458716.53912605	5439869.10647565	Zapf	1-verkehrssicher	1-höher	2-geschwächt	2
27	01_1162	Nord	1162	Präsidium	Pinus sylvestris	17.09.2019	2021 Q1	19	167	13	3458367.62912568	5439781.89647561	Zapf	1-verkehrssicher	1-höher	1-vital	2
28	06_6168	Nord	6168	Gebäude 681	Acer platanoides	10.10.2019	2021 Q2	13	101	8	3458680.32525196	5440559.1599521	Zapf	1-verkehrssicher	1-höher	3-sehr geschwächt	2
29	06_6277	Nord	6277	Gebäude 693	Acer platanoides	10.10.2019	2021 Q2	12	97	11	3458889.1601262	5440512.25647602	Zapf	1-verkehrssicher	1-höher	2-geschwächt	2
30	06_6164	Nord	6164	Gebäude 681	Acer platanoides	10.10.2019	2021 Q2	15	113	10	3458675.88712597	5440541.00247604	Zapf	1-verkehrssicher	1-höher	2-geschwächt	2

Abbildung 4: Datenansichtsfenster des Programmes unter Windows 8.1 mit tabellarischer Anzeige der Baumdaten des KIT Campus Nord (eigene Darstellung)

Über einen Rechtsklick auf eine Spaltenüberschrift hat der Benutzer die Möglichkeit, die Tabelle nach dieser Spalte auf- oder absteigend zu sortieren oder diese Spalte auszublenden. Außerdem kann er per Drag-and-Drop die Reihenfolge der Spalten verändern. Über das Hauptmenü können alle wichtigen Funktionen des Programmes aufgerufen werden, wie z.B. das Einlesen einer Datei mit Baumdaten, den Export eines Datensatzes als CityGML, die Analyse der Daten und die Erweiterung der Daten. Zum jetzigen Zeitpunkt ist lediglich ein CityGML-Export des parametrisierten Baummodells möglich, Generierung und Export eines geometrischen Baummodells ist noch nicht möglich.

6 FAZIT UND AUSBLICK

Wie in diesem Beitrag gezeigt wurde, wird mit diesem Programm ein Werkzeug geschaffen, das es ermöglicht, strukturierte, nicht-standardisierte Baumdaten in das standardisierte, semantische Datenmodell CityGML zu überführen. Da das Datenformat der OGC-Standard für 3D-Stadtmodelle ist, kann es von vielen Programmen eingelesen und weiterverarbeitet werden. Es stellt also das Bindeglied zwischen Programmen zur Baumkatasterverwaltung und Programmen der Visualisierung und Analyse von Stadtmodellen dar.

Im weiteren Verlauf der Entwicklung dieses Programmes soll zunächst der Export der 3D-Baumgeometrien in den verschiedenen LODs realisiert werden. Der Nutzer soll außerdem auswählen können, ob weitere

Attribute, die zwar im Baumkataster erfasst aber nicht von der CityGML-Klasse SolitaryVegetationObject abgebildet werden können, als generische Attribute ins Datenmodell eingefügt werden sollen. Es sollen außerdem weitere Funktionen zur Anreicherung der Baumdaten implementiert werden. So soll es möglich sein, die im Baumkataster gespeicherte Baumhöhe mithilfe eines Laserscanning-Datensatzes aus einer Befliegung des Geländes zu verifizieren. Um realitätsgetreuere 3D-Modelle der Bäume zu erstellen, ist es außerdem notwendig die Höhe des Laubansatzes des Baumes zu kennen. Diese wird allerdings bei den Baumkontrollen häufig nicht erfasst und ist daher nicht im Baumkataster gespeichert. Daher soll untersucht werden, ob es möglich ist, diese ebenfalls aus den Laserscanning-Daten der Befliegung abzuleiten.

7 LITERATURVERZEICHNIS

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🏆 *reviewed paper*

Behaviour Change towards Sustainable Mobility triggered by Nudging Initiatives

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1 ABSTRACT

This paper presents a comprehensive overview about methods and practice cases regarding behavioural change initiatives towards sustainable mobility triggered by nudging techniques. “Nudges refer to purposeful changes in the choice architecture that influence peoples' behaviour by making changes in the environment that guide and enable individuals to make choices almost automatically. This can be done by simplifying the information provided or by offering default choices in a way that facilitates socially desirable decisions. Thus, nudges do not try to change one's value system or increase information provision. Instead they focus on enabling behaviours and private decisions that are beneficial for society and usually in the individual's long-term interests, as well.” Lehner et al. (2016). Four types of tools are part of nudging: 1) simplification and framing of information, 2) changes to the physical environment, 3) changes to the default policy, and 4) the use of social norms. The objective of nudging originally is to promote certain behaviour, which is beneficial for individuals as well as the society and increases the effectiveness of policy. All these techniques are well known, successful and applied in many areas such as for super markets selling their products or in politics campaigning for the next elections. Surprisingly, such techniques are less known in the field of mobility aiming at leading people towards a more sustainable behaviour. Nevertheless, isolated activities were successfully applied already as pilot actions.

Regarding 1): Simplification and framing mean that information is made more straightforward. It fits the information processing capabilities and decision-making processes of the target group because not only the amount or accessibility of provided information matters, but also how the information is presented. Therefore, it matters how the situation/nudge is presented or with what words. E.g. people in a rush will try to reduce complexity regarding the information they use to make a decision. As examples in the area of sustainable mobility information about public transport such as time tables need to be visible and easily understandable, e.g. not only at the bus stops, but at public places, restaurants, hotels, working places as well, ideally online screens with departures. Nudging through changes in physical environment is well known, for example in placement of preferred products in shelves in supermarkets. Good examples are to place sustainable mobility options with a higher priorisation on a homepage and leaflet, or to put the bus stop area closer at a destination as the car park. Defaults are set standards, which determine the result as long as the addressed person does not take action and insist in making changes, e.g.: “print double sided copy” as standard instead of “print single pages” at a printer. An example in the area of sustainable mobility can be the strategy, if one asks in a tourism office or at the hotel reception, how to reach a specific destination, he/she get explained how to reach by means of public transport or bicycle and not by car instead of. Social norms are a strong force that influence human behaviour. However, social norms can influence human behaviour if they are salient and visible for the target group. Examples are announcements such as “in our company already xx km were cycled this month for commuting with the bicycle already, saving xx CO2 emissions at the same time” which are send out to the employees in the course of an active mobility campaign in a company.

Keywords: Intervention, Behaviour change , Sustainable Mobility, Nudging, Tools

2 INTRODUCTION

Within the project SMACKER - funded under the Interreg Central Europe programme - mobility issues related to peripheral and rural areas, and main barriers are assessed and addressed by providing solutions that draw on the best international know-how. SMACKER promotes demand-responsive transport services to connect local and regional systems to main transport corridors and nodes such as the TEN-T network: soft measures (e.g. behaviour change campaigns) and hard measures (e.g. mobility service pilots) are used to identify and promote eco-friendly solutions for public transport in rural and peripheral areas to achieve more liveable and sustainable environments, better accessibility for the population to main corridors and better

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feeder services. SMACKER also encourages the use of new transport services through motivating and incentivizing campaigns (Batiajew et al. 2019). The direct beneficiaries of the actions are residents, commuters and tourists. This paper presents a comprehensive overview about methods regarding behavioural change initiatives based on nudging techniques. This overview will allow to identify suiting methods for supporting the implementation of new mobility offers or promote existing, but underused supplies of sustainable transport. In the first part of this paper a definition about nudging is given and the target groups of the methods are described. Different channels for the communication of the nudging methods are explained as well as potential points of contact, which may act as entry point for the introduction of a nudging method. In the second part a comprehensive overview presents all the methods and an overview is given.

3 THE CONCEPT OF NUDGING

3.1 Definition

“Nudges refer to purposeful changes in the choice architecture that influence peoples' behaviour by making changes in the environment that guide and enable individuals to make choices almost automatically. This can be done by simplifying the information provided or by offering default choices in a way that facilitates socially desirable decisions. Thus, nudges do not try to change one's value system or increase information provision; instead they focus on enabling behaviours and private decisions that are beneficial for society and usually in the individual's long-term interests, as well.” Lehner et al. (2016) based on Thaler and Sunstein (2008). According to Lehner et al (2016) these four types of tools are part of nudging: 1) simplification and framing of information, 2) changes to the physical environment, 3) changes to the default policy, and 4) the use of social norms. Regarding 1): Simplification and framing mean that information is made more straightforward. It fits the information processing capabilities and decision-making processes of the target group because not only the amount or accessibility of provided information matters, but also how the information is presented (Lehner et al. 2016). Therefore, it matters how the situation/nudge is presented or with what words (Lehner et al. 2016). E. g. people in a rush will try to reduce complexity regarding the information they use to make a decision. Nudging through changes in physical environment is well known, for example in placement of preferred products in shelves. Defaults are set standards, which determine the result as long as the addressed person does not take action and insist in making changes, e. g.: “print double sided copy” as standard instead of “print single pages”. According to Lehner et al. (2016) social norms are “a strong force that influence human behaviour”. However, social norms can influence human behaviour if they are salient and visible for the target group (Chialdini and Goldstein 2004). The objective of nudging originally is to promote certain behaviour, which is beneficial for individuals as well as the society and increases the effectiveness of policy (Thaler and Sunstein, 2008 in Lehner et al. 2016).

3.2 Target groups

Target groups relevant for nudging towards the use of flexible transport are residents, commuters and visitors (tourists) of a specific region, which may need to be addressed in different ways and through different channels. Residents are very open for interventions in regard to their mobility choice, if changes in their individual stages of life take place, like starting at a new school or workplace, relocation of the place of residence, the household size is extended (e. g. children were born), the household size was decreased (e. g. grown up children were leaving the household, divorce), medical reasons, which implicate the need to change mobility patterns. These framework conditions often cause the reflection of usual activity patterns and the need to adapt individual behaviour. Each new stage of life offers the possibility to nudge residents towards the use of sustainable mobility. Mobility patterns of commuters are highly repetitive and thus have a high potential to provoke sustainable behaviour. In particular, employees that change their work place are open to new mobility options due to changed framework conditions. Contrary to this, tourists usually do not have habitual trips at their holiday destination. They often have to find their way themselves in a new area, thus, they are open for mobility options offered (especially, if they do not have their car available at the holiday destination). Addressing tourists offers a high potential to nudge towards sustainable mobility and could stimulate them to rethink their mobility at home as well.

3.3 Channels of communication

This chapter includes a description of channels which can be used as starting point for nudging. These channels describe ideas how to get in contact with the target groups. At first there is an alternative to directly contact your target group or indirectly via a third party. Direct ways of contact are direct written information paper based or electronic. This includes sending an information letter and a registration postcard for further information to potential participants by post or email. An alternative, but more costly are direct face-to-face information. One can get in touch with potential participants directly on local events or by creating an own event, knocking on the door, at public meeting points etc. A third alternative are direct phone contact and getting in touch with potential participants directly by phone. But usually, telephone lists are outdated or incomplete and there are some legal restrictions. So there need to be a strategy established to collect the phone numbers, either via direct contacts or via mail (which usually includes the agreement to contact these persons via telephone).

Indirect ways of contact means to include a trustful third party to convey the nudgings, ideally local stakeholders, employees in contact with the envisaged target group or any other multiplier or role model who is getting into direct contact with the target group. If these persons play a main role in the campaign, they need to be prepared and trained for this task. Not to let others do too much work, sending an information letter/ email and/or face-to-face contact from such persons could be a door opener (by creating a friendly background for the direct contact with the participants) and then get in direct contact with the target groups. Other indirect channels (but only supporting a more interactive campaign) can be the usage of info boards, which can provide relevant information for the target group in different settings, (preferably local) radio or TV providing relevant information for the target groups, so many potential participants can be reached. Ideally the messages are not reduced on advertisement jingles only but embedded in infotainment sections of the programme, e.g. interviews or editorial contributions.

4 NUDGING INTERVENTIONS FOR SUSTAINABLE MOBILITY

The different types of action and intervention are described below. All of these were already carried out in different target areas, reference is given in each chapter.

4.1 Mobility stand on local or regional event

At regular local events (e.g. farmer's market) a mobility stand provides general explanation of sustainable transport modes and in detail the following question get answered: How to get the information I need, e. g. in the case of flexible transport offers in the area: How to get a bus picking me up? How much will the using of (flexible) PT cost for the customer? The information is provided by trained staff for individual dialogs and consultation but also via infofolders and other information material to take away. Specific information for commuters, pupils etc. can be provided. An example is the Verkehrsverbund Rhein Sieg, Germany, see www.vrs.de/fileadmin/Dateien/downloadcenter/VRSundNVR_gemeinsam_fuer_die_Region_2014.pdf.

4.2 Self-organized event about sustainable local mobility

Self-organized events about sustainable local mobility supported by the municipality or the PT/mobility provider take place. Presentation and discussions about local PT provide information and insights. Contrary to measure 3.1, an additional task is to motivate people to visit the event by including an attractive program for this event (e.g. games, demonstrations of vehicles, presentations, discussion rounds etc.). A location needs to be organised: An accessible site within the municipality, e.g. municipal office. Often the municipalities or local organisations (social clubs, health care centres, schools, homes for elderly and similar) can offer relevant infrastructure. Depending on the target group, daytime, duration and kind of day need to be arranged, ideally a date which is not favouring a specific group. Trained staff from a mobility agency or PT/mobility provider or project partner need to provide adequate presentations, depending on the target group. It is important, how the invitations to the event will be sent out. Often the municipalities can assist because they are owning relevant address lists (if not selective, excluding some groups of citizens), but also can publish the event in their media or at their homepages. Additionally, local media can be contacted to report about the event. Prepare layout and contents of the presentation. When sending out an invitation letter, participants can be asked for the most important information they want to hear. This can be a valuable input, if preparing the presentations. Typical topics to be presented are: Understanding the operation times, maps of

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area of operation, tariff information (specific and general), how to book or modify a trip (if flexible system is in operation), how the local bike sharing system works, the bicycle infrastructure in the area etc. Hand out material should be provided for the event. Gaming elements, lotteries, the presentation of vehicles and test rides or other mobility related demonstrations can accompany the event. An example of this action is the Project Midas, see https://ec.europa.eu/energy/intelligent/ projects/en/projects/midas.

4.3 Presentations at periodic local meetings, establishment of a local mobility forum

Open periodic discussion rounds/open meetings about important local concerns in the municipality (or within a bigger company) provide a good platform where topics about sustainable local mobility are attached. Target groups get addresses by the local municipality. This could be either a regular meeting series, where all topics residents are concerned with, are included or periodic meetings with a focus on mobility within the municipality (or within a bigger company). A regular meeting is chosen, which guarantees an "open" characteristic, so that no citizens are excluded in these events and various issues are discussed. Local stakeholders/multipliers should be included in the meetings attracting citizens/employees to attend. An example of this action are the partner regions of the SMACKER project, see https://www.interreg-central.eu/Content.Node/SMACKER.html.

4.4 Empowering pupils to use public transport

Trained staff presents threats of car usage and highlights alternatives in schools. Pupils learn how to use PT, biking or even walking including the legal situation. If possible, try out activities are provided in cooperation with the transport providers. Discussions with pupils about e. g. daily mobility patterns in a playful way shall encourage the process of reflexion. Schools need to be contacted to provide time and space for the event (directors and teachers, where the activity could be integrated in the courses). In case, try out activities are planned, local transport providers need to be contacted as well. If there exists an initiative for sustainable behaviour already (e.g. Fridays for Future), representatives of this initiatives within the school can be integrated in the activities. Trained staff needs to provide a presentation, which is well tailored for the target group (preferably children in primary school or young children in high school due to openness for new mobility options and the need to establish new daily mobility routines). Information material is a must have to bring, to provide information not only for the pupils but also for their parents. Gaming elements could support the usage of public transport (e.g. traffic snake game, where classes are compared with regard to their sustainable mobility). An example of this action is the Staffordshire County Council case study, see https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/575323/ Home_to_school_travel_and_transport_guidance.pdf.

4.5 Mobility managers in companies, institutions or other organisations

Work places or organisations like schools, tourist accommodations set up a representative, who is a contact person to provide help for individual mobility concerns but also to provide information about alternatives to car usage in general (e. g. through presentations or include aspects in newsletters). Preferably, this representative acts as a role model (uses PT or the bicycle for way to work), but actively contacts the employees to put sustainable mobility on the agenda within the company or organisation. Furthermore, organisations implement a bonus system, which encourages the usage of PT and active transport modes. Work places and organisations need to be contacted and empowered to highlight the importance of the action. Benefits need to be pointed out and the work places and organisations need to be supported by developing and implementing a strategy for mobility management. Information material and options of concrete actions (job ticket, commuter lottery for sustainable mobility) need to be provided for the representative to forward these actions within the companies or organisations. An example of this action is the Travel Smart Initiative in Singapore http://viajeoplus.eu/wp-content/uploads/sites/4/2015/11/ Viajeo_PPT_Travel-Smart-LTA.pdf.

4.6 Guided PT, walking or cycling tour per target group

This event takes the target groups on a tour. The tour can be combined with (small) touristic events. If focusing on PT, timetables, tariffs and ticketing are explained and tested, as well as safety rules. The tours are designed for specific target groups like elderly people, pupils, parents and commuters so attention is drawn to specific needs of the target group, e. g. usage of PT by wheelchair or walking frame for elderly

people. This event can either be attached to an existing local event (e. g. farmers market) or established on its own. Either way, trained staff needs to be found and information for the target group needs to be prepared. Potential points of contact are the following: schools, local municipality, at home, work places, doctors, participation at local events, self-organized events, club associations and radio. If the event is established on its own, a meeting point needs to be organised per target group. Club associations or local municipality and schools can provide sensible meeting points. An example of this action is an initiative in Münster, Germany, see www.stadtwerke-muenster.de/privatkunden/busverkehr/kundenservice/bustraining/vorschulkinder.html.

4.7 Personal mobility assistants for elderly people at major transport interchanges

This measure involves the provision of a personal assistance service at major public transport interchanges. The measure will help older citizens to travel independently and increase the attractiveness of PT for older people. Project staff should be located at one or two public transport interchange points for certain time slots. A group of young, trained persons are positioned ready to help older people at the bus and tram stops at public transport interchanges. These staff help older people to enter and to exit buses and trams, based on previously defined rules and advice. They can also provide information about PT connections and bus and tram schedules and assist with the use of ticket vending machines or apps. Assistants are available e. g. in the morning, every day from Monday to Friday. In order to be properly recognized, they should wear colourful jackets or T-shirts with logos (ideally provided by the local PT/mobility provider). They should also have special ID-cards that are kept visible. The idea is not only to help older people directly, but also to raise awareness among others and to encourage travellers to assist each other. As a result, it is expected that more and more younger people will help older people to enter and leave the vehicles, provide information about available connections, and help with ticket purchase, etc. Potential points of contact, which inform the target group about this service can be: Local municipality, at home, doctors, local events, self-organized events, radio, TV, club associations. An example of this action provides the AENEAS project, Krakow Poland, see http://www.eltis.org/resources/videos/krakow-assistance-service-older-people-major-public-transport-interchanges.

4.8 "Car-free day"/EU Mobility week

The EUROPEAN MOBILITYWEEK campaign provides the perfect opportunity to present sustainable mobility alternatives to local residents and to explain the challenges that cities and regions are facing. By taking part, towns and regions can showcase the benefits of cleaner transport choices and make progress towards better mobility in Europe. Local authorities are strongly encouraged to use the week to test new transport measures and get feedback from the public. It is also an excellent opportunity for local stakeholders to get together and discuss the different aspects of mobility and air quality, find innovative solutions to reduce car-use and transport emissions, and test new technologies and planning measures. (see http://www.mobilityweek.eu/the-campaign/). Interested towns and regions register for the European mobility week. Every European mobility week uses a special topic, which is the theme of the week throughout Europe (e. g. "Safe Walking and Cycling" for 2019). Participating towns can either organize activities, which promote public transport, cycling and walking and other forms of sustainable mobility or can implement permanent measures during this week. Finally yet importantly, towns can carry out a "Car free day", preferably on "World car-free day". The chosen activities are promoted through all points of contact. Depending on the chosen activities, different cooperation partners needs to be contacted. An example of this action is the city of Igoumenitsa (Greece), which is the winner of the EUROPEAN MOBILITY WEEK Award 2017 for smaller municipalities, see http://www.mobilityweek.eu/fileadmin/user_upload/materials/participation_resources/2018/2018%20EMW%20Best%20Practice%20Guide%20LR.pdf.

4.9 Public transport try-out activities (free PT test ticket etc.)

With this measure, potential public transport users get in contact with the public transport system either for the whole trip or in combination with other feeder systems (incl. flexible transport). With the free try-out ticket there is no financial risk for the user (e. g. that she/he did not purchase the correct ticket). Nevertheless, the persons receiving a try out ticket for public transport should be contacted again after the usage of the try out ticket asking them to report (and discuss) their experience made. At least a return ticket should be offered to test a trip to a destination within a pre-defined area. If budgetary resources are available or a sponsor can be found, full day or weekly tickets would increase the attractiveness of the measure. This

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measure can be accompanied by a social media campaign, encouraging people, who try out PT the first time, to "post" a picture or similar at social media, about their experience travelling with public transport. This measure can also be extended to other sustainable modes of transport. An example of this action was carried out in the city of Salzburg, Austria, where 20.000 test tickets were distributed, https://salzburg-verkehr.at/pa_file/presseinformation-testticket-gewinnspiel-vom-testfahrer-zum-gewinner/?download=650983d5b3b7919354a5fb32fe5a1968.

4.10 "Trips for Trash" & other local charity activities

Free PT tickets are exchanged for recyclable materials like plastic bottles and paper (e. g. one ticket per 5 kg plastic waste). The measure can be extended to other charity activities too, where credits can be earned for obtaining a public transport ticket (like assisting senior citizens, doing voluntary community work etc.). Information about PT is given as well at point of exchange credits/waste against the public transport ticket. Depending on the format, companies need to be contacted to create an incentive (e. g. waste collection, social institutions etc.) A place for the exchange needs to be organised, the local municipality can probably help to find a suitable place or take over this task. In case no trash is returned and instead other social efforts are supported, these need to be proven (e. g. via notification). In case trash is returned, it is necessary to provide suitable containers for the trash. The local waste collection company or the municipality can provide these. An example of this action is carried out in the is the city of Rome, see Trips of Trash, https://www.thelocal.it/20190725/you-can-now-trade-plastic-bottles-for-metro-tickets-in-rome?fbclid=IwAR3-H5vWt_OCwAcpSnaiCkHesFAKu9Gau0Zz5TMuZ85WcllY-E-SVH2o-sk or the city of Almada (Portugal), see Trips for Trash, http://www.epomm.eu/old_website/study_sheet.phtml?sprache=en&study_id=2887.

4.11 With PT/bicycle/on foot to work/school competition with lottery

A competition with lottery is set up with a competitive character, in which people are acknowledged if using sustainable modes of transport on a specific day or can collect "kilometres" or "points/kilometre" travelled by sustainable modes and have the chance to win prizes, which, at best, encourage further travelling with sustainable modes (e. g. high quality rain jackets, umbrella etc.). Potential participants (pupils, employees) need to be contacted, e. g. via schools or work places. A website and/or app is created to give the opportunity that participants can record their travelled kilometres and with this create a basis for the lottery. Prizes of the lottery can be contributed by local PT/mobility provider or local municipality. Alternatively, to the collection of mileage approach a randomly selected day can be the reference day and all registered players win or are in the drawing of the lottery, who used sustainable modes of transport that day. Examples of this action are the "Austria cycles" initiative in Austria, https://www.radelt.at/, the LOVE TO RIDE activity, https://www.lovetoride.net/global?locale=de-DE or the Travel Smart Initiative, Singapore, http://viajeoplus.eu/wp-content/uploads/sites/4/2015/11/Viajeo_PPT_Travel-Smart-LTA.pdf.

4.12 Bonus mile programme for PT

Kilometres travelled by PT are collected via smartphone or social media and get rewarded with discounts at local shops or other goodies. Ideally, the bonus mile programme is accompanied by a social media campaign: e. g. a winner is selected each week/month etc. and gets honoured on (social) media. In principle the system works as any other customer loyalty program, e. g. of telephone companies, supermarkets etc. Potential participants (e. g. pupils and employees) need to be contacted through all points of contact, but especially via work places. Participants will register themselves to start to collect, e. g. by downloading an app or receiving a booklet. An app is created to give the opportunity that participants can record their travelled kilometres with PT and create a basis for the discounts in local shops. As low tech alternative a booklet (for stamps) or sticker album can be used, where conductors or bus drivers (in rural areas with less crowded buses advisable only) confirm the usage. If electronic ticketing system is in use (e. g. electronic check-in and checkout), this technology may be used for the recording as well. Interested local shops, museums, pubs or other potential cooperation partners need to be contacted, for preparing discounts or little presents ready to offer to the participants or other goodies need to be purchased. The handing over process needs to be defined. Selected winners, who enjoy using social media can be encouraged to post about being selected on social media. Therefore moderation of the activities need to be clarified (host of social media). Potential followers and participants need to be contacted. Examples of this action are the Bella Mossa

campaign, Bologna, Italy, https://www.bellamossa.it/ or the Better Points campaign, Wroclaw, Poland, https://www.wroclaw.pl/wroclawskie-wyzwanie-mobilnosc.

4.13 Gamification for sustainable modes

The use of sustainable modes and the collection of "kilometres" or "points/kilometres" is implemented with a playful approach. In this approach the use of sustainable modes is encouraged by visualizing the user's scores allowing the user to reach different levels, collecting "trophies", geocaching etc. (e. g. comparable to "Pokemon Go"). Progress bars, which show the amount of CO2 or money saved by using sustainable modes shall further encourage the behaviour. An app with gamification needs to be developed. Therefore, guidelines about the goal of the app and target groups need to be clarified. A system, how to record the mileage need to be included in this app, possibly using interfaces with other tools such as electronic ticketing. Maybe responders in the buses are needed (e. g. blue tooth or nfc) to confirm the usage. In case, winners are selected, similar to measure 3.12, awards need to be organised and the handing over procedure need to be specified, preferably accompanied with a (social) media campaigning. Examples of this action are Bolzano in South Tirol, Italy https://www.masstransitmag.com/technology/press-release/12270742/onyx-beacon-gamification-in-public-transportation-passengers-quit-using-own-vehicles-and-participate-in-ecological-competition-based-on-kilometers-of-bus-travel-measured-by-onyx-beacons or the Viaggia Trento e Rovereto Play&Go, Trentino, Italy, https://www.smartcommunitylab.it/apps/viaggia-trento-e-rovereto-playgo/.

4.14 Use of social media to make sustainable modes visible

Sustainable modes will be visible in social media through its users by putting pictures and stories on the social media page e.g. of the regional/local public transport operator, etc. or at the users´ page themselves, e. g. by using a specific #hashtag. Cooperation with regional media (e. g. online magazines or print) may be a further option. Participating people can get rewarded and encouraged to join social media challenges. Moderation of the activities needs to be clarified (host of social media). Potential followers and participants need to be contacted. If foreseen, awards need to be organised for competition, e. g. for the best pictures etc. Rewards can be based on number of shares or likes. Ideally, the campaign gets recognition in regional media as well. Therefore regional media needs to be contacted. Examples of this action are the Youth Alpine Interrail initiative, see http://yoalin.org/challenges/, https://www.instagram.com/p/BwRO2OmAMF-/ and http://yoalin.org/do-the-yoaling/ or the Austrian federal railways ÖBB, see http://blog.oebb.at/schaumalraus-macht-mal-gemuetlich/ and https://www.facebook.com/unsereOEBB/posts/ fotowettbewerb-wir-rufen-unter-dem-motto-175-jahre-eisenbahn-alle-hobbyfotografi/248421711927148/.

4.15 "Thank you" – Incentives for current users of sustainable transport modes

Current users of sustainable transport modes receive a little present (like coffee, cake, flowers etc.) e. g. before or after leaving the PT or at the cycle path to show appreciation for the persons effort to actually use sustainable transport modes. PT or mobility providers or the local municipality need to be contacted, to request interest in this measure. If these institutions show interest, they can support the measure by providing staff for the distribution of the presents or sponsor such items. Points of distribution should be chosen carefully: e. g. PT interchanges, (touristic) destinations or in the PT vehicle or cycle paths itself. Activities can be done at any day, but typically to select a specific day, e. g. a jubilee of the bus line concerned, a modification or upgrading of a line or the time table, in the course of events such as the European mobility week or local events, etc. Alternatively the beginning of a typical season, e. g. school start, semester start of the university etc. can be selected as well, if the target group is defined as pupils or students. An example of this action is the Bike breakfast, Bologna, Italy, see http://salvaiciclisti.bologna.it/bike-breakfast.

4.16 Entertainment event at PT

Stand-up entertainers perform for current PT users in the PT vehicle in an unexpected way (e.g. little concerts, circus, "pub quiz" etc.), preferably at off peak time like in the evening. Alternatively interested people can participate at a "surprise ride" with PT, where they use PT on a certain day and time and PT takes them to interesting sites. An example of this action is the Verkéiersverbond Luxembourg, https://www.mobiliteit.lu/de/uber-uns/verkeiersverbond/ or the so called Staukonzert in Salzburg, Austria, see https://www.fraeuleinflora.at/salzburg/fraeulein-flora-staukonzert/.

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4.17 Customized information packages on paper about selected topics

Interested people order customized information packages on paper in which they are interested, e. g.: ticket purchase, usage of flexible transport, receive individual time table information online & offline, PT network map or cycling network map. In a first step, they receive an order form, where they select the required documents. Some of these can be tailor made as the foot path to the next PT stop, an individual time table of their specific trip demand, an orientation map of their place of residence, a calculation of the ticket costs for their individual travel needs etc. Based on this feedback (via online form, paper form or telephone contact), the people only receive the information, which is relevant to them and do not have the burden of researching this information by themselves. An example of this action is the project SmartMove, see http://www.smartmove-project.eu/.

4.18 Welcome kit - information packages for new residents about sustainable mobility

Providing comprehensive information regarding the range of PT options/sustainable mobility available in the region/neighbourhood for new residents. A welcome kit info package will be sent individually to new residents in the area. The main objective is to inform new residents and take advantage of the change in personal life to foster the use of sustainable mobility. The target group can be accessed during the handing over the keys of a new housing development (in cooperation with the developers) or with a cooperation with other institutions like cable tv providers, water or energy providers as they know about new residents even in exisiting buildings. An example of this action is carried out in the Portuguese city of Almada, see https://www.eltis.org/discover/case-studies/new-residents-mobility-welcome-kit-almada-portugal.

4.19 Folder for specific target groups such as commuters/tourists/elderly persons/pupils

Creation of a folder, which promotes and informs about special tickets or other offers for different target groups (tickets for: commuters, tourists, elderly persons, pupils). The folder(s) will be available at all points of contacts, to reach each target group. An example of this action is the VOR – Youth ticket folder in the Eastern region of Austria, www.vor.at/fileadmin/CONTENT/Downloads/Folder/Infofolder/Jugendticket_Flyer_2019-20.pdf.

4.20 Sustainable mobility guidebook with comprehensive information for sustainable mobility of a whole region

A comprehensive guidebook including information about public transport, taxi, cycling, walking, vehicle sharing, ride sharing, taxies, micro mobility community and hiking bus offers etc. is put together. This measure aims at improving people´s mobility through the provision of information and guidance all in one. Occasionally, by sending in a reply-card, further information material can be obtained free of charge (e. g. customized PT information). Another option is to include touristic or other practical information about the region as well. The guidebook should be additionally available at important points, e. g. touristic destinations, transport nodes, in the buses at the driver, travel agencies, etc. Mobility guidance on the phone is delivered as well if requested. An example of this action is the Lungau Tälerbus, Austria, see http://www.taelerbus.at/.

4.21 Salient implementation of PT information on webpages of destinations

Work places, tourist accommodations, municipalities, tourist destinations etc. offer salient implementation of PT information on webpages. “Arrival” with PT is displayed. The nearest PT station and an interface for journey planning regarding national, regional and local PT is implemented. Where possible, the option to make a booking for PT on the webpage itself (e.g. webpage of a tourist accommodation) is provided, to offer an easy booking experience. Links to other local mobility options like flexible PT, bike/car-sharing systems, bike/car rental, etc. are displayed, too. This section should be found easily at the start page of any web pages of organizations creating transport demand. Priority should be given to sustainable modes in the web design and order of link lists. An expert should be available to support and train the organisations how to implement these information at their webpages. An example of this action is the tourist association Tyrol, Austria, see https://www.tyrol.com/good-to-know/arrival/by-train#anchor-anker-journey-planner.

4.22 Eco-labelling of organisations supporting sustainable mobility

An eco-label about sustainable mobility for municipalities and tourist accommodations highlights the efforts of the municipalities and tourist accommodations regarding sustainable mobility. Participating organisations provide the following information on the webpage and on-site: e. g. booking options for PT, information about PT (time tables etc.) before and during the stay of tourists etc. Other criteria regarding sustainable mobility are possible, e.g. offer bicycles for the guests or cooperating with a bike renting system. Participating entities receive their eco-label at a media-effective ceremony. The ceremony also can be part of a social media campaign forwarded by local municipality, tourist associations etc. It is important, criteria to receive an eco-label can be influenced by the organisation itself, e.g. if talking about hotels, pt information at the rooms available, trained staff at the recption, a poster with the time table etc. An example of this action is the Stars for mobility initiative in Tyrol, Austria, https://www.klimabuendnis.at/tiroler_mobilitaetssterne.

4.23 Time table and other information as APP for mobile devices

Provision of a journey planner, time tables, reservations and real-time information and if further development is wanted, the inclusion of payment and booking etc. via one App for PT and all other transport modes (like car-sharing, taxi etc.). An example of this action is the Whim APP in Finland, see https:// helpcenter.whimapp.com/hc/en-us/articles/115003538029-Whim-and-the-Mobility-as-a-Service-concept.

4.24 Making public transport and other sustainable mobility visible on public places and places were people meet and likely need mobility supply

This measure can be manifold, e. g. basic information on public transport such as a network map & phone number for flexible transport on coasters at bars, at tickets for concerts, museum tickets etc. This measure shall inform potential customers about the offer, especially to present an alternative to car usage. The idea is, to be visible at places were people have time to receive such information und a big group of people can be reached. Special flyers or giveaways can be produced and distributed at places where people meet or stay, such as in waiting rooms of doctors or other social services, administrative offices etc. At these places explanations videos about how PT works are also an option. QR-Codes on flyer or at public places can link to explanation videos, flyers etc. An example of this action is the coasters as ticket for PT in Hamburg, Germany, see https://www.horizont.net/marketing/nachrichten/eins-noch.-aber-dann-ist-bus-wie-die-hvv-und-astra-ein-bisschen-bvg-magie-nach-hamburg-holen-174343.

4.25 Training events for multipliers

Staff with contact to residents, pupils, employees or tourists, acts as a “multiplier” and participate in training events to be able to provide the necessary knowledge in upcoming situations. The following jobs can be seen as “multiplier”: teacher, hotel receptionists, PT drivers, staff at tourist destinations etc. These persons are the contact persons, with which people of the target group can directly communicate and therefore can provide highly relevant information about sustainable mobility. This measure can be accompanied by a (social) media campaign, in which the “multipliers” post about their engagement and at its best, also act as role models and post this as well. An example of this action is the mobility manager training in Tyrol, Austria, see https://www.tirol2050.at/de/geschichten-des-gelingens/mobilitaetscoach/.

4.26 Provision of sustainable mobility related information for touristic destinations at public places or where tourists meet

Information for touristic attractions (like information boards or signposts for hiking, cycling etc.) also provide information about the next PT station, operating times of PT, links to relevant APPS and e. g. phone number for booking flexible transport (for cyclists the options for bicycle transport as well). Recommended hiking routes and bicycle routes in info folders (and at the sites itself) are created in a non-circular way so the usage of a car becomes less attractive. Information about next PT station and time tables need to be provided with the information about recommended routes in any case and were accessible (web, boards, flyers etc.). An example of this action is the presentation of different hiking routes in Styria, Austria, see https://www.verbundlinie.at/freizeit1/freizeit/wanderfolder.

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4.27 Mobility packages for tourists

At origin: The idea is that tourists receive a package about sustainable mobility at the tourist destination before they start their travel and therefore can decide whether travelling by car is an appropriate choice or if sustainable transport modes might offer an acceptable or even a better option. Therefore, tourists receive a package directly after their booking with detailed information about sustainable mobility at the travel destination, including e. g. luggage transport, pickup service from PT etc. At destination: An information package is displayed in each room and/or at the reception desk of the tourist accommodation. In these mobility packages, tourists can find detailed information about all local sustainable mobility options. If possible, free tickets for PT are provided for the tourists, as well (included in the room price). An example of this action is the Lungau Tälerbus in Salzburg, Austria, see http://www.taelerbus.at/.

5 CONCLUSIONS

The options choosing appropriate measures nudging residents, tourists or commuters towards the use of sustainable mobility are manifold. There is a big variety of options available. All of them were implemented already in different places and environments and have proven succesful applications. Ideally - based on a complete offer of sustainable modes without any gaps in a region - these various activities accompany this integrated offer and motivate people to behave in a sustainable way. Because of the ongoing discussion due to the obvious climate crises, the majority of people are especially open to these topics and are willing to use sustainable modes in principle. In particular, if the information is easily accessible, the targeted persons would feel a social norm to use sustainable modes and to receive positive feedback when using sustainable modes, and that will break the ice. Additionally, if most of the measures described above can be implemented within the region on a permanent level, the effect will be stronger compared to single and isolated activities, because residents, commuters or tourists would be confronted with sustainable mobility on a daily basis.

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🏆 *reviewed paper*

Between Urban Transformation and Everyday Practices – Participation and Co-Production in the City of Tarija, Bolivia

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1 ABSTRACT

By 2050, around two-thirds of the global population will live in an urban environment. Urban growth is currently prevailing in the developing world, and in this context informality is seen as a general mode of urbanisation. The patterns of growth vary regionally, and the resultant urban fabric is expected to become more complex in various world regions in the years to come. In addition, not only are many regions facing dramatic and unforeseeable changes in the environment, but non-renewable resources are also becoming increasingly scarce; thus, concerns regarding sustainable and resilient development have been internationally voiced. Therefore, understanding and managing urban growth has become of general concern to a wider public.

In particular in the Global South, a dichotomy between formal and informal urbanisation has prevailed that has hindered a sustainable and resilient development in various ways. What comes to mind, here, is the often-used image of a São Paolo favela segregated from the city's wealthier neighbourhoods—a common phenomenon in many cities of the developing world. Against this background, many efforts have taken a more social and political approach in order to overcome this dichotomy and, thus, to promote more inclusive development—a cities for all approach. At the core of these approaches are co-ordination and communication between top-down and bottom-up approaches, the reduction of tensions between formally and informally developed urban areas, and modes of participation and co-production that consider local action as well as long-term and large-scale effects. However, what does participation and co-production mean and which are the framing conditions under which they can be implemented? The paper pursues these questions for the medium-sized City in Tarija, Bolivia, where a massive urban expansion has overwhelmed formal planning instruments in recent years. Moreover, it aims to contribute with practical experiences to the conference on how social segregation in fast growing city regions could be overcome.

The paper describes Tarija's urban expansion from a historical perspective and identifies critical environmental as well as social challenges as well as the shaping dynamics. Furthermore, the literature and development plans review is enhanced by semi-structured interviews and by two transdisciplinary workshops that where held in 2018, in the city of Tarija, in the framework of a real-world laboratory. This paper argues that urbanisation as it transpired in Tarija was highly inefficient and that the main benefactors were land traffickers, which has promoted the formal/informal dichotomy even further. The paper discusses three main points to tackle this issue. First, it identifies an institutional gap between the central and local government, which is considered the main cause for this formal/informal dichotomy. Second, it proposes the real-world laboratory as a more dynamic and adaptive instrument for urban development than formal planning, as well as a mediator between top-down and bottom-up approaches. And third, it discusses the framing conditions under which informally developed urban areas could be further developed.

Keywords: adaptive urbanism, informal settlements, Latin America, Urbanisation, real-world laboratory

2 INTRODUCTION

By 2050, around two-thirds of the global population will live in an urban environment. Urban growth is currently prevailing in the developing world, and in this context informality is seen as a general mode of urbanisation (Roy 2005). The patterns of growth vary regionally, however, and the resultant urban fabric is expected to become more complex in various world regions in the years to come. Not only are many regions facing dramatic and unforeseeable changes in the environment, but non-renewable resources are also becoming increasingly scarce; thus, concerns regarding sustainable and resilient development have been internationally voiced (UN-Habitat 2014 & 2017, WBGU 2016). As a consequence, understanding and managing urban growth has become of general concern to a wider public.

Latin American rates of urbanisation are among the highest in the world, and it is expected that the region's cities will continue to grow (UN-WUP 2018). The increasing social inequality and environmental damage

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following this trend have been identified and widely discussed (Butterworth 1981, Angotti 1995, Hall/Pfeiffer 2000, Rodgers et al 2012), especially at UN-Habitat III in Quito in 2016. What comes to mind, here, is the often-used image of a São Paolo favela segregated from the city's wealthier neighbourhoods – a common phenomenon in many cities of the developing world. In this context, two points of view are commonly discussed: one of crisis and misery, and one of heroism; both, however, contemplate informality as fundamentally separated from formality (Roy 2005, p. 148). For instance, spatially the informal city is differentiated as the urban poor build their own city with no regards to existing formal planning and regulatory frameworks. Furthermore, the urban poor are excluded from trading their assets in the formal sector, which also strengthens this fundamental separation. Challenging this dichotomy of formality and informality, Roy argues that urban informality can be seen as a series of transactions that connect different economies and spaces to one another – an organising logic – and that learning from emerging solutions should be of particular interest to urban studies (ibid.).

Likewise, McGuirk (2014) argues for a 'learning from approach' and, in the latest research, discusses radical solutions in Latin American cities that address rapid urbanisation and resource scarcity with approaches that are both more social and political; approaches that question the modes of modernist planning that have dramatically shaped Latin American cities until recently. With a 'needles instead of scalpels' approach, urban informality has been addressed in various ways (McGurik 2014, p. 14f); for instance, the transformation of the cities of Bogota and Medellin in Colombia. Two aspects were key to this development: firstly, civic education programmes for rehabilitation of the public realm, as introduced by the Mayor of Bogota, Antanas Mockus; secondly, innovative mobility concepts that allowed for the creation of social relations through the linkage of the informal city with the formal city (McGurik 2014). In particular, Alejandro Aravena's approach to social housing in Chile has been much discussed. He proposed an open-ended approach that provided families with half of a house, leaving the other half to be built according to their means and within a defined structural framework; moreover, where public money should be spent was co-decided (Aravena/Iacobelli 2016). At the core of these approaches are co-ordination and communication between top-down and bottom-up approaches, the reduction of tensions between formal and informal urban areas, and modes of co-production that consider local action as well as long-term and large-scale effects (McGuirk 2014, Aravena/Iacobelli 2016, Brillembourg/Klumpner 2019, Forman/Cruz 2019).

The paper operates on the premise that there are uncertain and manifold outcomes to planning. As such, planning should not be thought of as absolute, but rather as an open process of discovery – but under which framework could such a discovery process be operationalised? Three points are relevant to address this. Firstly, cities need to be thought of as a process where decisions are made along the way involving manifold perspectives as well as sustainable and resilient development (WBGU 2016). Secondly, local actions and long-term and large-scale effects need to be considered together (McGuirk 2014, Aravena/Iacobelli 2016, Moroni/Cozzolino 2019, Krebs and Tomaselli 2019). Thirdly, urban studies could learn from on-site and problem-solving experiences (Roy 2005). These aspects are put into relation with the urban expansion of the city of Tarija in Bolivia, which is described from a historical perspective in Section 3. In doing so, this paper identifies a contested situation between spaces within formality and spaces within informality in Tarija (Section 4). In this context, the paper sees overcoming this dilemma as a central challenge and, as such, proposes a more adaptive framework for Tarija in Section 5 based on a transdiscplinary approach.

Thie paper argues that urbanisation as it transpired in Tarija was highly inefficient and that the main benefactors were land traffickers, which has promoted the formal/informal dichotomy even further. The paper discusses three main points to tackle this issue. First, it identifies an institutional gap between the central and local government, which is the main cause for this formal/informal dichotomy. Second, it proposes the real-world laboratory as a more adaptive instrument for urban development with a mediator role between top-down and bottom-up approaches than formal planning. And third, it discusses the framing conditions under which informally developed urban areas could be further developed.

3 URBAN GROWTH IN THE CITY OF TARIJA, BOLIVIA

The city of Tarija is located in a valley in the south of Bolivia, about 1,850 metres above sea level, in an area that is defined by the South American Andean Mountains. Founded in 1574, the city alongside the Guadalquivir River was a strategic location for the expansion of the Spanish Empire towards the south. The city's urban layout and expansion followed a traditional grid-iron urbanism, with a north-south and east-west

orientation of its streets, typical to monocentric Latin American cities. This development can be better understood from three periods of time: the colonial, from 1574 to 1825; the republican, from 1825 until 1952; and the modern, from 1952 onwards (Lea Plaza Dorado et al 2003, Trigo O'Connor d'Arlach 2017, de Mesa Figueroa et al 1998).

During colonial and republican times, city development was framed by the Spanish semi-feudal regime. Commodities were produced in rural areas and traded in the city, and housing and political participation in the city was mainly reserved for aristocrats and wealthy members of society. In 1825, Bolivia proclaimed its independence from Spain and became a republic; however, the semi-feudal regime continued to define society as in colonial times (Trigo O'Connor d'Arlach 2017). Indigenous and farmers' communities lived and worked in haciendas in rural areas, with no right to own property (Larson 2017). Urban growth was low in terms of the surface area the city covered; in terms of population and built structure, however, the city became denser as the plots were subdivided due to growing families and migration (Lea Plaza Dorado et al 2003). In the early 1930s, this dynamic was slightly disrupted by an increase in migration triggered by the discovery of oil in the southern region of Gran Chaco. The new neighbourhoods with lower population densities that emerged around the city's centre (GAMT 2008) are now considered as the formal city as they concur, to a certain degree, with zoning plans and building codes.

In 1952, Bolivia saw great transformations in citizenship, political participation, land distribution, and state control of the national economy and natural resources (Vargas Gamboa 2016, Urioste 2012). Furthermore, the right to vote was universalised, which gave women and indigenous and farmers' communities a new role in society. After the agrarian reform in 1953, everyone was able to own property. Moreover, the state provided fiscal land to families as non-transferable and indivisible private property (Urioste 2012). However, over time these large properties were either sold to developers at low prices or sub-divided by the families themselves. Particularly during the dictatorial military regimens of the 1970s and early 1980s and the neoliberal governments in the early 1990s, land with no arable value from indigenous and farmers' communities was freely distributed to political supporters and foreign investors. This led to the establishment of a land market that freely operated on rural territory with few governmental constraints (Urioste 2012, pp. 61-64). A lucrative business developed for those who re-sold land they had acquired from the state for free or for very little money. Moreover, in the mid 1990s, the election of a neoliberal government led to the closure of state-owned mines in the city of Potosí. As a consequence, thousands of unemployed miners migrated in search of new economic opportunities. This, combined with the discovery of natural gas reserves in the Department of Tarija, led to a pattern of heavy migration towards the city of Tarija. As a result, the existing regulatory frameworks and municipal capacities were overwhelmed by the influx and the compact structure of Tarija collapsed (PNUD 2015, GAMT 2008 & 2016, GADT 2015, Vargas Gamboa 2014).

In 2006, a socialist government, represented by Evo Morales, assumed office, and since then Bolivia has seen profound socio-political changes (Lazar 2013). Furthermore, Bolivia was termed a pluri-national state in 2007 with 34 indigenous nations (Estado Plurinacional de Bolivia 2007). Of particular relevance to urbanisation in Bolivia were shifts in policy addressing land ownership and housing as they reacted to the great demand mentioned above. A revised agrarian reform was promulgated to tackle neoliberal decisions and corruption from previous periods; now the state had the capacity to secure land for indigenous communities and to expropriate unproductive lands so as to avoid land speculation (Urioste 2012, p. 64). Moreover, the construction of social housing was intensified and accessible financing systems were developed (AEVIVIENDA 2019). Further, the state, through its Ministry for Development Planning, promulgated the law N° 247, which addresses regularisation of land tenure in urban environments and the right to adequate housing (Ministerio de Planificación del Desarrollo 2012).The law did not only apply to urban environments, however, and settlements and squatters outside the urban radius could also legalise tenure after demonstrating five years of permanent residency (ibid., p. 7). In consequence, municipal zoning plans experienced modifications and urban radiuses were expanded several times, but the monocentric structure remained. Furthermore, legalisation processes led to heavy discussions. For instance, urbanisation of the municipal park 'Las Barrancas' in Tarija, after being squatted for more than five years, was heavily criticised by the general public (El Periódico 2019). It was seen as an invasion of public and private land and counterproductive to development, which remains a general discussion up to now and often carries a discriminatory tone. However, a critical issue is missing in this point of view: the main benefactors of shifts in policy were land speculators and land traffickers, as people who previously did not have the resources to

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buy land could afford it now and rural land could be transformed into urban without having infrastructure or being envisioned as such (Vargas Gamboa 2014).

It was during this period that Tarija grew the most in terms of covered surface area, and its expansion was primarily shaped by land speculation and with little institutional control (Bayro-Kaiser, forthcoming). This has had critical effects on the natural environment, as land speculation has deprived the city of valuable natural land and bodies of water, and biodiversity has been destroyed in the process. As Figure 1 shows, the emerging surroundings are approximately four times larger than the actual consolidated city. These emerging surroundings are, nowadays, considered as informal settlements. In conclusion, analysing urban expansion in Tarija from a historical perspective has shown the tension between the formal and informal city, and that the spaces in between are contested. Moreover, through the analysis it can be visualised that the city of Tarija is predominately informal and that formal planning and regulatory frameworks played a minor role in the recent expansions.

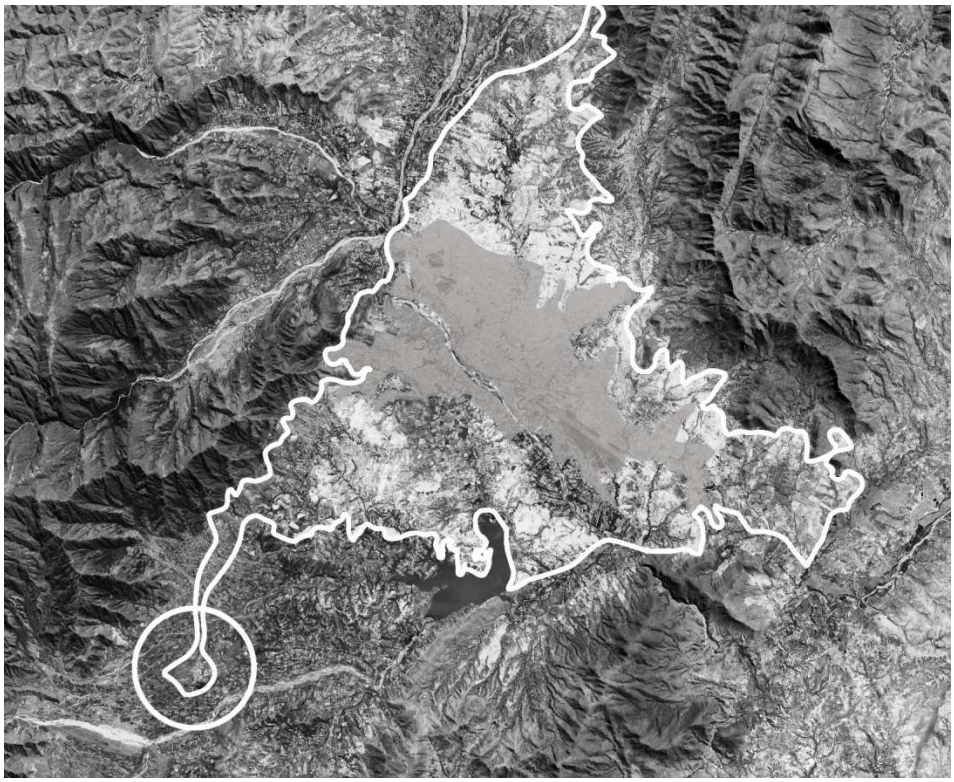

Figure 1: The consolidated city of Tarija, urban expansion, and localisation of the community of San Andres. Source: DigitalGlobe 2019 (edited)

The year 2025 marks the bicentennial of Bolivia's founding. For this occasion, the Ministry of Autonomy of the Pluri-national State of Bolivia proposes a patriotic agenda with thirteen pillars for development towards a dignified and sovereign Bolivia, based on international agreements on sustainable development. The Ministry, moreover, has identified the role of each level of government for the operationalisation of these pillars (Ministerio de Autonomías Estado Plurinacional de Bolivia 2014, p. 13-14). At the centre of this agenda is the promotion of an inclusive, participative, and democratic society and nation – without discrimination, racism, hatred, or division. Furthermore, the agenda proposes an inclusive and strategic collaboration between the four levels of government: central, departmental, municipal, and native indigenous peasants. In particular, the key role of the autonomous territorial entity (ETA) in achieving such goals is stressed. The pillars range from the eradication of extreme poverty through universal provision of basic infrastructure, the right to adequate housing, and the protection of the natural environment. It is under this scheme that Tarija is to be further developed and, thus, existing planning and regulatory frameworks ought to be reformed accordingly.

4 BETWEEN URBAN TRANSFORMATION AND EVERYDAY PRACTICES

In Tarija, two realities clash: the formal, which is within the urban radius, and the informal, which has emerged outside of the urban radius. Furthermore, there is no institution responsible for the spaces in-

between the urban and the rural. The central government attends to the needs of the rural dwellers, whereas the municipal government only to those within the urban radius. As a consequence, people who bought a parcel of land in the informal market lack formal property titles and are unable to develop their habitat in a formal manner; thus, dwellers of these contested spaces find themselves between constitutionality and illegality (Vargas Gamboa 2016). The approach of the local government has been to modify zoning plans and impose building codes, i.e., to expand the urban radius in order to legalise tenure. However, building codes do not concur with existing practices of construction and, in this respect, are outdated; this also hinders the process of legalisation. Moreover, issues such as infrastructure and liveable environment are rarely discussed. The stages of development are visualised in Figure 2. From the city centre towards the periphery, development has mainly happened on a self-organised and incremental basis, i.e., in an informal manner. This development does not have the scale or complexity of cities such as Sao Paolo or Mexico City, but it concurs with the perspectives initially discussed (see Introduction). A fundamental separation between the formal and the informal city can be observed in Tarija, and this has been underpinned by associations of informality with disorder, poverty, criminality, and vulnerability by the general public (El Pais 2013 & 2019, El Períodico 2019). Furthermore, planning in Tarija has mainly followed a top-down approach of imposing formality through the restructuring of existing settlements in order to include them in municipal zoning plans (Bayro-Kaiser, forthcoming).

Figure 2: Different stages of self-organised and incremental development can be found in the informally developed areas from the centre towards the periphery. Source: Author

In this contested situation, a desired and undesired situation is constructed: from an informal perspective, the formal is desired as it is the solution to everything that is wrong (especially infrastructure), and from a formal perspective, the informal is undesired as it risks everything that has been solved (disorder, criminality, and land encroachment, among others). This binary point of view, however, hinders addressing the complexity of urban expansion and, in turn, development. Moreover, this critical construction often leads to the social and spatial segregation of the informal city and, thereby, to the closure of the formal city from the emerging surroundings – a situation of contestation that can be observed in many cities around the world. Following this reflexion, a central question arises: what does participation and co-production mean and which are the framing conditions under which they can be implemented?

5 CITIES FOR ALL THROUGH TRANSDISCIPLINARITY

This research draws its findings from a real-world laboratory approach in the city of Tarija initiated in 2018 – the Real-World Laboratory: San Andrés and surroundings. This approach was proposed as framework to understand and manage urban growth in Tarija and was developed in collaboration with the UAJMS University of Tarija, the Municipal Government of Tarija, and the RWTH Aachen University. As such, it opened the planning discussion to manifold perspectives by gathering researchers from academia and actors from practice and civil society, and has had a co-ordinating role between formal institutions and informal organisations and initiatives in Tarija. It aims to reform existing planning and regulatory frameworks in Tarija to be more open to what is on offer in informal areas and, also, to raise awareness within the general public regarding sustainable and resilient urban growth. Here, resilience is understood as a precondition for sustainable development and as being able to respond to changing conditions, both reactively and proactively (Bott et al 2019, p. 13f); thus, openness, responsiveness, and the ability to learn and to adapt are central to this approach. It focuses, in particular, on San Andres Road, which connects the urban centre with the rural community of San Andres (see Figure 1), and addresses neighbourhood, city, and regional development in Tarija. This initiative is at its infancy and, therefore, the discussion presented here cannot be seen as concluded and, instead, should be seen as a contribution to more open discussions around development in

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cities facing similar challenges. The results of two experimental and transdisciplinary workshops held in 2018 will be discussed in this section.

Figure 3: Housing on top of a ravine. A situation of vulnerability and environmental damage produced by uncontrolled urban expansion shaped by land speculation. Source: Author

Within the laboratory's first year of operation, two transdisciplinary workshops were held. They raised questions of regional, city, and neighbourhood scale addressing issues such as infrastructure, mobility, housing, public space, and natural environment. The workshops were visited by researchers and students from the collaborating universities, representatives from the municipal government, representatives from the farmers and the neighbourhood associations, practitioners from various disciplines, and the general public. In particular, the dialogue between the municipal government and citizen-driven initiatives was of importance. During the workshops, input on the status-quo of urbanisation in Tarija was given by institutional actors, which was then discussed based on on-site surveys as well as residents' testimonies and participation. As described in Section 2, urban expansion in the city of Tarija is shaped by land speculation, which has been out of control for the last three decades and has thus deprived the city of valuable natural land. Furthermore, urbanisation has destroyed important water bodies and biodiversity has suffered greatly. This is, thus, a highly inefficient way of achieving urbanisation. In response, two overall goals were formulated: firstly, restoration and preservation of vital water-bodies and the region's biodiversity, and, secondly, spatial and social integration of the informal city. To achieve this, transformative actions and everyday-life practices have to be negotiated on various spatial scales and levels.

Additional effort was put into round tables, where the overall goals were intensively discussed and the strategies and instruments needed to achieve them were elaborated. To be more specific, a multi-scale model for development was proposed in which the real-world laboratory plays a central and mediator role on the city level (see Table 1). The inclusion of manifold perspectives is possible when the regional, city, and neighbourhood development is considered together. Moreover, various fields of action were identified. In this particular context, there are five: development, biodiversity, mobility, inclusion, infrastructure, and densification. They all have to be thought in accordance to national, regional and local development and zoning plans; however, plans need to be updated and, thereby, become more adaptive to unforeseeable changes. Besides development and zoning plans, (revised) urban codes and co-production are important instruments. They allow, firstly, for a relational production of habitat and, secondly, a learning process. The discussions concluded with an ambitious agenda combining local actions and long-term and large-scale effects.

The need for housing and the promotion of low-density development in Tarija created favourable conditions for a profitable land market; therefore, actors involved in land speculation and development have promoted this type of model. The laboratory, which challenges this model, puts tackling land speculation on the agenda of the local governments. In doing so, it proposes densification and adaptation of existing structures as a

more economical and sustainable way of achieving urbanisation. It is, however, important to consider site-specific circumstances, and trade-offs between institutions, actors, and future dwellers. The co-operation of national, regional and municipal governments, and indigenous and farmers' organisations is fundamental to this approach. Moreover, first experiences have shown great acceptance by the public, as different actors were able to stress their concerns and to participate in discussions previously unreachable to them. However, two risks were identified. Firstly, corruption and client-politics are a common thing and they hinder inclusive and community-based development. Secondly, land speculation, which promotes individual interests over the common good has severely damaged vital water bodies and biodiversity and has been an attractive business in Bolivia. Therefore, creating an institution with the necessary legal competences to address contested spaces and capable of mediating between top-down and bottom-up approaches is proposed; and as such, the real-world laboratory will continue to play a crucial advisory role.

	Strategies	**Instruments**	**Agenda**
Region	Sustainable and resilient development Restoring and preserving bio-diversity Regional connectivity Inclusive urban communities Infrastructure and basic services Densification	National and regional development plans and zoning plans	Lively and healthy environment
City		Municipal development plans and zoning plans Urban codes **Real-world laboratory**	Inclusion of the informal city Tackling land speculation and land traffickers Dialogue between national, regional and municipal governments
Neighbourhood		Neighbourhood development plans Co-production	(Re)development of leftover spaces (Re)naturalisation of eroded land Attractive public spaces and walkability Mixed-use and new typologies

Table 1: Strategies, instruments, and agenda. Open planning framework for the city of Tarija. Source: Author (based on Kaiser and Bayro-Kaiser 2019)

6 CONCLUSION

The formal/informal dilemma outlined in Section 4 is a consequence of an institutional gap: the central government manages the rural land and the local government manages the urban areas; thus, the contested spaces cannot be developed and an undesired situation is produced. This has had severe effects on the natural environment and has produced discrimination within society towards newcomers. The paper argues that in order to sustainably develop the city of Tarija, and cities that face similar challenges, it is crucial to overcome this dilemma and that municipal planning and regulatory frameworks should be reformed towards a more-integrated approach (as presented in Table 1). In particular, development should be looked at from various spatial scales and levels, transformative actions should be considered, and everyday-life practices included as well. This is essential for promoting an open city discourse, and underscores the importance of a median between top-down and bottom-up approaches. So far, this has not been achieved institutionally in Tarija and this initiative remains an informal instrument. As such, however, it is more responsive and capable of producing knowledge in the short-term. Therefore, it has been anchored in teaching and research activities at the local university where, we believe, it will contribute more efficiently to structural changes in local institutions as well as in the general public opinion towards informal urbanisation. Both dimensions are important when thinking about a more adaptive urbanism. Above all, the promoted transdisciplinary discussions and transparency have dramatically changed the mindset around development in Tarija, which has set off a new dynamic. In the future, different perspectives will have to be integrated, the natural environment will have to play a role, and development plans will have to be socialised before being operationalised. This means, development will have to be negotiated on various spatial scales and levels, but also how knowledge—that sustains our actions—is produced and acquired needs to be discussed.

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🏆 *reviewed paper*

Bridging Policy Streams of Minerals and Land Use Planning: a Conceptualisation and Comparative Analysis of Instruments for Policy Integration in 11 European Member States

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1 ABSTRACT

Minerals play an important role for the European economy, hence the secure and sustainable supply of minerals is of political importance for the EU and its Member States (MS). Despite the fact that Europe has a potential for minerals development, access to minerals is, however, influenced by different stakeholder interests, often reflected in competing forms of land-use and institutional complexity of two policy streams of minerals and land use planning. Recent public sector responses in EU MS introduce new instruments such as safeguarding or protection of minerals deposits or valorisation schemes for minerals development, both aiming to bridge the two policy streams. However, there are significant challenges for governments and public administrations on all levels to achieve the effective integration of the two policy streams: Institutional and administrative fragmentation, unclear roles and duties, coordination deficiencies between levels of governance (departmentalism) or lack of willingness or ability to collaborate (Endl, 2017; Gugerell, 2019).

Thus, our research identifies different approaches to policy integration of minerals and land use planning policy based on a qualitative analysis of 12 case studies from 11 different EU MS. Against this background, the article conceptualises and analyses policy integration with regards to: 1) instruments for horizontal and vertical integration; 2) degree of integration - full versus partial integration (e.g. for horizontal integration: considering integration ex-ante/in the design versus ex-post/during implementation); 3) which aspects of horizontal or vertical policy integration are outlined (e.g. protection of deposits or design of land use plans); and 4) the capacity and willingness for policy integration by different actors.

The results indicate two central characteristics for policy integration: (i) the mix of different types of instruments for horizontal and vertical integration and (ii) capacity of the involved actors. Across the 12 case studies we identified a mix of regulatory, economic or informative instruments, national strategies/ policy guidelines across horizontal as well as vertical policy integration. However, we recognised a trend across all 11 countries: instruments that signify full integration of minerals and land use planning on both horizontal and vertical levels; the application of soft rather than coercive instruments; and a prevalence for instruments in the form of planning tools and/or maps with the objective of enhancing knowledge of potential land use, mitigate land use conflicts and/or integrating minerals into land use planning processes.

Our research shows that across 11 countries policy instruments are assembled to policy mixes for integrating minerals and land use planning policy combining regulatory, economic (fiscal) tools, (national) strategies and guidelines and information-based instruments. In the specific context of instruments for minerals planning (e.g. multi-criteria assessment, safeguarding) the results indicate that in order to support the integration of land-use and mineral policy, instruments should be adapted to the land-use planning system and a good fit with the actual processes on the lower level of implementation (local and regional). Moreover, the results illustrated that willingness and capacity of actors play a crucial role for policy integration and implementation. Against this backdrop, more centralised public administration can more readily support lower levels to manage policy challenges: they can support lower levels by providing expertise, capacity building activities and create platforms where the different policy sectors can meet. Conversely, in decentralised systems and systems where policy design and implementation are dispersed among different levels of government the willingness to collaborate between higher and lower levels of government is important to support later policy implementation.

Keywords: Policy instruments, Mineral policy, policy integration, Mineral resources, Land-use planning

2 INTRODUCTION

European economies are dependent on the secure and stable supply of raw materials and minerals. The access to raw materials for sectors such as the construction, chemicals, automotive, aerospace, machinery and equipment are estimated to be connected to the existence of 30 million job opportunities in Europe (European Commission, 2013). Import dependency and the need for minerals (including Critical Raw Materials, CRMs) for the transition to cleaner technology are necessitating a coherent and comprehensive minerals policy framework in the EU and EU Member States (MS) (Dooley, & Leddin, 2005; Tiess, 2010; Thomashausen et al. 2018, Fraser Institute, 2018).

A national policy framework can either enable or hamper the development of sustainable mineral production. Due to the cross- spatial, temporal, and sectoral nature of mineral- and raw material production, minerals policy constitutes a particularly "wicked" policy problem (Endl, 2017). Defined as intractable, ill-structured, fragmented and contested a wicked policy problem resists standard approaches to problem solving (Daviter, 2019). The governance of wicked problems constitutes an administrative challenge too complex to be tackled by prevalent sectoral silo thinking and specialisation (Daviter, 2019). Avoiding silo-thinking and engaging in coherent policy approaches, is particularly relevant in the context of land-use planning (LUP) and mineral policy for achieving access to and protecting minerals resources, managing the contested nature of exploitation and exploring new approaches for integrated policy design and implementation. Up until today, there are significant challenges for public administration on all levels to achieve the effective integration of the two policy streams: Institutional and administrative fragmentation, unclear roles and duties, coordination deficiencies between levels of governance (departmentalism) or lack of willingness or ability to collaborate (Endl, 2017; Gugerell, 2019). The paper gives an overview about concrete examples of EU Member State policy instruments for integrated minerals and LUP policy and their design and implementation experiences in order to address above-mentioned challenges.

3 BACKGROUND

3.1 Mineral resources in mineral and land use planning policy

Several EU MS have established more strategic policy approaches to secure minerals supply from primary sources. However, public disapproval, incoherence with other policy areas and lack of business incentives constitute barriers and challenges to ensuring effective policies and implementation (Everingham et al., 2013, Moffat & Zhang, 2014). Governing the secure and sustainable supply of minerals from primary production faces particularly "wicked" dynamics. Minerals policies need to address various factors such as multiple stakeholder interests, competing land-use interests, as well as conflicting agendas and objectives. Hence, studies focusing on governance of wicked policy problems often focus on the need for government coordination and/or collaborative governance to challenge existing patterns of sectoral responsibilities (Askim et al., 2009; Christensen & Laegreid, 2007, 2008; Flynn et al., 2011; Kavanagh & Richards, 2001; Bryson et al., 2006; Ferlie et al., 2011; Weber & Khademian, 2008).

The complexity of minerals policy-making warrants the consideration and application of different policy- and decision-making instruments; voluntary, regulatory and strategic, whilst recognising stakeholder and public interests (Clausen & McAllister, 2001). Nevertheless, studies on resource governance often tend to focus on the effectiveness of a single policy instrument rather than underlying factors of policy governance for managing the complex dynamics of primary mineral production (Söderholm, 2015; Endl, 2017). Hence, this paper explores the notion of a more integrated and comprehensive approach to minerals policy which addresses the instruments for horizontal and vertical policy integration; as well as degrees, aspects and capacity of such integration in the 14 EU MS case studies, thereby extending research on minerals- and land use policy integration beyond 'environmental trade-offs' to recognise inclusion of present (and future) socioeconomic and political needs in society.

Overall, LUP deals with assessments of potential land-use options serving the demands and needs of communities while managing natural resources of that option. These natural resources cover, for example, water(sheds) (Boschet and Rambonilaza, 2015), forests and agriculture (Ayambire et al., 2019; Gosnell et al., 2011), ecosystem services (Grêt-Regamey et al., 2017) or mineral resources (Bax et al., 2019; Lopes et al., 2018). Against this backdrop, LUP systems (i.e. instruments and processes) are expected to manage competing demands (e.g. nature protection, residential, agriculture (Gałaś, 2017; Mitchell et al., 2004;

Mitchell, 2016) and integrate them into the socio-spatial context (Gustafsson and Scurrah, 2019; Roth and Howie, 2015).

The current literature on land-use planning and mineral resources largely investigates valuation of mineral resources for LUP decision making (EUROMINES, 2011), modelling of decision support tools (e.g. for Strategic Environmental Assessments) considering different social, environmental and economic aspects (Lechner et al., 2017; Ustaoglu et al., 2018) and LUP instruments (e.g. Gustafsson and Scurrah, 2019). Altough research on linking or integrating mineral resources into LUP policies exists (Baker and Hendy, 2005; Roth and Howie, 2015; Wagner et al., 2006; Wrighton et al., 2014), there is no comprehensive overview that provides a more nuanced picture on different approaches in EU Member States. This article address this gap by looking into 11 EU MS and their setup of policy instruments covering a wide range of different aspects of minerals and LUP policy and outlining their success in integrating these two policy streams.

3.2 Forms of policy Integration - horizontal, vertical, diagonal

Policy integration can be understood as "the replacement of specific elements of existing policy 'mixes' or 'regimes' – the goals and objectives and calibrations of existing policy tools and goals – by a new policy mix, in the expectation of avoiding the counterproductive or sub-optimal policy outcomes that arise from treating interrelated policy regimes and components in isolation from one another"(Rayner and Howlett, 2009, p.99).

Policy integration can take place at different moments and/or periods of the policy cycle: either in the policy design and –development process, implementation, evaluation or in the re-design or update of a policy (Kivimaa and Mickwitz, 2006). Prior research advocates that the policy design and decision-making phase might be better suited for policy integration than later stages of the cycle, such as implementation (Jordan and Lenschow, 2010a; Uittenbroek et al., 2013). Two lines of arguments are supporting that consideration: a) early integration efforts are assisting the consideration of other actors/stakeholders' interests and policy objectives in the policy design and the development of implementation actions and measures; b) administrative procedures and routines of other administrative units might differ and thus sufficient time for coordination and administrative and pre-information is needed. However, the implementation phase and implementation actions and measures are the ones where the actual impact of integrated policies is created (Kohlhoff et al., 2016).

Horizontal policy integration is often understood as pertaining to organisational and institutional interactions across distinct sectors or, the extent to which a central authority has developed a comprehensive cross-sectoral strategy (Di Gregorio et al., 2017; Lafferty and Hovden, 2003). Horizontal policy integration can thus be seen in converging two (or more) policy streams to obtain a coherent approach, as policy streams with conflicting goals and objectives may undermine long-term alignment of overarching objectives across sectors (Nilsson, 2005). Horizontal policy integration is particularly addressed as paramount in 'naturally' cross-sectoral topics such as environmental- or climate policy (Di Gregorio et al., 2017; Jordan and Lenschow, 2010; Nilsson, 2005; Lafferty and Hovden, 2003) but also for minerals and raw materials policy (Endl, 2017; Clausen and Mcallister, 2001). Vertical policy integration, on the other hand, takes place among different levels and hierarchies across political administrative levels and/or territories (Endl, 2017). Hence, vertical policy integration involves actors from different levels of government such as, for example, national ministries, regional authorities and local governments, thereby increasing the need for capacity within and between such actors to achieve integration. Vertical policy integration can involve processes of devolving responsibility to local levels, and can foster coherency, consistency and learning between different levels of government (Nilsson, 2005). When the coordination efforts are crossing policy streams and administrative level, one speaks of diagonal policy integration: such cases can become apparent in strongly decentralised or federal systems, where setting the policy goals and their implementation is dispersed over different levels of government and policy sectors. Steurer and Clar (Steurer and Clar, 2015) are stressing, that, in such settings early agreements and commitment between the different administrative levels and the actors responsible for implementation are crucial in policy design and goal setting.

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3.3 Enabling factors of policy integration: tools, capacity and willingness

In order to be effective in terms of delivering policy goals, policy integration is subject to the availability of tools, and the capacity and willingness of public institutions to employ these tools. With regards to tools, we will mainly draw on EPI (Environmental Policy Integration) research done by Runhaar (2016), which has a long tradition and has produced a strong body of knowledge on policy integration. Runhaar (2016) distinguishes four types of integration tools:

(1) Regulatory tools (restricting/allowing certain options, actions and behaviour),

(2) Information tools (steer by providing information and guidance)

(3) Economic tools (e.g. change cost-to-benefit ratios)

(4) Organisational tools (organisational conditions such as capacity/willingness, procedures, etc.)

Regulatory tools are regulating choices: Runhaar (2016) also introduces regulatory tools relying on interactive governance modes (e.g. voluntary agreements, covenants). Voluntary agreements are criticised for their limited capacity to unfold implementation and integration pressure, due to too much flexibility and ambiguity (room for interpretation), lack of enforcement mechanisms, limited compensation measures (Glasbergen, 1998; Wu et al., 2018).

Information and voluntary tools are considered to drive behaviour through learning and grants of the addressed audience with a large freedom of discretion and freedom to act on the provided information. Voluntary usage of indicators (such as environmental indicators) is challenging in practice, due to language asymmetries (e.g. planners/policy makers) or insufficient involvement of planners (or other end-users) in the indicator development, which subsequently results in limited, fragmented or no application later on (Brown, 2003) or a mismatch between indicator scale and user-needs (Graymore et al., 2008).

Typical incentive structures are economic tools. Economic tools are supporting integration by either setting financial incentives, rewards or punishments. They are on the interface of top-down steering and voluntary behaviour: they might be put in place by higher levels of administration or government but depend on the voluntary behaviour (by contracting) of the involved actors and stakeholder. In EPI different studies have shown the effectiveness of market-based tools: their effectiveness depends on the financial reward and the enforcement power and possible trade-offs with other policy objectives and issues. EEA emphasises that economic tools should only be one part of a broader package and toolset that steers policy integration (EEA, 2005).

Organisational tools are stressing the importance of organisational structure and organisational practises, as well as the establishment of partnerships and networks that are supporting integration in different stages of the policy cycle. However, also those partnerships are assessed critically by stressing that they "seem to solve some problems but also create new ones". Partnerships and networks are long-term voluntary engagements that need trust building efforts and the willingness to share duties and responsibilities (Klijn and Koppenjan, 2016).

Capacity and willingness are key for effective policy integration (Fleurke and Hulst, 2006; Wu et al., 2018; Zuidema, 2016). Capacity (ability) refers to an organisation's or unit's capacity to perform certain tasks and objectives. Prud'homme (Prud'homme, 1995) explains that it cannot be assumed that (local) units are in command of all technical and managerial expertise and skills to perform certain tasks. This observation is important considering mining and mineral extraction is a very specific and technically sophisticated topic. Zuidema (Zuidema, 2016) is emphasising so called 'economies of scale' where larger (e.g. central government) units might have greater resources or the ability to attract and/or allocate resources to handle broad and complex policy issues. Ostrom (Ostrom, 2015) is noticing the importance of the central government to support local (and regional) authorities to handle and overcome possible challenges and hindrances.

4 METHODS

In our paper we screened a total of 16 case studies originally compiled via two MINLAND Horizon 2020 project reports for evidence of integrated minerals and LUP policy approaches (Luodes et al., 2019; Endl et al., 2019). Complementary information on case studies was retrieved from additional sources, such as summaries and minutes from MinLand Local Workshops and descriptive policy networks (Gugerell, 2019).

As a result the authors identified a total of 12 MINLAND cases that described 13 policy tools dealing with different aspects of minerals and LUP policy, and addressing different phases in the policy cycle. The identified policy instrument types are listed in the table below.

Policy tool	**Regulatory:** demanding compliance equally, steering predictability of governmental decisions (rule of law) and often followed by sanctions for non-compliance.
	Economic or fiscal: designed to encourage investments into exploration and access to raw materials, e.g. tax rebates for research activities (prospecting and exploration)
	National strategies/ policy guidelines: proposing a framework and/or identifying suggested criteria for consideration of minerals in e.g. land use planning
	Information-based: maps, data and tools to be utilised (on a voluntary or regulated basis) for the integration of minerals/land-use plans.

Table 1: Policy tool types differentiated for analysis.

Drawing insights from the literature review on policy integration and respective challenges dealt within minerals and LUP policy, the authors set up the following analytical framework where distinctions were made between 'low degree' and 'high degree' of integration efforts and potential:

	Degree of integration		
Vertical Policy Integration	**Low:** national voluntary or non-mandatory tools addressing minerals (often related to safeguarding objectives)	**Capacity for policy integration**	**Technical capacity** is referring to content-specific knowledge and skills, existence of other supportive policies (e.g. project subsidies, rewards, regulatory instruments)
	High: considers of minerals in land-use planning (input into land use planning originates from other levels of governance)		
Horizontal Policy Integration	**Low:** Land-use (or mineral) issues integrated into minerals (or land-use) planning documents, primarily in ex-post or in the implementation stage		**Managerial expertise** is referring to sufficient expertise regarding integrated policy approaches and/or expertise and skills for collaboration and working across departmental and governmental organisational borders
	High: considers minerals in preparation or design stage of land-use plans/ zoning documents or considers land-use planning in minerals planning documents.		

Table 2: Analysis framework for forms of policy integration, degree of integration and capacity.

The distinction between 'low' and 'high' degree of integration efforts was based on emprical findings from the cases, as well as evidence from the literature on minerals- and LUP policy integration. 'Low degree' in the vertical level hence refers to the existence of a tool with the intention to include e.g. minerals safeguarding into land use plans, whereas a 'high degree' is evidence of actual consideration (and inclusion) in the design and development phase of land-use planning. Similarly, with regards to horizontal integration again 'low degree' was used to describe practices of integrating mineral aspects into land-use (or vice versa) ex-post or in the implementation stage, rather than considering integration on a preparation or design phase, which was then deemed to display 'high degrees' of integration efforts and practices.

5 RESULTS

5.1 Policy instruments for minerals and land-use policy integration

12 MINLAND casess were assessed for horizontal and vertical mineral and land-use policy integration. Furthermore, following the framework of policy instrument type, instruments for vertical and horizontal policy integration were grouped according to: (i) strategies and regulatory instruments, or; (ii) informative policy instruments.

5.1.1 Vertical policy integration instruments

In Finland and Ireland mineral interests outlined in the national guidelines and planning frameworks directly fed into regional and local planning documents, thereby indicating high vertical integration. In Sweden, the regional level (municipalities) preside over the discretion to weigh the 'areas of national' interests (defined through horizontal/sectorial integration) with their regional land-use objectives, thereby signalling this as a low (and flexible) degree of vertical integration. See table 3 below for an overview.

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Country	Policy Tools	Aspect of Vertical Policy Integration	Degree of integration
Finland	National land use guidelines stipulate policy streams and strategic goals (including mining and deposits) in a centralised approach.	Top-down implementation in the regions – although regions can contribute to goals and objectives through setting their own priorities.	High
Ireland	Planning and Development Act complemented by a National Planning Framework (addresses objectives of minerals policy horizontally on a national level).	Top-down regulatory framework: general objectives are translated into regional and county level land-use plans.	High
Sweden	System of 'national interests' (horizontal/sectorial) definition of land-use interests and objectives.	Local levels responsible for land-use plans, system of 'national interests' can be weighed (partial vertical integration) on a local level and chief mining inspectorate or national levels can be involved if conflict arises.	Low

Table 3: Vertical policy integration in strategies and regulatory instruments.

The informative and voluntary tools by Austria, Portugal and Spain are all subject to challenges of vertical integration as they are designed on a national level but with the intention to support minerals policy (and safeguarding) integration in local and regional land-use plans of federal or decentralised systems. All cases discussed the need for coordination and communication between national and regional/local levels of government in achieving 'uptake' and integration of the tools on lower levels of government. A specific challenge that was brought up in the cases was the need to involve regional/local authorities already in the design-process of instruments as this would ensure 'ownership' and thus, willingness to integrate the tool or outcomes thereof in regional/local land-use plans. Two more MINLAND cases addressed the design and implementation of an informative policy tool (from a national to a regional level), similar to the cases outlined above. The tool from Greece was implemented in a centralised (top-down) manner, thereby, ensuring integration into spatial plans. In Norway the case study showed that the integration of the land-use management tool was successful in the county of Nordland (high integration).The pilot will now be extended to other municipalities and regions (no integration currently known). See table 4 for an overview.

Country	Policy tools	Aspect of Vertical Policy Integration	Degree of integration
Greece	National level policy tool for safeguarding the exploitation of primary aggregates – focus on framework applied for delineation of conflict free (land-use) aggregates extraction areas	Top-down implementation of national safeguarding policy (aggregates) in regional/local land use planning (spatial plans).	High
Norway	National land-use management tool with the objective of mediating potential land-use conflicts and safeguarding mineral resources of possible current and future value	Responsibility of planning lies with municipal council and regional authorities. Nordland case used as a pilot; the instrument contributed to increased awareness of mineral safeguarding on all levels of governance and is set to be implemented in all municipals and regions	High
Austria	Austrian Raw Materials Plan (ARMP). Soft-policy informative tool designed on a national level to avoid land-use conflicts and ensure mineral safeguarding	Local levels responsible for land-use plans – consultations between different levels occur in the form of checks and balances, review of the proposed plan on regional level and partly on national level if related to responsible department.	Low
Portugal	National voluntary instrument (land use planning methodology for mineral resources – LUP-MR)	Municipalities responsible for land-use planning, some have used the sub-categories of land proposed by the LUP-MR. National authorities approach municipalities not adopting the LUP-MR in an effort to increase understanding of the importance of minerals safeguarding	Low
Spain	National informative and voluntary instrument of mining-environmental planning map intended to be used as a starting point of defining mineral and mining strategies in regional land-use plans.	Challenges of vertical integration in a decentralised system where regional levels are responsible for land-use plans. Implementation met with challenges and is yet to be seen	Low

Table 4: Vertical policy integration in informative instruments.

5.1.2 Horizontal Policy Integration instruments

Regulation, strategies, informative instruments (land use planning or zoning) were most common instruments for horizontal policy integration during the implementation phase. Mineral issues integrated at a design stage (of land-use planning or a policy) were considered to signal a high degree of horizontal integration. Other instruments where minerals issues were considered (more ad-hoc) in the implementation stage were considered as evidence for low degree of integration. The information in table 5 outlines

strategies and regulatory policies that address horizontal integration of minerals resources in land-use policy (or vice versa) and the different aspects thereof.

Country	Policy Tools	Aspect of Horizontal Policy Integration	Degree of integration
Finland	Regional development strategies	Preparation phase of regional land use plans considers minerals exploitation via regional development strategies; consultation is conducted and regional strategy zoning updated/proposed.	High
Finland	Flexible zoning plans	Land use planning processes allows for re-evaluation of land use zoning according to development possibilities; e.g. re-evaluation can be conducted based on company plans for exploitation	High
Sweden	System of 'national interests'	National interests determined through sectorial integration – minerals and other land use interests determined through mechanisms of horizontal integration (respective authorities and actors involved).	High
Norway	Planning and Building Act (National)	Revised to include mineral resources as a specific topic (design) in the Norwegian land use legislation, mineral resources must be considered in the land use planning process.	High
Italy	Regional land-use and minerals strategy / municipality mining plan	Mapping geological heritage, flora and fauna with the intention of modifying the current planning instrument to consider e.g. touristic possibility of geological heritage.	High
Ireland	Planning and Development Act complemented by a National Planning Framework 2040	One policy objective of the national planning framework addresses 'rural development through the sustainable and economically viability of extractive industries, bio-economy and accelerating other sectors whilst protecting the natural landscape and cultural heritage. *The case still indicates that the integration of minerals policy in land-use planning appear modest.*	Low

Table 5: Horizontal policy integration in strategies and regulatory instruments.

Our results indicate that some countries cover instruments that weigh different land-use interests in the design phase of the policy on different levels of government: for example, whereas in Italy this was done on a regional level, in Sweden it was on a national level. Some cases also showed evidence that mineral resources have been integrated to a high (Norway), or low degree (Ireland). Finland also included an aspect of having flexible zoning plans that allowed for 'reformulated' strategies and land-use processes if new deposits were discovered (thereby integrating minerals into land-use plans in a flexible and on-demand basis). The cases, thus, indicated that horizontal integration of minerals and land-use planning represent different shapes and forms and can occur on different levels of government.

Similar to the section on vertical integration was the prevalence of informative policy instruments for horizontal integration. As outlined above, these instruments were characterised by a varying degree of vertical integration success in the different EU MS. Utilising a high degree of horizontal integration as pertaining to integration in the design of the policy instrument, the majority of informative instruments were considered to achieve a high degree as they often accounted for different land-use and societal interests already in their design phase. In one case, the informative instrument integrated aspects of already existing policy streams to achieve coherency and compliance, this was considered as low instead of a high degree of integration (Austria).

Country	Policy Tools	Aspect of Horizontal Policy Integration	Degree of integration
Greece	National Policy for Minerals Safeguarding (Quarrying Areas).	Designed for vertical integration into regional spatial plans this policy tool considers minimisation of environmental footprint, the national spatial strategy, socioeconomic factors and protection of archaeological and cultural heritage.	High
Spain	National mining-environmental mapping	Early phases of environmental land use assessment: territorial analysis factoring in environmental inventory, exploitable resources, cultural heritage, and visible impacts on landscape.	High
Portugal	Land use planning methodology for mineral resources (LUP-MR)	LUP-MR refers to the practice applied by the mining authority when contributing to Land Use Planning review processes of municipal land use plans. Full-integration of minerals safeguarding into land-use plan processes on a national level but modest implementation on sub-levels of government (vertical).	High
Austria	Austrian Raw Materials Strategy and Austrian Mineral Resources Plan	Coordinating parts and components of other policies such as Land-Use and Nature Protection into a Raw Materials Plan.	Low

Table 6: Horizontal policy integration in informative instruments.

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5.2 Capacity for policy integration

Technical and managerial capacities are necessary to support and perform coordination and policy integration. Technical capacity is referring to content-specific knowledge and skills, existence of other supportive policies (e.g. project subsidies, rewards, regulatory instruments). Managerial expertise is referring to sufficient expertise regarding integrated policy approaches and/or expertise and skills for collaboration and working across departmental and governmental organisational borders.

Our data on policy tools illustrate a differentiated perception regarding ability and capacities of involved actors, covering the entire scale from perceived low to high capacity. While respondents with geological and/or mining background consider LUP technical capacity in general rather low (e.g. Spain, Finland, Norway). On the other hand, MINLAND project meetings are illustrating a rather modest LUP knowledge (objectives, approaches, tools etc.) from many involved actors affiliated with geology or mining. This situation emphasises the importance of projects like MINLAND, to establish platforms for capacity building, knowledge sharing and as meeting space for involved parties.

Our results indicated that the availability of data for GIS and the necessary skills and knowledge for the integration of provided GIS data into LUP practise was prevalent in the planning departments and LUP authorities (see table 7 below) for most countries: GIS applications are standard applications in GIS practice, hence suitable interfaces and low-threshold download options with the necessary data provide a suitable base for LUP activities and support the integration of mineral resources in LUP practise (e.g. Austria).

Country	GIS tools and skills
Portugal	GIS tools assisting planners, all data in GIS systems
Austria	GIS processing tools are in full use, interface
Greece	Sufficient expertise and tools
Sweden	GIS data sharing
Italy	Specific data base is existing, assisting the mining and LUP
Finland	Each organisation relies on their GIS resources
Hungary	Data provided for GIS applications & National or Regional Development and Spatial Planning Information

Table 7: Technical skills for GIS and Information Systems for mineral resources and LUP, outlined in the MINLAND case studies

Among the abovementioned countries there are, however, differences regarding the general availability to mining experts and/or geologists in public administration and for immediate availability for LUP authorities: while in some cases geologists are available in public administration on regional or provincial level (e.g. Austria/Styria/Tyrol) in other cases they are not (e.g. Poland). Minerals, quarrying and mining is considered a delicate topic with very specific questions, which cannot be covered in house but experts are needed. The MINLAND cases show, that for authorities it is not always possible to have an expert on site, but it becomes clear that they either collaborate with experts or with geological surveys to tackle specific and complex questions they cannot cover by themselves (e.g. Ireland, Spain, Sweden).

6 CONCLUSION

Our paper indicates that in EU Member States a diversity of policy tools are assembled into policy mixes combining regulatory, economic (fiscal) tools, (national) strategies and guidelines and information-based instruments. One challenge of introducing new policy tools is their evalution in the context of the existing policy regime, and how the different tools work and fuction together. Existing research (e.g. Howlett and del Rio, 2015; Rayner et al., 2017) points out, that the mere adding or replacing of policy tools can result in a situation in which the policy tool and/or the entire policy mix cannot unfold its expected performance and/or can lead to underperformance and inefficiencies (e.g. resource expenditure).

The tools addressing vertical integration indicate the importance of coordination and communication between different levels of government. This is of high importance in decentralised and federal systems where involvement of lower levels of government early on in the design of tools were mentioned as key to ensure integration and implementation (e.g. Norway, Spain). It was apparent that a high degree of vertical integration was more prevalent in centralised systems where regulatory tools demanded integration of objectives or goals in lower levels of government planning. Interesting to note is the mandate of local

authorities to prioritise (Sweden) or identify own pathways toward realising national goals and objectives (Finland), which also gives flexibility of prioritising local interests and may increase legitimacy and ownership of policy and responsibility over connected challenges (Nilsson, 2005).

Our results on horizontal (sectorial) integration most commonly outline nationally developed policy tools with the intention of integrating mineral resources into land-use planning. However, there appears to be a deficit in vertical integration of such tools in systems where regional and local levels of governments have land-use planning mandates, as seen in the examples from Portugal and Austria. This suggests that although a high degree of integration can occur on a horizontal level, challenges remain to successfully achieve vertical integration in such systems. As seen from literature on policy integration, this again strengthens the notion that both dimensions of horizontal and vertical mechanisms are needed to achieve 'full policy integration' (Jacob and Volkery, 2004).

Capacity for policy integration plays a crucial role for effective policy implementation and delivery, which should be considered in both policy design and its translation into policy instruments. As regards the capacity of public authorities for policy integration, MINLAND cases indicate that for particular questions experts are needed to advise public authorities. Support, exchange and capacity building is considered particularly important for municipalities and regions which have no long tradition as an industry player and where public authorities and public administration were not engaged with mining earlier (e.g. cases Spain, Austria/Styria). Aligning with Zuidema (2016) and Ostrom (2015) we can see that the support of the central government or higher levels of government are needed to provide such resources and that smaller units (e.g. regions, municipalities) often do not have the capacities to utilise such resources (e.g. hired geologist). The cases of Sweden and Austria show that geological surveys provide support. For example, the Swedish Geological Survey provides particular support for the industry. Hence, it is important to note, that for advising public administration unbiased consultancy is required, apart from lobbying activities of industry, since LUP is expected to weigh, value and integrate various needs, expectations and policy streams.

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🏆 *reviewed paper*

Building a Common Platform: Integrative and Territorial Approach to Planning Cultural Heritage within the Framework of the Spatial Plan of the Republic of Serbia 2021-2035

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1 ABSTRACT

In accordance with international documents, European regulations and standards, recent documents of spatial and urban planning in Serbia promote the objectives of an integrative and territorial approach for the protection and planning of cultural heritage. This is intended as a cross-institutional, cross-sectoral approach and extending the scope of the protection of single monuments to wider spatial entities. Institutional and legal frameworks of the cultural heritage protection and planning have not yet been harmonised with international recommendations and do not support achieving these goals. Cultural Property Law (1994) is still in force and does not recognise the categories of cultural landscape (although the European Landscape Convention was ratified in Serbia in 2011) and of urban landscape (as the UNESCO's Recommendation on the Historic Urban Landscape from 2011 has not been ratified yet, although the scientific and professional community has been acquainted with it). In accordance with the current law, single monuments dominate the structure of the Central Registry of immovable cultural properties. Considering that registration is not legally binding, there is a lack of additional research to recognise the architectural and urban heritage that is not under institutional protection. This has resulted in the decline of valuable buildings and ensembles, including entire urban settlements that represent important constituents of the cultural and urban identity of Serbia. Furthermore, Reports on the Implementation of the Spatial Plan of the Republic of Serbia from 2010 point to an unequal spatial distribution of registered cultural goods, which is not related to the factual cultural and historical importance of certain areas, but to the degree of economic development and the activity of certain regional protection services. This sets an additional task for the planning documents on enhanced urban protection measures in these areas. The preparation of the Spatial Plan of the Republic of Serbia 2021-2035 is underway, which affirms that cultural heritage is a resource of sustainable development as well as of national, regional and urban identity as one of the general objectives of spatial development. This paper is a summary of an initial analysis of the draft plan. It indicates the need to establish a common platform for the protection, planning and sustainable use of cultural heritage in Serbia. This platform should act on three main levels, firstly gathering data on cultural properties; secondly compounding all formal and informal documents relating to cultural heritage, especially s regards its spatial dimension; and last but not least, inolving a wide range of participants in the protection, planning and management of cultural heritage.

Keywords: Spatial plan of the Republic of Serbia, protection, planning, use, cultural heritage, sustainable development, spatial dimension

2 INTRODUCTION

In accordance with international documents, European regulations and standards, recent spatial and urban planning documents in Serbia promote the objectives of an integrative and territorial approach to the protection and planning of cultural heritage. Such a cross-institutional, cross-sectoral approach extends extening the scope of the protection of individual monuments to wider spatial entities. Servian institutional and legal frameworks of cultural heritage protection and planning have not yet been harmonised with international recommendations and do not support achieving these goals. Cultural Property Law (1994) is still in force and does not recognise the categories of cultural landscape (although the European Landscape Convention was ratified in Serbia in 2011) and of urban landscape (as UNESCO's Recommendation on the Historic Urban Landscape from 2011 has not been ratified yet, although scientific and professional community has been acquainted with it). In accordance with the existing law, individual monuments dominate the structure of the Central Registry of immovable cultural properties (Republic Institute for the Protection of Cultural Monuments of Serbia, 2017). Considering that this is not legally binding, there is a lack of additional research to recognise the architectural and urban heritage that is not under institutional protection which would be needed to review the boundaries of cultural properties and protect the adjacent units. This situation has resulted in the decline of valuable buildings and units, including entire urban

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settlements that represent important constituents of the cultural and urban identity of Serbia. Furthermore, Reports on the Implementation of the 2010 Spatial Plan of the Republic of Serbia point to an unequal spatial distribution of registered cultural goods, which is not related to the factual cultural and historical importance of certain areas, but to the degree of economic development and the activity of certain regional protection services. This sets an additional task for the planning documents to enhance urban protection measures in these areas. The preparation of the 2021-2035 Spatial Plan of the Republic of Serbia is underway, which affirms the cultural heritage as a resource of sustainable development as well as of national, regional and urban identity as one of the general objectives of spatial development. This paper presents the results of one of the initial analyses of the draft plan. It indicates the need to establish a common platform for the protection, planning and sustainable use of cultural heritage in Serbia. This platform should act at three main levels; firstly gathering data on cultural properties; secondly compounding all formal and informal documents relating to cultural heritage, especially its spatial dimension; and last but not least, involving a wide range of participants in the protection, planning and management of cultural heritage.

In accordance with the contemporary debate on the conservation and planning of cultural heritage, sustainability is one of the common denominators of conservation and urban planning. However, there is a lack of a balanced and holistic approach to managing development and focusing on sustainability. In doing so, conservation would be a major componeont, not an 'elitist niche', and conservationists would be important stakeholders in the planning and decision-making process (Chakravarty, 2017). This problem is particularly obvious in developing countries (Steinberg, 1996). In addition, it is important to note that neglecting the spatial dimension of cultural heritage in terms of character and place identity remains a global problem, mostly due to institutional and sectoral division that has negative spatial effects (Samuels, 2010; Bienstman, 2011).

The paper primarily points to the relationship between the international and national frameworks for the protection, planning and use of cultural heritage and to the existing capacities for reviewing the spatial dimension of cultural heritage in current spatial development policies and strategies of the Republic of Serbia (RS). It then presents strategic planning of cultural heritage in Serbia in the spatial plan instrument. Particular attention is given to the treatment of cultural heritage in planning documents that are adopted in accordance with higher order plans and their strategic goals, whose implementation directly affects changes in space.

3 THE RELATIONSHIP OF THE INTERNATIONAL AND NATIONAL FRAMEWORK FOR THE PROTECTION, PLANNING AND USE OF CULTURAL HERITAGE

3.1 Current international guidelines and trends

The following international charters in the field of the protection of cultural heritage have been ratified in Serbia: Convention Concerning the Protection of the World Cultural and Natural Heritage (UNESCO,1972, ratified in 1974); Convention for the Protection of the Architectural Heritage of Europe-Granada (Council of Europe, 1985, ratifed in 1991), European Convention on the Protection of the Archaeological Heritage (Council of Europe, 1992, ratified in 2009), Convention on the Value of Cultural Heritage for Society (Faro Convention, Council of Europe, 2005, ratified in 2010); European Landscape Convention (Council of Europe, 2000, ratified in 2011).

3.2 Current development policies and strategies

The map of strategically important public policy documents of the RS (available on the website of the Government of the RS, the Public Policy Secretariat) includes various planning areas. There are still no documents in the field of culture (the Draft Strategy for the Development of Culture of the RS from 2019-2029 is in process). In the field of urbanism, spatial planning and construction, the Sustainable and Integrated Urban Development Strategy of the Republic of Serbia until 2030 was adopted, in which the theme of protection and planning of cultural heritage was addressed within the framework of urban settlements, with the overall goal of improved and harmonised quality of urban organisation and accessibility of urban space.

3.2.1 Policy of Cultural Heritage Development

The Strategy for the Development of Culture of the RS 2019 - 2029 defines three priorities: personnel development (education, digitalisation, development of creative industries); infrastructure development (development of new and reconstruction of existing objects and spaces in the function of culture, improvement of the conditions of protection of cultural heritage, information and communication infrastructure, physical relations and networking with digital technologies); and European integration and international cooperation (participation in EU programmes and projects, conformation to international standards). The Strategy points to the need to improve the legislative framework in the field of protection of immovable cultural heritage and aligning it with the international charters in the field of cultural heritage protection that have been ratified in Serbia so far.

The Sustainable and Integrated Urban Development Strategy of the Republic of Serbia until 2030 is a public policy document, addressing the topic of protection and planning of cultural heritage within the framework of urban settlements, and defining the overall goal as improved and harmonised quality of organisation and accessibility of urban space. Development policy is in line with the binding policies and documents of the United Nations and the European Union.

3.2.2 Spatial aspect of the policy of cultural heritage development

The Strategy for the Development of Culture of the RS 2019 - 2029 suggests the digitalisation of heritage, a cross-sectoral approach, stronger partnership between administrative and professional institutions for the protection of cultural heritage and urban and spatial planning, in particular by adopting management plans for certain types of cultural heritage and enacting spatial plans for certain types of immovable cultural property. The strategy indicates that due to incomplete decentralisation and a non-unified system of protection services, the immovable cultural heritage in the RS is in an unequal position, i.e. it depends on the financial and personnel capacities of individual institutes and municipalities, which differ significantly and are insufficient in many cases.

In accordance with the spatial dimension of the Sustainable and Integrated Urban Development Strategy of the Republic of Serbia until 2030, priority areas of urban intervention have been identified, linking identified development problems with concrete locations thus directing local integrated urban development strategies to priority funding projects. Spatial units with cultural and architectural heritage and important reference points of cultural and historical development of urban settlements and groups of urban settlements were singled out, due to the need to extend the subject of protection and the notion of cultural heritage. The following interventions are proposed: rehabilitation and revitalisation of buildings and architectural heritage units, an integrative approach to the protection of cultural property and urban protection of buildings and entities which are not under institutional protection, especially from the second half of the 20th century, adaptation of architectural heritage facilities to modern requirements, such as energy efficiency. Measures to achieve the objectives of the Strategy are combined and applied to: urban reconstruction of central urban areas; urban regeneration of parts of urban settlements exposed to devastating processes; reactivation and development of brownfield zones, complexes and sites with industrial heritage; protection of buildings and units which are not protected as cultural assets; more efficient use of units with underutilised structures; landscaping and preservation of public spaces; and use of renewable energy sources.

4 STRATEGIC PLANNING OF CULTURAL HERITAGE IN SERBIA THROUGH THE SPATIAL PLAN INSTRUMENT

The planning system in Serbia has similar procedures as in most countries with a comprehensive planning approach and the principle of hierarchical integration of different spatial plans - from a larger scope of spatial plans to a smaller scope of urban plans. The Spatial Plan Instrument is a strategic document defining the goals and principles of spatial development of larger spatial units. In particular, it defines the planning units of common spatial and developmental features, for which smaller scope planning documents will be adopted (typological classification of areas), as well as the spatial development of transport and infrastructure systems of general importance. Prior to the Spatial Plan currently under development, the 1996 and 2010 Spatial Plans of the RS were adopted.

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4.1 Key objectives, planning solutions and priorities for development in the field of cultural heritage protection in the previous Spatial Plans of the RS

In the 1996 Spatial Plan of the RS, besides preserving material remains of different cultures developed on Serbian ground, the emphasis is on the importance of preserving national identity through strengthening awareness of cultural heritage and the importance of continuity in the development and use of immovable cultural assets, through their reintegration into the contemporary context of life. The protection of immovable cultural property is considered an integral part of the development of society, and cultural heritage is considered an activator of the development of various activities that can have economic effects. The protection includes not only registered immovable cultural property, but also a heritage which was not included in the regime of protection, especially complexes, objects and places from 19th and 20th centuries. This implies a revaluation of cultural heritage and an even territorial presence of protection.

In the 2010 Spatial Plan of the RS, the development of cultural identity and territorial recognition and the promotion and protection of natural and cultural heritage as a development resource is one of the general principles of Serbia's spatial development, which forms also part of other general principles: sustainability, territorial cohesion, formation and strengthening of networks of cities and towns that can provide development of complementary functions and public-private partnerships. Cultural heritage is subject to protection, regulation and use (controlled and sustainable) in accordance with European regulations and conservation standards and is treated integrally with natural heritage and landscape protection. An integrative territorial approach implies further systematisation of cultural heritage and the development of networks of natural entities and cultural landscapes that are protected or have special values.

4.2 Basic concept of spatial development in the field of cultural heritage protection in the previous Spatial Plans of the RS

The 1996 Spatial Plan of the RS provides planning protection measures for three types of areas: protected urban structures and urban environments, rural architecture and sites, and archeological sites. This classification corresponds to the categories of immovable cultural property in the system of valorisation of the protection services and in that sense facilitates implementation. It is important that the previous 1996 Protection Plan of the RS suggests additional explorations of the territory of the RS in order to fully record cultural assets, especially in large spatial units such as e.g. the valleys of large rivers (Danube, Morava, Ibar), etc. Also, additional research is needed to review the protected environment of cultural property to include other spaces relevant to the experience and presentation of the property. Given the uneven distribution of cultural property on the territory of the Republic, greater attention is suggested regarding planning protection in areas of poorer heritage. Important advances in the field of planning protection under the previous 1996 Spatial Plan of the RS relate to the importance of identifying and delimiting a territory into parts that have homogeneous features, according to certain criteria. This further enables the planning of settlements by historical and topographical units in the way they were created. Particular emphasis is given to the importance of harmonising transport and infrastructural corridors with cultural heritage zones, as well as ensuring the accessibility of cultural monuments located in hard-to-reach sites (medieval and early antique fortifications).

The 2010 Spatial Plan of the RS introduces an integrative territorial approach to the protection of cultural and natural heritage and landscapes, in accordance with European standards of protection. This implies the introduction and definition of cultural areas, which will then be divided into zones with varying degrees of protection and treatment of cultural heritage. Priority cultural areas have been identified that should receive special treatment, regardless of their status within the protection services. Although this approach contributes greatly to the recognition of cultural heritage as a resource for sustainable development, the problem remains of a legal and institutional framework of protection that is still inconsistent with contemporary conservation approaches, which raises the question of the possibility of implementing planning recommendations. In accordance with the general principle of territorial cohesion, the division of the territory of Serbia into 7 large spatial units with their particular geographical, historical, functional and cultural characteristics is relevant for the planned protection of cultural heritage. In addition, the previous 2010 Spatial Plan of the RS identifies three development directions whose development would incite spatial integration and functional connectivity of regional entities. Particularly recognisable are the key characteristic entities and objects/

They are: urban centres, points of intersection of important corridors, objects of cultural and natural heritage, objects of social infrastructure, symbols of statehood.

4.3 Assessment of the realisation of the concept of spatial development in the field of cultural heritage protection

The reports on the implementation of the Spatial Plan of the RS (2011, 2012, 2013, 2014 and 2016) show the state of spatial development indicators of the RS, realisation of priority strategic projects from the Spatial Plan of the RS and the spatial planning documentation, based on which the assessment is given of the status of spatial development of the RS. Indicators are the number of protected cultural assets in the area (source: the Republic Institute for the Protection of Cultural Monuments of Serbia) and the number of immovable cultural assets enjoying prior protection (source: regional institutes for the protection of cultural monuments), according to legally defined categories and degree of protection.

The Report on the Implementation of the 2010 Spatial Plan of the RS (2015) estimates that there are significant differences in the number of protected cultural assets between administrative districts and that, in general, the number of cultural assets is increasing, whereas trends of disparity and spatial cohesion are stable. The number of cultural heritage sites and integral entities under previous protection is declining, whereas long-standing value trends are stable. It is pointed out that, in order to gain a better understanding and a more reliable assessment of the realisation of this indicator, additional spatial development criteria should be provided in the future. The largest number of recorded cultural assets is concentrated in the Belgrade and Vojvodina regions (the Danube Region), which are the most economically developed, while the sites on the World Heritage List are concentrated in other regions (south, east, west).

There is a constant increase in the number of recorded and declared cultural property, whereas the number of cultural property under previous protection is in stagnation or declining. This is a consequence of the slow process of declaring property, as well as the uneven methodology of record keeping in all protection services. There is a need for additional reconnaissance of the terrain. For spatial development, the property enjoying prior protection must be treated in the same way as the protected cultural property. Conversely, the preparation of spatial plans should include the recording of cultural assets, whereas planning documents that are directly implemented (urban planning, special purpose spatial plans and spatial plans of local self-government units) should define the rules of regulation and construction.

The following strategic priorities are defined in the sub-area of Protection and Sustainable Use of Cultural Heritage: arrangement, presentation and management of Roman sites in Niš and Mediana; development of national and regional "cultural pathways"; development and adoption of management plans for cultural property on the World Heritage List; preparation of nomination files and management plans for cultural property on the preliminary UNESCO World Heritage List; drafting the Strategy for the Development of Culture of the RS; revision of the status of identified immovable cultural property and compliance with applicable legislation; preparation of an analysis of the condition of industrial heritage facilities (complexes) for the purpose of defining criteria for industrial heritage valuation in order to determine the protection measures for industrial facilities (complexes) in the RS; identification of characteristic authentic types of rural settlements in all regions of the RS; elaboration of protection proposals for five selected types of the most preserved authentic rural entities with monumental features.

5 CULTURAL HERITAGE TREATMENT IN PLANNING DOCUMENTS

Planning documents incorporate data on protected cultural property and conditions for their preservation together with instruments for their preservation. Planning is based on the results of the work of the protection service which classifies cultural assets in the territory of the RS into 4 types of monuments: spatial cultural-historical units; cultural monuments; archeological sites and landmarks; and objects under previous protection. The regime of space protection, the instruments of protection, the size of the protected space, etc. is determined based on valorisation.

5.1 Regional spatial plans

In regional spatial plans, the area of cultural heritage protection represents a structural part of the integral protection of space and environment. The concept of protection and improvement of the environment is based on the projection of spatial development, which is harmonised with the specific regional character of

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the landscape and the physical structure of the settlements in the territory of the plan; promotion, protection and sustainable use of declared natural and cultural heritage (landscapes and natural and cultural values in settlements), their integration in space (local, regional, national ecological and cultural networks), and strengthening and promoting the existing and creating new values in the spaces in which the value of landscapes and ambient of settlements is of particular importance for the development (tourist, cultural areas) that represent the part of international networks and border areas. The regional spatial plan is implemented by elaboration of planning solutions and spatial plans of the special purpose areas, spatial plans of local self-government units, urban plans and sectoral plans and programmes in accordance with the law, respecting the principle of horizontal and vertical connection.

Cultural heritage in the higher order plans, especially in the spatial plan of the RS, is unequally distributed on the territory of the Republic (See Fig.1 in: Niković and Manić, 2018). The lower order plans lack the results of additional research in the planning process that would predict urban protection for valuable objects and entities that are not subject to institutional protection and possess architectural, urban, historical, ambient and other values.

5.2 Spatial plans of special purpose areas and spatial planning in local self-governments

In addition to 9 regional and municipal spatial plans, several special purpose spatial plans for cultural landscapes (Bač), archeological sites (Viminacium) and areas with outstanding natural features and cultural and historical heritage (Sremski Karlovci, Radan, Ovčar-Kablar Gorge) were adopted.

In the spatial plans of the areas of special purpose, the concept of spatial development is based on the determination of measures for the protection of cultural property in accordance with the data of the competent protection services, as well as on the designation of the protective zone of cultural assets in accordance with detailed reconnaissance in the field. The most common developmental conflicts are the uncontrolled construction of protected areas and urban sprawl that disrupts the existing compact settlement structures.

5.3 Spatial planning in local governments

The spatial plans of the local government units mainly incorporate data obtained from the competent protection services and provide an overview of the cultural assets in the scope of the plan, together with protection measures. The protection zone of immovable cultural property generally coincides with the boundary established by the competent protection service, although it often does not cover other areas of importance for the experience and presentation of the property.

6 GENERAL ASSESSMENT OF THE SPATIAL DEVELOPMENT OF CULTURAL HERITAGE IN SERBIA

In Serbia, as in most developing countries, there is a problem of inconsistency of the institutional and legal framework with international recommendations, despite the existence of favorable preconditions for the improvement of the already developed system of protection. Cultural heritage still includes primarily individual monuments that dominate in number the structure of registered cultural assets. In this context, buildings of vernacular architecture, industrial heritage, modern architecture and valuable ambient units are not usually subject to conservation and restoration programmes, although they have significant architectural, urban, civilizational values and/or represent important reference points of cultural and historical development.

On the one hand, the current approach to the valorisation of the created structure leads to the neglect of the environment of the protected entities, and very often to the degradation of ambient entities, especially by illegal construction, which is a distinct problem in urban development in Serbia. On the other hand, we have the problem of decaying urban settlements and valuable examples of architecture that are not recognised through institutional protection, plans and strategies. These problems must be addressed by applying an integrative and territorial approach to cultural heritage planning.

STRENGTHS (advantages)	**WEAKNESSES (disadvantages)**
• Rich cultural heritage and cultural diversity • Urban settlements with specific typological characteristics • Recognizable architectural typologies • Developed system of the protection of cultural property • Trend of steady increase of the number of protected cultural assets in the Central Register of ICP (immovable cultural property) • Programs to encourage the preservation of old crafts • Serbia's representation in programs and projects for the rehabilitation of the architectural and archeological heritage of Southeastern Europe, under the patronage of the Council of Europe and the European Commission • The project "Digitalization of immovable cultural heritage" – Ministry of Culture and Information and Serbian Academy of Sciences and Arts has started • Several international charters in the field of cultural heritage protection have been ratified • International cultural cooperation proclaiming Novi Sad the European Capital of Culture for 2021; participation of Belgrade, Novi Sad, Sremska Mitrovica and Smederevo in EU program for culture - Creative Europe	• Insufficiently developed database on cultural assets • Non-alignment of the institutional and legal framework for the protection of cultural heritage with international recommendations, conventions and ratified charters • Long-lasting processes for the declaration of cultural property, especially those under prior protection • Insufficient cooperation of the professions involved in cultural heritage protection, planning and management - lacking practical guides and methodologies • Inadequate treatment of immovable cultural property in planning documents - lack of contextual analysis and valuation of the building stock and spatial verification of individual sites • Directing funds intended for the maintenance of cultural monuments primarily to the technical protection and maintenance, without emphasizing the elaboration of development programs and projects that would contribute to the integration of cultural monuments in the environment and contemporary life • The typology of urban structure is not sufficiently recognized through planning documents • Declining urban settlements that represent important reference points of Serbia's cultural and historical past - especially smaller ones, in less economically developed parts of the country • Decay of valuable examples of urban architecture types (especially buildings and urban units from the other half of the 20th century and Industrial heritage) • Inadequate funding for heritage protection, cultural infrastructure, cultural programs and projects • Insufficient capacity of the cultural heritage protection service • Underdeveloped interpretation, animation and mediation at the immovable cultural heritage sites and cultural institutions • Low level of citizen participation
OPPORTUNITIES (chances, potentials)	**THREATS (risks)**
• The availability of digital technologies to integrate cultural property data into a single, central database • Awareness of the scientific and professional public on the importance of culture and the protection of cultural heritage • Liaison between educational institutions and institutions dealing with the protection and planning of cultural heritage; creative educational programs for raising awareness of cultural heritage from the earliest age • Diversification of the financing system and ensuring greater involvement of the private sector, public-private partnerships, donations and funds from various European and international programs and funds (greater representation of urban settlements in the EU program for Culture - Creative Europe, etc.) • Strengthening urban identity based on cultural diversity • Realization of projects in culture and heritage protection in individual and groups of urban settlements and their rural environment - projects in the Danube area, wine routes, roads of Roman rulers, etc. • Development of cultural tourism and urban tourist destinations with cultural heritage offering cultural content and natural heritage in the destination • Development of promotion of cultural heritage sites, programs and projects in culture • Encouraging the development of old crafts • Promoting good practice examples • Active participation of citizens, cultural and artistic societies and representative associations in decision making on cultural development and heritage protection • Development of international cultural cooperation • Improvement of cultural heritage management instruments	• The system of protection of immovable cultural heritage is decentralized in an incomplete manner - it does not allow for a uniform approach to the protection of heritage in accordance with the cultural and historical significance of particular areas • Sectoral approach to the protection and planning of cultural heritage • Insufficient cooperation between protection and planning institutions and insufficient awareness of the need of modernizing protection and planning procedures • Decay of valuable objects and entities • Economic underdevelopment of areas with important cultural potential • In urban development planning and management procedures, insufficient recognition and differentiation of important features of urban structure that represent elements of their identity and potential for development • New typologies that violate the identity of urban settlements due to the dominance of investors' economic interests - partial construction, illegal construction, etc. • The unresolved issue of improving funding for heritage protection, cultural infrastructure, cultural programs and projects

Table 1: SWOT analysis of the spatial development of immovable cultural heritage in Serbia – prepared for the Sustainable and Integrated Urban Development Strategy of the Republic of Serbia until 2030 (by authors)

7 GENERAL OBJECTIVES, PRINCIPLES AND CONCEPTS OF SPATIAL DEVELOPMENT OF CULTURAL HERITAGE IN THE 2021-2035 SPATIAL PLAN OF THE RS

The overall objective of spatial development in the field of protection and planning of cultural heritage is to affirm cultural heritage as a resource for sustainable development and a factor of national, regional and urban identity. The principles of spatial development in the field of protection and planning of cultural heritage are:

- Integrative approach to the protection and planning of cultural heritage: cultural heritage consists not only of individual monuments and registered cultural assets, but also of objects of vernacular

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architecture, industrial heritage, modern architecture and valuable ambient units, including the levels of the cultural area and cultural landscape;

- Harmonisation with international regulations: Serbia's cultural heritage is part of the international cultural heritage and, accordingly, protection and planning must be in accordance with international recommendations and standards;
- Sustainability: continued use of facilities that enjoy the status of cultural property saves resources and energy;
- Cultural heritage is a resource for sustainable development and a significant impetus to the development of urban settlements in Serbia, becoming a benchmark on tourist routes and contributing to the economic development of the community;
- Active public participation: the planning process takes place through a continuous dialogue between professionals and residents / users of the space;
- Respect for the context is the basis for improving the planning methodology in protected areas and in protected cultural assets; valorisation criteria must be applied to the overall physical structure in the environment of cultural property for the purposes of determining the precise protection zone;
- Digitalisation of cultural heritage for the purpose of more fruitful interdisciplinary cooperation, creation of a digital platform with a database and a map of cultural goods and cultural areas, with the possibility of filtering the database according to different attributes of cultural goods; in this way it is possible to assess the harmonised distribution of cultural property in the territory of Serbia and, through planned protection, to further affirm the lower category heritage in economically less developed areas, which in Serbia represent areas with rich culture and history (e.g. southern and eastern Serbia);
- Promotion and presentation of cultural heritage: national, regional and local identities are enhanced by raising awareness of cultural heritage and the responsibility of local and regional communities to their environment;
- Territorial approach to heritage conservation: cultural heritage is an integral part of broader spatial units to which it belongs, together with their ecological and landscape values, which imposes the need for integrated spatial management and development of holistic strategies and coordinated actions of all participants involved in urban development processes of contemporary cities in accordance with international documents dealing with the sustainable development of modern cities.
- Public-private partnership.

The expected effects of implementing an integrative and territorial approach to the protection and planning of heritage are:

- Connecting institutions through digitalisation of cultural heritage, better cooperation and awareness, transparency and visibility of cultural assets that are protected, in the process of protection or proposed for protection;
- Formation of networks and sub-networks, cultural routes and cultural areas through a territorial approach, which opens the possibility for project financing, special programmes (especially cultural tourism) for the regeneration and revitalisation of certain areas, which creates economic effects;
- Recognition of architectural and urban heritage and their inclusion in planning and institutional protection in accordance with the most recent international recommendations and charters;
- Strengthening of national, regional and urban identity as an important lever for sustainable development - increase of tourist appeal and consequently economic effects;
- Inclusion of Serbia in international cultural routes recognising its cultural potential, especially as part of its international cultural heritage.

8 CONCLUSION

Integrative approach, territorialisation and digitalisation were the 3 key topics of the principles of spatial development of Serbia in the field of protection and planning of cultural heritage. They are related to charters and recommendations adopted at European level since the adoption of the previous spatial plan (2010), primarily the UNESCO Recommendation on the Historic Urban Landscape 2011 and the Territorial Agenda of the European Union 2011.

The principle of an integrative approach to the protection and planning of cultural heritage is in line with the first topic. Therefore, not only individual monuments and registered cultural assets are included in cultural heritage, but also objects of vernacular architecture, industrial heritage, Modern architecture and valuable ambient units, including the levels of the cultural area and cultural landscape. Respect for context represents the basis for advanced planning methodology in protected areas and in protected cultural assets. In order to determine precisely the protection zone, valorisation criteria must be applied to the overall physical structure in the environment of cultural property.

The principle of a territorial approach to heritage conservation is in line with the second topic: cultural heritage is an integral part of the wider spatial units to which it belongs, together with their ecological and landscape values, which imposes the need for integrated space management and the development of holistic strategies and coordinated actions of all participants involved in urban development processes of modern cities in accordance with international documents dealing with the sustainable development of modern cities.

The principle of digitalisation of cultural heritage is in line with the third topic. For the purpose of more fruitful interdisciplinary cooperation a digital platform is suggested with a database and a map of cultural goods and cultural areas, with the possibility of filtering the database by different attributes of cultural goods. In this way, it is possible to assess the uniformity of distribution of cultural assets in the territory of Serbia and, through planned protection, to further affirm the lower category heritage in economically less developed areas, which in Serbia represent areas with rich culture and history (e.g. southern and eastern Serbia).

The access analysis of the drafting of the new 2021-2035 Spatial Plan of the RS indicates the need of a common platform for the protection, planning and sustainable use of cultural heritage. This platform should operate on three levels, first linking data on cultural property; second, all formal and informal documents relating to cultural heritage, and above all its spatial dimension; and last but not least, a wide range of participants engaged in the protection, planning and management of cultural heritage.

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Campus Development of the IDEA League Universities

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1 ABSTRACT

The university campus – for centuries an important urban building block and also in our future cities of tomorrow: it is impossible to imagine life without it. But what does modern campus planning look like in a re-mixing city of tomorrow and what concepts are being followed to integrate the university campus in the 21st century and to adapt it to digitalization and networking and develop it further?

What concepts can be derived from networks, such as strategic alliances like the IDEA League, an association of five leading technical universities in Europe? How do these universities help to shape our European cities, what urban development ideas do they follow and how can they serve as a motor for urban development?

Based on the IDEA-League partners: Delft University of Technology (Netherlands), ETH Zurich (Switzerland), RWTH Aachen University (Germany), Chalmers University of Technology (Sweden) and the University Politecnico di Milano (Italy), these research questions will be examined and analysed in detail with the aim of developing a design guideline for campus development.

Based on current plannings, such as the campus redesign in Milan by Renzo Piano, the Science City at the ETH Zurich and the RWTH Aachen extensions Campus Melaten and Campus West, first results of the analysis are presented below. Important aspects that will also form the first cornerstones of the design handbook are the “24-student campus”, “outdoor space” and the “recreational area”.

Keywords: IDEA League Universities, campus development, redesign, future cities, urban development

2 INTRODUCTION

What exactly is meant when we talk about “Future Cities”, “Re-Mixing the City: Concepts and Perspectives for Mixed Use in Future Cities?” (REAL CORP 2020) What are the uses, the building blocks, the contents that put together such a future city?

Especially in Aachen, one of the most important and largest urban building blocks is the university, namely the RWTH Aachen University. Campus development and planning is not only in Aachen a current topic of urban development. Universities are growing, student numbers are increasing and more and more people are deciding to study after school. Society is increasingly transforming itself into a knowledge society.

Growth, digitalization and new media have an impact on the teaching units of the universities and force them to adapt and change again and again, regardless of their sometimes centuries-long traditions, such as the RWTH Aachen University, which is celebrating its 150th anniversary this year. Universities are thus involved in constant processes of change, which not only affect aspects of content or the further development of curricula, but are also physically manifested in the expansion of campus areas in the urban space. Despite digitalization, the physical presence of the universities remains untouched, current surveys show that demand for student learning jobs and places to stay at the universities is constantly growing, and that digitalization itself requires increasing space. This is because servers and technical infrastructures also require university buildings, and despite the fact that more and more lectures are available on the Internet, new research clusters and university departments are being developed and built.

Not only are new research areas increasingly emerging, but digitalization also leads to ever new networks. University departments and research institutions are combining forces in an interdisciplinary way, even beyond national borders. One example is the IDEA League, an association of the leading European technical universities. Technical and scientific exchange, which is currently already taking place in the field of traditional engineering subjects, also represents a great potential to be used on an architectural level.

All of these five universities have faculties of architecture and the question that now arises is how these renowned universities can help to shape their home towns and cities and thus be a motor for urban development? Can this network be used to develop guiding principles for urban development and what goals can be identified and how can future urban planning benefit from the knowledge gained?

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In summary, the objective is to analyse the aforementioned research questions in more detail with regard to the IDEA League locations and to derive guiding principles from them as to how future campus development should be designed. In this process, we will take a closer look at how campus development and urban development concepts of the European university network of the IDEA League work and how they can be mutually dependent on each other to develop future design principles and concepts.

This goal is to be achieved by analyzing the existing literature and planning documents, by on-site research and interviews with planners, in order to be able to map the developments and active planning in the field of campus development.

3 CAMPUS DEVELOPMENT

By definition, the campus is the site, the field on which the university with its entire number of faculties is housed, but how does one develop such a campus area in terms of urban planning today?

From historical sources, universities have developed in urban locations with an exposed location of their main building (Kruschwitz 2011: 218). The inner-city connection between university and city was not only identity-forming for university life but also for the entire city.

However, the question that now arises is, how can these same old inner-city universities develop in the future and what will future university development models and campuses look like?

The IBA Heidelberg is running from 2012 to 2022 under the heading “Knowledge Creates City”. The IBA is concerned precisely with the question of how university and city and the associated development work together.

But where exactly is the campus development going? Today the campus is no longer just the former field - it is much more the outdoor space around the individual university buildings that is gaining in importance. The public outdoor space is increasingly becoming a place for living and working through digitalisation and mobile user terminals.

On the one hand, our teaching is also becoming increasingly digitalized, with lectures being retrievable and traceable from the Internet. The time students spend on campus is being reduced, but at the same time a contrary development can be observed, with students increasingly visiting study and work rooms on campus to meet and let ideas grow through chance encounters. The world is becoming increasingly networked, the campus of tomorrow will be different from the mere place where knowledge is absorbed, but what does this mean in terms of urban planning and architecture, how can one learn from such networks there as well?

These campus development analyses are to be examined and executed on the basis of five leading technical, European universities, which have joined together to form the IDEA League University Network.

4 THE IDEA LEAGUE UNIVERSITIES

4.1 The Idea of the IDEA League

The IDEA League is a strategic alliance of currently five leading European universities, which pursue the goal of representing Europe as a leading technology and innovation location worldwide. The five research-oriented partner universities have a high international reputation and educate future generations of engineers.

The title of the IDEA League goes back to the names of the four founding universities. These include Imperial College London (United Kingdom), Delft University of Technology (Netherlands), ETH Zurich (Switzerland) and RWTH Aachen University (Germany). In addition, ParisTech (France) joined the league in 2006. Imperial College London and ParisTech have already left this network and were replaced in 2014 by Chalmers University of Technology (Sweden) and the University Politecnico di Milano (Italy) in 2016.

For Imperial College London, the reasons for leaving the alliance were financial, and for ParisTech, the reorganization into Université Paris-Saclay (UPS). (Schlaefli 2014)

The League is an alliance whose name “IDEA” stands for its basic attitude, namely to act less out of lobbistic, political interests and more with the motivation of a common exchange of ideas. (Schlaefli 2014)

In addition to the function of the best possible European representation, the network aims to link research and teaching and to promote technological exchange and knowledge sharing between leading European

technical universities. Through exchange programs and summer schools, for example, students and scientists in many fields of study come together to network the universities.

4.2 Urban Development in the European Context

Especially in the field of architecture and urban planning, however, very little discourse takes place in the context of the IDEA League, which means that the potential of different urban development ideas and concepts within the university network is not exploited. Especially with regard to the urban development planning of the campus areas in the individual IDEA League cities, synergies could be used and strategies could be exchanged and thus mutual inspiration and learning could take place.

What role do urban planners play in these development strategies and which actors work together in these campus development processes?

The intention is not only to achieve a functioning campus planning, but also to create a “livable city” in which there are no urban parallel societies between university and city society. The aim is to create a “city for all” that integrates knowledge into the city and thus allows the public welfare of an interlocking and multi-layered urban society to be experienced.

Furthermore, it is not only the spatial integration of the university into the city that must work, but also a social integration is crucial. The university must not see itself as an elitist, difficult-to-access urban component, but rather it must be accessible at various levels, to all social classes, in order to be able to integrate itself really actively into the city structure. Recent efforts such as children's universities, summer schools or the concept of study courses for senior citizens contribute precisely to such an opening of the university and create integration and networking with the city. Due to the subliminal use of the university in the everyday life of the non-university urban population, a natural and true integration of the university into the urban fabric is achieved.

This aspect also leads to the fact that the urban fringes of university campuses, which often show hard urban breaks, begin to intertwine with the usual urban fabric, because the campus areas are then also used by the entire urban population. A prerequisite for this, however, is that the university understands and designs the areas around its research buildings as atmospheric outdoor spaces and recreational areas of the city and does not see them as purely functional, as a park or a rubbish dump. The integration of gastronomy, sales and recreational areas, as an extension of the urban mix of uses, especially at the edges of the campus, will allow the campus to be successfully linked to the city.

4.3 Future Campus

“The identity of a city cannot be measured” (Reicher 2019: 27), but it is particularly the interplay of the individual city components that makes up the identity of a city. A university is also one of these city building blocks and the example of the five IDEA League universities shows how campus planning and development can be thought of in very different ways in connection with the city.

How do these five differently sized cities of the League deal with the challenge of campus development and how can a university influence an entire region or metropolis?

The examples of Aachen, Zurich or Delft show how globally identity-giving for the entire city are their universities, whereas Milan or Gothenburg are not necessarily known primarily through them.

However, the connecting element of these five universities is that they are constantly growing and also have to expand spatially, resulting in five very different campus development systems, which are to be analysed and compared.

A campus development is currently taking place in Milan. Milan is not only known for its university, but increasingly sees itself as a city of science, and the Politecnico di Milano with its inner-city locations the Campus Leonardo and the younger Campus Bovisa shall be complemented by the Renzo Piano Campus. The Renzo Piano Campus will be created by redesigning the campus areas along the Via Bonardi. The decisive design element is to connect the individual solitary university buildings by means of new buildings and to open up the intermediate areas, the exterior space by means of intensive greenery. This will create a liveable campus and a completely new urban area of knowledge.

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What exactly is the so-called “Science City” (Schmitt 2004: 3) as propagated by the ETH Zurich as a campus and urban development system and what exactly is the implementation of this idea of a sustainable city district that includes knowledge locations?

In 2010, the new ETH Zurich Hönggerberg campus was awarded the European Science Culture Prize. This campus area, located on the outskirts of the city just outside the city centre, is aimed to become the new flagship of ETH Zurich as "Science City". As an expansion opportunity for the university, which is actually located in the city centre, an attempt was made to directly shape the aspect of the stay on the campus through its location in a former natural recreation area, through living and sports facilities.

In the same way, the example of RWTH Aachen University also raises the question of how campus development clusters in Aachen West or Aachen Melaten function detached from the innercity campus.

RWTH Aachen University is a constantly growing group of new faculties and comprised 32,240 students in the winter semester 2010/2011, which has now increased to 45,628 students in the current winter semester 2019/2020. (RWTH Aachen University 2020)

Particularly in so-called university cities such as Aachen, the university is the largest employer and closely interwoven with the city. But campus expansions are increasingly being relocated to peripheral locations, which means that the city loses the positive influence of demographic change and thus also part of its identity as a university city.

Another question that can be derived from this aspect is the question of if a university in its function as an economic real estate player and employer would not have to intervene much more strongly with its campus development in the context of urban development in order to do justice to its identity-forming role?

An example of this would be the campus developments at RWTH Aachen University. With its newly built research clusters on the Melaten campus, the university has moved away from Aachen city centre. But RWTH Aachen University is continuing to expand, and in June 2018 it purchased the Aachen West area, a disused railway area at Aachen’s Westbahnhof station. The university now has the opportunity to build a completely new campus in the link between the original inner-city Mitte campus and the new Melaten campus, and to build a new piece of the city as a developer, so to speak.

RWTH Aachen University will thus not only become one of the largest research campuses in Europe, but will also have the opportunity to connect its campus areas. In contrast to the campus development in the Melaten area, the goal was once again defined: not only to create more university and research clusters that are completely empty at night as on the Melaten campus, but also to revitalize the west campus with housing, shops, restaurants and cultural offerings. The question that now arises is whether RWTH Aachen University will be able to create the so-called 24-hour campus and if it creates an integrated new urban quarter with the campus.

Furthermore, the question arises if an integrated urban district is created when living on the campus is only planned for students or university members. On the one hand, this would create a ghettoising, planning definition, while on the other hand, it would help to tackle the acute housing shortage for students. However, in view of the prospect of the Re-Mixing City, an attractive residential area should be created on campus for all parts of the city’s population to ensure that this part of the city is not only busy during the semester.

5 CONCLUSION

In summary, the first results of the campus analysis in Milan, Zurich and Aachen show the aspect of a re-mixing city. An essential component of a functioning, high-quality campus structure is the integration of mixed use. City and campus development must be thought and developed together so that they are positively interlinked. The campus must be designed like a piece of quality city and not like a collection of faculty buildings that seem abandoned at night.

The often mentioned and demanded 24-hour campus is based on exactly this model of mixed use. It is especially the main attraction of living that leads to a 24-hour revitalization of a campus area. A positive side-effect of the residential use is a public transport connection that must be guaranteed 365 days a year, whereby learning rooms and, for example, sports facilities on the campus are also well connected at weekends.

Through a connection with gastronomy, utilities and cultural offers, living on the university campus itself becomes an attractive area of public life and is included in the urban space.

This makes it clear that living is the guarantee for a 24-hour lively quarter and that this aspect should be taken into account in new campus developments or extensions. Regardless of whether it is an inner-city campus area or a spin-off, the remixing city aspect is essential for a qualitative atmosphere on the campus. From an inner-city point of view, the campus must be seen as a piece of the city and try to develop it further in a peripheral location, otherwise industrial area-like structures will be created and the homogeneity of the campus landscape will break up urban structures or prevent them from being created. It is precisely this homogeneity of a single use that is responsible for the creation of a ghost campus, where after the end of lectures and on weekends areas lie fallow and the potential of urban building blocks is not used.

This aspect leads to a further analysis result, the residence areas. As banal and simple as this aspect may seem, it is also decisive. The aim is to increase the quality of life on the campus. Because it is precisely the intermediate areas between the lecture hall and the seminar rooms that allow time for creativity to develop and create space for encounters. It is about creating a campus where people like to be in the city and even spend their free time. Because this is the breeding ground for new ideas, initiatives and start-ups. Various studies show that boredom promotes creativity and how important it is in the development of children to awaken their own creative will and fantasies. Large corporations have also taken this insight on board and create consciously atmospheric lounges and areas to stimulate their employees' idea development through brief relaxation phases. The campus therefore needs areas where people like to get bored and simply linger. Today's working time models are becoming more and more flexible and longer, so places to relax on the campus are essential, and it is also essential to offer catering in the later evening hours. It is not acceptable that elitist research is carried out on the university campuses of today and that new research clusters are constantly being created, but that the essential infrastructural aspects of daily needs do not grow with them.

This aspect also leads to the third result of the analysis, the external space / interspace. What may have been simple pathways or traffic areas in the past is now used much more naturally as outdoor space. Public places, but also open staircases are becoming meeting places and recreational areas in public urban space. The outside space is getting prominent. Since working and learning is no longer limited to libraries or power connections due to the progressing technology, this is now possible on the entire campus and especially in the outdoor areas. Some university campuses have managed to create and secure atmospheric outdoor spaces or even green spaces, but many campuses are an accumulation of different solitaires from different decades. The challenge now is to combine them into an atmospheric campus by upgrading the exterior and intermediate areas and creating recreational spaces.

These initial results of the analysis will serve as basic building blocks for the design guidelines and will provide a more in-depth analysis of how the different university cities deal with these issues. Country-specific planning ideas and approaches on the urban planning level will be considered and worked out in further steps in order to create a design guideline for inner-city campus development as an objective and imlication of research.

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Campus Sustainability Appraisal in Nigeria: Setting up Sustainable Attributes for Higher Educational Institutions

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1 ABSTRACT

Sustainable campus development has gained the attention of several policymakers and urban planners within the past decades with different campuses across the world claiming to be sustainable or have adopted initiatives of becoming sustainable. The different tools for assessing sustainability in higher education cannot be utilised in all institutions across the globe due to factors such as regional variation. This paper established and formalised a systematic approach to comprehensively review sustainability indicators identified in 13 campus sustainability assessment tools. Thereafter, Twitter social media and an online big data analysis tool were utilised in selecting environmental-based sustainability indicators for higher educational institutions in Nigeria. The rise in the use of social media amongst tertiary institution stakeholders ensures that a better understanding of environmental challenges can be derived from the perspectives of these stakeholders. The findings from the comprehensive review of the selected 13 tools reveal that there are variations in the sets of their sustainability indicators and selection process. None of the tools have compatible indicators for campus sustainability appraisal and none of the tools utilised social media and big data technology to arrive at the adopted set of indicators for their appraisal framework, threshold, and rating. We identified energy, environment, transport, infrastructure, waste, and water as the major categories for sustainability indicators in Nigeria. The current research gap identified from literature strongly justifies the purpose of this study that setup sustainability indicators that are peculiar to tertiary institutions in Nigeria that will bring about an appraisal framework and also give room for campuses to compare their sustainability performance and interchange of standard practices.

Keywords: Elastic stack, Campus sustainability, Social media data, Nigeria, Sustainability indicators

2 INTRODUCTION

For several decades, campus sustainability appraisal (CSA) has been identified as a paramount initiative in different academic disciplines such as urban planning, urban design, environmental design, landscape architecture, social sciences, and others. Research on CSA differs based on methodology, aim, objectives, nature of the study and the local conditions of the location where it is being carried out. Different researchers in academic fields have an interest in multiple aspects of CSA, therefore its implementation has been initiated, conceived and measured differently over time. While some scholars are interested in the appraisal of sustainability courses in tertiary institutions' curriculum, research, scholarships, and campus operations; others are paying attention to sustainability accounting and outreach to the larger society. According to Sonetti et al. (2016), CSA “have been used for more than a decade, as tools for identifying best practices, communicating goals and experiences, and measuring progress towards achieving the concept of a sustainable campus” p.2. A sustainable university is defined by Velazquez (2006) as ‘‘a higher educational institution, as a whole or as a part, that addresses, involves and promotes, on a regional or a global level, the minimisation of negative environmental, economic, societal, and health effects generated in the use of their resources in order to fulfil its functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable lifestyles“p.30.

Different scholars at university, non-governmental, country-level in addition to the United Nations Environment Programme (UNEP) have established toolkits, ratings, models, frameworks for CSA as a tool to evaluate the level of environmental, social, economic and institutional sustainability in higher educational institutions (HEI) campuses. In such an appraisal, the first task is usually the identification of the various dimensions and attributes of the CSA in HEIs settings. In general, the CSA attributes are categorised into main criteria, sub-criteria, and indicators. The hierarchy and number of CSA criteria and indicators specified and addressed in different tools are numerous and differ from framework to framework. However, despite various definitions of CSA, a larger percentage of researchers in the area of campus sustainability tend to

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always conduct their studies with the approach that the CSA framework is multidimensional. They also agree that CSA tools have subjective and objective attributes and that these should serve as the foundation of CSA as a whole.

CSA studies in HEI campuses have been driven by the United Nations Environment Programme, Education for Sustainability Development Innovations Programmes for Universities in Africa (Lotz-sisitka 2013) and many more. This trans-continental, extensive development and utilisation makes the CSA an effective, useful and practical approach of measuring and rating the impact of campus developmental and sustainability policies. As a result, CSA can be referred to as a pragmatic tool that gives a broad base of information for HEIs authorities, administrators, campus planners, and local policymakers. For instance, the outputs of CSA exercise can be utilised by HEIs policymakers to evaluate the accomplishment of their policies and action plans. The appraisal of sustainability at the HEI level can also be perceived as a way of monitoring changes in HEI stakeholders' view of the level of importance for improving campus life and direction for future development in developing nations like Nigeria.

Nigeria is a country located in West Africa with huge crude oil and gas reservoirs and is among the countries with the highest Gross Domestic Product (GDP) in Africa. The country was transformed from an underdeveloped sub-Saharan African country to a powerhouse in Africa mostly due to huge revenue from the sales of crude oil. The spontaneous development of university campuses to meet the demand of the huge population of the country and the migration of people from the hinterland to the urban centre for the acquisition of higher education degrees had led to the difficulties of initiating and implementing new and adequate facilities and infrastructure. These challenges have been creating some significant impacts on the people residing within these HEI campuses and their environs. Urban planners and government officials have been formulating plans and policies to curb these challenges without any significant improvement leading to the need for CSA research. In approaching these challenges, there is a need for the establishment of an assessment tool/framework for the appraisal of campus environmental development within the HEI campuses in Nigeria with a corresponding policy manual on campus environmental sustainability. To achieve these enormous tasks, there is a need for setting up sustainable appraisal indicators that are in line with the situation on campuses within Nigeria.

Despite the high investment in planning, designing and establishment of HEI campus across the geopolitical zones in Nigeria, there is an absence of metrics to appraise the environmental sustainability of these campuses for adequate quality of life. A comprehensive review of the literature reveals that studies using social media data and or big data analysis tool to ascertain the peculiar sustainability indicators of the region where CSA techniques are being implemented has not been conducted before. Despite the focus of some of the targets of the Sustainable Development Goals (SDGs) on information and communication technology (ICT), it can be observed that this has not been fully implemented. This study utilised a technology-driven (open-source software and social media data) methodology that bridges the gaps in existing research and produces an outcome that has the potential of ensuring liveable campuses and cities for all. The findings of this study are also very useful for all professionals in the built environment as well as researchers in the area of sustainable and green campus planning. It will also serve as the foundation for studies, projects, and research on CSA in Nigeria HEI campuses.

3 LITERATURE REVIEW

3.1 Social media Data and Campus Sustainability Appraisal Research

The social media has completely changed the way people communicate within the last decade. Different social media platform provides a huge volume of information which has led to a new field of research known as big data. Researchers are now relying on a large amount of data from various social media channels to conduct social science projects rather than wasting huge financial cost and time on ethnographic trips, questionnaire survey or interviews. This is because the social media is currently the most preferred means of communication which do not restrict the users the expression of their feelings within their comfort zones and available time, unlike conventional survey and interview that will require that the interviewer book an appointment with the interviewees or encroach on their privacy and busy schedule. At present, virtually everyone with access to the internet has at least a social media platform for interacting with family and friends, colleagues, groups, news channels, organisations, politicians and institutions administrators.

Moreover, social media is now gradually eliminating the print media, television channels, and other media channels. There are currently more than 2.82 billion of the world population with internet service on social media making social media one of the highest means of communication and sharing of online information (Pitrov and Krejˇ 2019). The increase in the use of social media can also be related to the wireless internet connection to tablets and smartphones which are easy to move around and easily accessible unlike laptops, personal computers, and desktop computers. The connection of the internet to different devices is no more a daunting challenge in the current age and time in most developed and developing countries of the world.

The social media is now transforming communication from physical (face to face) interaction to virtual interaction on different electronic gadgets. The dramatic decrease in the price of electronic gadgets and a corresponding increase in the performance of software/hardware, wireless connection, computer processing unit and application that is being witnessed across the globe have given rise to the concept of social media big data analytics and artificial intelligence. This has also led to the implementation of projects in various fields like transportation, e-tourism, e-commerce and construction and environment. Presently the huge volume of social media data mined by different researchers, analytic companies and institutions are much easier to clean, filtered and interpreted in different cloud storage environments to bring about new services or approaches to conduction business or designing transportation route, etc. These new discoveries emanating from the use of data from social media is opening new commercial, investment, sustainable planning and construction opportunities. The era of experiencing difficulties with the storage of a huge volume of social media is gone as there are several cloud storage environments that can be utilised for free or via the payment of subscription fees. Now, the vital aspect of the social media big data research is the development of models, framework or logical approach towards efficient utilisation of the data to bring out excellent outcomes.

In the nearest future, there is a high tendency for the adoption of social media data in several fields will escalate. A comprehensive review of literature on tools and framework for the assessment of sustainability in HEIs across the globe reviews that the utilisation of social media data is lagging. Studies conducted by Carpenter et. al., (2016) and Hamid et. al., (2017) recommended the promotion and the awareness of social media roles in sustainability in higher education. This study seeks to bridge this gap identified in the existing literature and advanced the studies of environmental sustainability in Nigeria higher education with the incorporation of social media data. Currently, there are several conferences, workshops, and seminars on several social media research outcomes. Although, there are difficulties with the use of social media data for conducting different types of research, the most prominent one is the trade-off between privacy and utility. The difficulties of accessibility and privacy were eliminated in this study by obtaining a Twitter developer account application as well as the use of a Python 3 library in addition to a complementary codes/command lines for accessing old Twitter data.

3.2 Elastic Stack for Campus Sustainability Appraisal Research

The three powerful online open-source software for a huge volume of data analysis from single or multiple sources which are (i) Elasticsearch, (ii) Logstash and (iii) Kibana are jointly referred to as Elastic Stack. Each can work independently but more reliable and efficient when incorporated together. The Elastic stack is designed to work as a software as a service but it can also be used on other premises/platforms (Bajer 2017). The first plugin-based which is known as Logstash is designed to mine different or single data source in the form of HTTP API, CSV file, etc. once or simultaneously; and thereafter, to modify and transfer the data to other software, devices or plugin-based features (Bajer 2017). The mining and transformation of data takes place usually in a three-phase process of (a) inputs (b) filters and (c) outputs. In most cases, the filtered data are shipped to Elasticsearch despite having the power of sending the processed data to other database or analytics algorithms. The second which is called an Elasticsearch performs simple and or complex search operations such as query in newline delimited JSON, statistical and CRUD (create, retrieve, update and delete) operations. The third powerful tool called Kibana is a visualisation internet-based platform for analysing, searching and viewing data that are contained in Elasticsearch assemblage.

In summary, Logstash can be referred to as a collecting and parsing tool; Elasticsearch, a storage, and searching tool while Kibana is a visualising tool. A fourth product known as Beat has been recently added to the stack. A comprehensive review of the literature shows that the integration of huge open source and commercial data sources, user-generated content on a various online platform, Internet of Thing (IoT) data,

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energy data, and open government data via the use of Elastic Stack for resolving different commercial and development projects have been conducted. Findings from this review reveal that the utilisation of these three online tools and technologies is lagging in the projects, studies, and research on CSA. None of the 13 CSA tools reviewed in this study utilised this software in mining, filtering or visualising social media data for conducting and implementing sustainable or green campus research.

3.3 Measuring Sustainability in Campuses: Indicators and Categories

Although there are several appraisal tools for measuring the level of sustainability in different parts of the world, it has been observed that a common approach of assessment exists among these tools. Assessment via the use of indicators remains the most widely adopted approach by many scholars in the field of sustainability in higher education (Alshuwaikhat et. al., (2017). CSA indicators can be regarded as the paramount component to be considered when conducting an appraisal of HEIs sustainability performance. This is due to their provision of reliable, useful and relevant information on specific attributes of HEI campuses. However, virtually all the CSA tools have a framework that is based on hierarchy in such a way that assessment indicators are categorised under criteria, dimensions, modules, aspects, principles, strategies, etc. A comprehensive review of 13 documents of the existing CSA tools reveals that there are diverse approaches to classifying the adopted indicators into a hierarchy. Findings show that three CSA tools adopted the criteria approach, five adopted the categories approach, two adopted the strategies approach and the remaining adopted the module, dimension, and principle approach each. In addition, a review of several works of literature on the subject of sustainability in higher education also shows that different scholars come up with a diverse classification of assessment tools into indicators as well. For instance, (Alghamdi et. al., (2017) adopted the hierarchy of assessment tools into criteria.

Also, there are multiple approaches that have been adopted by scholars in selecting suitable indicators for the development assessment tools for appraisal purposes. The two most widely adopted approaches are theory-driven and data-driven. Other approaches include but are not limited to policy-driven, reference values for indicators, ecological-based and spatial based indicators (Niemeijer 2002). The theory-driven approach to selecting indicators for sustainability assessment is based on the selection of sustainability indicators that are in line with a certain philosophical approach or theoretical framework. On the other hand, the data-driven approach is based on the availability and ease of accessing reliable and relevant sustainability data. It was discovered that the most widely adopted approach is data-driven.

A comprehensive review of 13 CSA tools shows that seven of these tools did not provide an explanation of the selection criteria for the adopted indicators. One of the tools adopted a subjective view of what the developers of the tools feel appropriate for sustainability in higher education with yearly modification. Another arrived at the adopted sustainability indicators for their tools by modifying the sustainability indicators contained in the Global Reporting Initiative (GRI) Sustainability Guidelines and thereafter validate the selected indicators at workshops on sustainability in higher education. The remaining two CSA tools conducted a comprehensive review of existing tools to extract sustainability indicators, thereafter adopted and developed a convenient filtering process for the selected indicators. After the filtering process, their final selection of indicators was concluded with the local expert analytic hierarchy process (AHP). It was observed that despite the involvement of local experts in the process of indicators selection by two of the existing CSA tools, none utilised the social media data, big data analytics tools and wide coverage of local stakeholders in HEI in arriving at the selection of sustainability indicators for their appraisal process. As such this study was designed to fill the existing gap in the literature. The next section presents the methodology adopted for this research.

4 METHODOLOGY

There are many well-known established assessment tools with the tendency of witnessing more in the coming years. After conducting a comprehensive review of extant literature, several CSA tools were studied and examined. However, the selected tools for this study were selected based on the following criteria: (1) they are all available in the English language and easily accessible on the internet. The tools that were identified but not written in English such as one developed by the German Commission for UNESCO was excluded from the list. (2) they are indicator-based appraisal frameworks. The selection of tools based on indicators was because they provide platforms for easy measurements and comparison. Appraisal tools based

on narrative assessment and an account of sustainability status were excluded. (3) they are developed specifically to be utilised in HEIs. These tools are mostly addressing specific requirements within HEIs campuses. (4) they are not designed for individual tertiary institutions but rather for institutions at either global, continental, regional and national level, and (5) their design approach, structure, background information, adopted criteria and indicators are all available in the form of either a technical manual, reports, documents or articles. Those tools that are online-based or well-known (such as The Green Plan and Benchmarking Indicators Questions – Alternative University Appraisal) but without their reference sources were excluded.

The comprehensive list of sustainability indicators that are peculiar to HEIs across the world was carried out by identifying and extracting all the various categories, indicators, and sub-indicators in the 13 CSA tools. A total of 55 categories, 220 indicators, and 266 sub-indicators were successfully identified (see Table 1). Thereafter, the indicators were subjected to exclusion criteria to ensure that the indicators that are only relevant to the scope and focus of this study were identified. The focus/scope of this study is on campus-wide (spatial) planning and measurable environmental pillar of sustainability that affect HEIs campuses in Nigeria. This is because HEIs campuses in Nigeria have substantial geographical areas (Adeniran, 2015; Adeniran, 2014) with severe impact and certain campus spatial data could be extracted without reliance on official data. The study also focuses on environmental and spatial-based indicators due to an increase in spatial decision support systems research which has not been extensively covered in campus sustainability research. As such, all the indicators that focus on aspects such as sustainability curriculum in HEIs, socio-economic sustainability and accountability and many more were excluded from the list.

CSA Tools	Version Reviewed	Categories	Indicators	Sub-indicators
Sustainability Assessment Questionnaire	2001	7	-	-
Graphical Assessment of Sustainability in University	2006	4	8	59
Sustainable University Model	2006	4	23	-
University Environmental Management System	2008	3	8	23
Assessment Instrument for Sustainability in Higher Education	2009	5	30	-
Unit-based Sustainability Assessment Tool	2009	-	9	-
Three dimension University Ranking	2009	3	15	-
DPSEEA-Sustainability index Model	2011	5	20	56
Graz Model for Integrative Development	2012	5	15	-
Sustainable Campus Assessment System	2013	4	25	34
Adaptable Model for Assessing Sustainability in Higher Education	2014	3	9	25
UI's GreenMetric University Sustainability Ranking	2019	6	39	-
Sustainability Tracking, Assessment and Rating System	2019	6	19	69
Total		55	220	266

Table 1: Overview of the 13 CSA tools analysed in this study

The stage that follows merged all the repeated indicators and then structured the reduced lists into only two hierarchies. This was done to eliminate the challenges of users of the proposed appraisal model of not being able to understand or utilise it due to complexities. For instance, (Lozano 2006) observed that the GRI indicators are too large and made it difficult for benchmarking and longitudinal comparison. In the process of structuring the sustainability indicators to fit the scope of this study, the authors carried out minor changes although the categorisation adopted in the 13 CSA tools was taken into considerations. The uniqueness of each sustainability indicator was investigated based on their operational definitions. This was considered to eliminate the challenges of differences in defining and measuring the indicators across the selected tools. Finally, the remaining indicators that are in line with the scope of the study were used as keywords to filtered the Twitter social media data that were mined from twitter handles of 142 Nigerian universities (34 Federal, 44 states and 64 private).

In ensuring that scholars conducting studies on big data and machine learning related topics, Twitter, Inc. made available data that the users have decided to release with people from around the globe for researchers

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after an application is granted. At the initial stage of this study, Logstash was utilised to extract tweets from Twitter via Twitter Application Programming Interface (API). After several attempts without substantial data, a Python 3 library (GetOldTweets3 0.0.11) in addition to specific command lines and a specific timeline was used to mine around a million tweets in CSV format from 142 universities in Nigeria. Thereafter, Python 3 library was utilised again with another set of command lines to ensure piping to another file in nlJSON format and run yet another command (Logstash: configuration file to cloud with key). This was because the CSV file format extracted data are not in the proper configuration for data analysis. Then, Logstash was used to feed the mined data into Elasticsearch for data cleaning while Kibana was used for data analysis. As for the identification of indicators for sustainability peculiar with Nigerian HEIs, the approach adopted at this stage of the study is the identification of tweets that contain the environmental-based sustainability indicators that are line with the scope of this study. The final filtering/selection process in ensuring that only tweets containing the targeted indicators were carried out on the Elasticsearch interface, Elastic Stack 7.5.0 version.

5 RESULTS AND DISCUSSION

Table 1 shows the displays of the breakdown of the selected 13 CSA tools. While the oldest version of the reviewed tool was designed in 2001, the latest version of the tools was modified in 2019. The categorisation of the indicators and sub-indicators into categories and hierarchies varies across the tools. The adopted indicators and sub-indicators amongst the tools also diverse from the indicators ranging from 8 to 39 while that of the sub-indicators is from 0 to 69. While some of the tools were designed solely for indicators, others are established with the classification of the indicators into categories. The remaining further sub-divided the indicators into sub-indicators. However, it was observed that one of the tools was designed as a questionnaire survey classified into seven categories. There are 55 categorisations of indicators across the 13 tools of which no single categorisation was used in all the tools and more than 10 categories were used in only one tool. This vividly shows a lack of uniformity in the categorisation of indicators across the CSA tools. Similar variations are observed in the adopted indicators and sub-indicators. This finding is interesting because most of these tools are developed and utilised mostly by the campuses of higher education in developed countries with closely related values. The authors are of the view that these variations are due to the tools differences in scope as well as accessibility and availability of data on selected indicators. The comprehensive review of the 13 tools reveals that the majority of the tools are establishment based on the availability of sustainability indicators for the appraisal process and not on the basis of public participation via social media. Although two of the tools invited local experts' contributions in the selection of indicators for these tools, only one reported that eight local experts were involved which is small and cannot be regarded as being representative enough.

The filtering process towards the identification of peculiar sustainability indicators for the establishment of the appraisal model and evaluated started with removing all indicators and sub-indicators with their categories that are not campus-wide, spatial and environmental in nature. This led to the reduction of the attributes to 13 categories, 50 indicators, and 66 sub-indicators. At the end of this stage, there are campus-wide, spatial-based and environmental indicators that could (i) not be measured (ii) repeated across the tools and (iii) too generic and complex for sustainability appraisal. This led to another round of filtering that reduces the categories to seven (i.e., operations, environment, setting and infrastructure, energy and climate, waste, water, and transportation) and 29 indicators. After the identification of indicators that are in line with the scope of this study, the indicators were then validated to the case of universities in Nigeria. Rather than relying on validation of the indicators by consulting members of Nigerian university management, administrators or local experts in the area of a sustainable campus, validation based on social media was utilised in this study. When the seven categories were used as keywords to determine their peculiarity with the situation in Nigeria, six unique categories were finally identified. They are (1) environment (2) infrastructure (3) energy (4) waste (5) water and (6) transportation. On the other hand, the 29 indicators were reduced to 11 unique indicators peculiar to HEIs within the context of Nigeria. The data from twitter social media shows that the HEIs stakeholders in Nigeria did not discuss and pay attention to the issue of campus operations, settings and climate. Table 2 shows some indicators which relate to the planning and management of campus functions and space, thus have a spatial dimension. It indicates how GIS and 3D modelling software can assist in measuring the spatially-related indicators that have been compiled from the 13 existing CSA tools and validated to the case of Nigerian HEIs.

	Category	Indicator	Role of Spatial-based Software in Indicator Measurement
1	Energy	Energy consumption	quantity of electricity per source, area and percent of buildings that generate greenhouse gases
		Greenhouse gas emissions	
2	Environment	Open space area	area and percent of land use, acreage of green area, acreage of landscape area
		Forest vegetation	
		Landscape	
3	Infrastructure	Buildings	area of buildings
4	Transportation	Campus fleet	length of walkways, bicycle lane, and communication route
		Pedestrian and cycling	
5	Waste	Waste management	quantity of waste per source
		Sewerage disposal	
6	Water	Water consumption	quantity of water per source

Table 2: Spatially related indicators for assessing campus environmental sustainability

6 SPATIAL-BASED INDICATORS IN THE CASE OF NIGERIA

The use of campus-wide, environmental and spatial-based indicator framework in the case of Nigeria will provide an accurate and spatially referenced data set that will act as a fact-based establishment for the decisions that are required to be carried out to achieve a sustainable campus for both present and future generations. As Nigeria moves forward with ensuring to create a more sustainable regional development across all regions where the current generation can meet their needs without compromising the ability of the future generations to do the same, the swiftly expanding HEI campuses across the country are becoming the centre of attention due to an increase in demand of staff and students, energy, waste generation, housing, etc.

Given the national increase in the number of universities and colleges in Nigeria between 1990 to 2015, many considered HEI campuses to be the epicentre of several challenges. Despite these challenges, campuses provide a better life and economic chances for many stakeholders. Herein lies the opportunity to look at campuses afresh and to shift the focus of their development and assessment to a spatial-based model.

In Nigeria and other developing countries, access to data is very difficult, thus undermining the conduct of sustainability assessment. After review of literature, it became apparent that there is no use of 3D and spatial-based technology by decision-makers to assess campus sustainability as well as the creation of a more sustainable campus policy based on those assessments. However, with regards to measuring the indicators for environmental sustainability and conducting the assessment, the GIS-based approach can play a vital role. A campus-wide and spatial-based integrated framework can be primarily used to assess campus operations and management as this dimension of sustainability consists of spatially related indicators. As such, a Cityengine and other conventional 3D modelling software database should be developed for the indicators after which sustainability assessment can be easily conducted. When remote sensing images are incorporated into the 3D modelling software database, it can facilitate the extraction of data from satellite sources. These spatial data can then be used to measure some spatially-related indicators. Because indicator selection is context-dependent. In this study, the selected indicators are prioritised due to local context via the use of Twitter social media.

7 CONCLUSION

This paper established and formalised a systematic approach to comprehensively review the level of sustainability indicators identified in 13 CSA tools. Thereafter, Twitter Social Media and an online big data analysis tool (Elastic stack) were utilised in selecting environmental-based sustainability indicators for universities in Nigeria. The findings from the comprehensive review of the selected 13 CSA tools reveal that there are variations in the sets of their sustainability attributes and selection process. None of the tools have compatible attributes for campus sustainability appraisal and no different tools can assess the level of sustainability across university campuses with the same appraisal framework, threshold, and rating. This strongly justifies the purpose of this study that calls for the adoption of setting up of environmentally-based sustainability attributes that are peculiar to the geographical locations with similar challenges and

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requirements that will bring about an appraisal framework that gives room for campuses to compare their CSA performance and interchange of standard practices.

The outcomes of this study have some pragmatic implications for scholars in the field of CSA. It also reveals how projects dealing with the identification, setting-up and developing CSA in developing and developed worlds can be enhanced. Firstly, this study shows that CSA attributes should focus more on the needs, preferences and the level of importance that the stakeholders within which the appraisal will be conducted rather than a comprehensive or long list of indicators based on developers' opinion. The comprehensive review of the 13 CSA tools reveals that there is no strong justification between the set of attributes adopted by each of the tools and their corresponding scope (the local area where it will be implemented). Findings from the literature also classify CSA tools with a long list of sustainability attributes as being complicated and difficult to use for users. Hence, this study established well-balanced sustainability attributes that are peculiar to the end-users and their campuses.

Secondly, the hierarchy of the CSA framework should not be extensively long and detail. Two-level (i.e., categories and indicators) makes it convenient and efficient to conduct a level of importance of the attributes using approaches such as the AHP and social media-based campus sustainability indicators preference model. Multiple levels will make the assessment process become complicated and difficult for adoption by other scholars. Thirdly, scholars conducting the setting-up of CSA attributes should ensure that a wide range of all environmental and spatial-based sustainability attributes was first considered before finalising the final set of indicators that meet the need of their study's scope, aim, and objectives. Selecting the adopted indicators without an initial full range coverage might introduce some scepticism in the final output of the appraisal.

Another finding of our research that has implications for CSA studies is the fact that setting-up or establishing a set of CSA indicators to be adopted for the specific geographical unit does not necessitate the development of a completely new set of indicators. Rather, they should be established by studying a comprehensive list of existing attributes and modify them to suit the new scope based on the requirements of that geographical region. How GIS, City Engine, and 3D modelling software based sustainability assessment for academic campuses and demonstrating its uniqueness as compared to other campus sustainability assessment frameworks and approaches was also discussed. For the said purpose, Geographic Information Systems will be used to develop a campus sustainability model within its sphere of operations. The use of GIS and CityEngine is primarily due to its application and ability to incorporate huge datasets within its program. Secondly, it has made more infiltration, than any other spatial application due to the increased awareness among policy and decision-makers to rely on these systems for public policy formulation. GIS, a computer-based system, can process the data from a variety of sources and integrating it with the geographical location while providing the user or the decision-maker with the information necessary for making informed decisions (Han and Kim 1989).

Lastly, the outcomes of this study show the importance of utilising social media data and Elastic Stack as a reliable, more efficient and intelligent way for selecting and setting-up CSA indicators for university campuses in both developed and developing countries. The approach as well as the findings of this research display paramount contributions that bridge the identified knowledge gap in the literature.

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Canberra – Cultural Controversies and Urban Change in a Capital City Region

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1 ABSTRACT

Making international headline news, the uncontrollable forest fires that have devastated much of Australia in the summer of 2019/2020 have added a dramatic sense of urgency to the focus of this paper on cultural controversies in Canberra – controversies that relate to key themes of the REALCORP 2020 conference: the links between climate change and immanent natural disasters; the problematic co-ordination of urban development among urban and regional authorities; the conflict-ridden connections between public planning and real estate interests; and the role of civil society in the urban transformation process.

The Australian Federal Capital has come a long way from its conception as a physical expression of parliamentary democracy designed in 1911 for a new, progressive nation, hailed at the time in Germany as 'The Social Continent.' Cultural controversies on ideals and issues such as urban vs. suburban ideal concepts, leasehold vs. freehold land, and welfare state politics vs. market-led development were reflected in the growth and change of the capital during the 20th century. By 1988, urban development under conditions of high planning control on leasehold land had led to the production of a city that could be summarized as 'a perfectionist garden city metropolis.'

This paper focuses on transformations that have eroded this ideal in recent years through a combination of dysfunctional inter-governmental relations, neoliberal policies, power plays among public and private actors, and superficial populism. In 1988, withdrawal of the Federal Government from most of its responsibilities for Canberra plunged the city into a fundamental crisis in term of its role and identity, its administration and its finance throwing up questions such as: Do we need a national capital at all? If so, which functions should the capital cater for? Should certain government departments be relocated to regional districts (preferably at the seat of the Federal politicians lobbying for such a strategy)? Does it make sense to maintain the ambitions the founders of Canberra had for creating a model city, 'The Pride of Time' or should Canberra pursue a path of 'normalization' by following the 'business as usual' pattern that characterizes urban development in most other Australian cities? Isn't public planning an expression of 'nanny state' ideologies anyway? And above all, how should the burden of national and local expenses for the capital be divided?

At the administrative level, Canberra was subjected to years of turbulent change, with negative consequences at many levels including poorly devolved responsibility for forest management. This contributed to the conditions for a devastating bush fire in 2003, a harbinger of the fires of 2019/2020, played out in a political climate of climate change denial. Establishment of new suburbs on the burnt-out western flank of the city, exposed to the same threat of wildfire as in 2003 are an ominous sign of a development ethos that has put real estate interests above sound planning principles. In another instance, independent review by the Auditor General of the Australian Capital Territory (ACT) exposed a serious "lack of transparency and accountability" in the way in which the ACT government mingled public and private real estate interests – an issue of continuing concern, particularly given the ACT's recent agreement to cross-border development on rural lands long-held by land owners in the state of New South Wales.

A core issue is that Federal Government divestment of all responsibilities beyond core national capital functions has meant that a substantial part of Canberra's local government revenue has been financed through the sale of greenfield land. Since this approach is unsustainable given the limited extent of developable land in the ACT, strategies have been adopted which have culminated in densification through high-rise luxury apartment blocks. The upshot has been an intense cultural controversy driven by a remarkably crude and aggressive campaign by local politicians in unison with one of the biggest local developers ridiculing the planning approaches of the past and literally smashing the long-established image of Canberra as 'The Bush Capital, ' a city oriented on the Australian landscape. Even the way in which the introduction of light rail is linked into this process does not come as the desired triumph of sustainability. One of the many issues there is that it is partly financed through the relocation of public housing to bushfire prone areas at the edge of the city. In the context of these cultural controversies, Canberra's civil society is beginning to raise its voice, but is still struggling to do so in a way that ensures more than sporadic victories.

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Keywords: Co-Ordinating Planning across Borders and Institutions, Climate Change and Natural Disasters, Planning and Real Estate Development, Transforming City Regions, Planned Capitals

2 CANBERRA – CULTURAL CONTROVERSIES AND URBAN CHANGE IN A CAPITAL REGION

2.1 Introduction – the significance of Australia, Canberra, the fires and the climate change debate

This paper begins with a perspective on the recent dramatic fires in Australia and its capital city. It does so not in order to wallow in sensationalism over the tragedy but to explore the significance of the cultural controversies confronting us in this context. These are controversies that relate to key themes of the REALCORP conference: the links between climate change and immanent natural disasters, the problematic co-ordination of urban development among urban and regional authorities; the conflict-ridden connections between public planning and real estate interests; and the role of civil society in the urban transformation process. These are themes that are confronting us on a global scale – in Australia no less than in Germany.

Uncontrollable forest fires burning in a continent at the other end of the world that made international headline news in the Australian summer of 2019/2020. Far away from the location of our Aachen conference, the bush fires were threatening not just any Australian city but Canberra, Australia's capital – a city that took pride in its name 'THE BUSH CAPITAL.' Even as the constant sea level rise diminishing the habitat of civilizations in the Pacific and elsewhere are continuing as silently as the expansion of the African desert, it was the roaring inferno of the Australian fires that added a dramatic sense of urgency to the threat of climate change – at least among those who believe that climate change is a reality.

The significance of Australia in the current international debate is that it has been the first country in which, in a short period of time, regions one third the size of Germany have gone up in flames killing dozens of people, destroying homes, leading to the possible extinction of entire species of animals and threatening the livelihood of the nation's big cities.[1] A dramatic wake-up call. Closer to the themes of our conference on planning and urbanism, the significance of Canberra lies in the fact that it directs our attention to the cultural controversies shaping the processes of urban and regional development.

Seventeen years before the current disaster, in 2003, Canberra had experienced a fire storm of similar ferocity, with 4 lives lost, more than 500 houses burnt and the historic Mt. Stromlo observatory destroyed. Built in 1924, the observatory had been part of the Research School of Astronomy of the Australian National University. Since its founding in 1946, the ANU has been a beacon of international research. In fact, research is one of the fields in which the small country with today 25 Million inhabitants has gained and maintained international recognition 'punching above its weight,' to quote a somewhat corny metaphor much used in Australia.

Research on climate change has been carried out at the ANU and in Australia's excellent national research organization, the Commonwealth Scientific Research Organisation CSIRO. But in the debate about climate change or global warming, its former professor of political studies and Chairman of the National Capital Authority, the body responsible for planning Canberra's areas of national concern, took a definite stand not long after the fires. Declaring himself an agnostic towards the findings of the Club of Rome, he urged everyone to 'keep a cool head' in the debate about the alleged connections between climate and 'the burning of coal and oil. ' Significantly, he did so in his address to the Planning Institute of Australia.[2] The following years saw budget cuts to the CSIRO which 'cut to the bone' of the organization's capacities for climate research.[3]

At the level of National politics, the Federal Minister Tony Abbott, later Prime Minister, has been quoted as saying that 'the science of climate change" was 'absolute crap'[4] and 'coal is good for humanity'[5] And at the level of symbolic Government actions, the enthusiastic advocacy of coal found its most curious expression in a spectacle staged by the then treasurer Scott Morrison. In order to demonstrate the innocent nature of the

[1] The fires in the Amazon rainforest are another tragedy of global dimensions.
[2] Aitkin 2008
[3] Duffy 2014. https://www.abc.net.au/news/2014-12-12/csiro-cut-to-the-bone-after-funding-cuts/5963994
[4] Yaxley 2017. https://www.abc.net.au/news/2017-10-10/tony-abbott-says-action-on-climate-change-is-like-killing-goats/9033090
[5] Anon 2014. https://www.abc.net.au/news/2014-10-13/coal-is-good-for-humanity-pm-tony-abbott-says/5810244

fossil fuel he took a lump of coal to Federal Parliament. The admiration of his party members would later propel him into his current office as Prime Minister.

As late as July 2019, Abbott proclaimed that there were no problems with coal, that indeed windmills were the 'dark satanic mills of the modern era. '[6]

Beyond the ludicrous spectacle at Parliament, where the unresolved climate change issue had led to chronic instability with six Prime Ministers succeeding each other since 2010, the processes in which new and expanded coalmines are allowed to operate are experienced as frightening. This is so not only because of the environmental damage but also because of the perceived reduction of civil liberties, in particular with regard to protest.[7] In a recent major development, a one-billion-dollar subsidy has been granted to Indian coal mining giant Adani for the construction of a railway line connecting the mine in Queensland to newly created port facilities near the Australian Barrier Reef. The links between national politics, the 'uncertainties for the longer-term outlook for coal exports'[8] and the alleged 'end of Australia's resources boom'[9] are all objects of controversial discussions in Australia.

We should not dismiss these developments as fringe phenomena with little relevance for Germany.[10] Siemens is right now selling its train signalling equipment to Adani in the face of international protest, obviously displaying a similar instinct for disastrous involvement with noxious industries as Bayer did with its purchase of Monsanto. Bayer is now facing enormous claims for compensation in connection with the use of Roundup (Glyphosat). And of course, we must not forget the piles of Australian coal on the wharves of Hansa Port, Hamburg, delivered to Germany, the 5th largest market of Australia, by the world's largest coal exporter.

The controversies around climate change and other global challenges are taking a significant share of the Australian public discussion in politics, academia, think tanks, and the media. The latest contribution is an open letter of 3 February 2020, signed by 274 climate scientists, which outlines the scientific basis for the links between climate change and bushfires in Australia.[11] The Murdoch Press, which publishes most Australian newspapers, has been propagating the view that 'it has never been shown that human emissions of

[6] Remeikis 2019. https://www.theguardian.com/australia-news/2019/jul/19/dark-satanic-mills-tony-abbott-continues-his-crusade-against-wind-turbines
[7] Gotsis 2015. https://www.parliament.nsw.gov.au/researchpapers/Pages/protests-and-the-law-in-nsw.aspx
[8] Cunningham et al.:2019, p.33
[9] Pearse 2019..
[10] Germany is the fifth largest importer of Australian coal. Australian Mining 2016. https://www.australianmining.com.au/features/where-does-australias-coal-go-infographic/
[11] Abram et al 2020. https://australianbushfiresandclimatechange.com/

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carbon dioxide drive global warming. '[12] The most important of its daily papers, *The Australian*, has engaged eminent figures such as geologist (and director of multiple mineral exploration and mining companies) Ian Plimer, who proclaimed 'There are no carbon emissions. If there were, we could not see, because carbon is black! '[13]

Cultural controversies such as these have always found their expression in the processes by which cities have grown, be it as a consequence of central planning or through incremental planning by individuals and groups. They can be traced from antiquity via the periods of the emerging industrial city through the transformations between the politics of the Welfare State to neo-liberalism, the age of modernism to whatever we want to call the phases coming thereafter.

3 CANBERRA

Similar to a majority of cities globally, planning discourse and politics in Canberra circle around themes such as: sustainability[14]; heritage and strategic planning[15] relating to fields such as urban renewal and densification; public and private transport[16]; and urban economics. As elsewhere, they are shaped by broadly-based cultural controversies such as those addressed in this paper.

Specific features of Canberra, a city of 460.000 in 2020, lie in its character as one of the great planned capitals of the 20th century and in its identity as a Garden City and 'Bush Capital.'[17] The term addresses Canberra's character as an inland city situated in the typical savannah landscape of south east Australia – the Australian Bush. Originally deployed in the early 20th century as an ideological expression of nation building and later as a shorthand formula for a low-rise 'City in the Landscape, '[18] the label of 'The Bush Capital' has become an object of serious cultural controversy in the last decade.

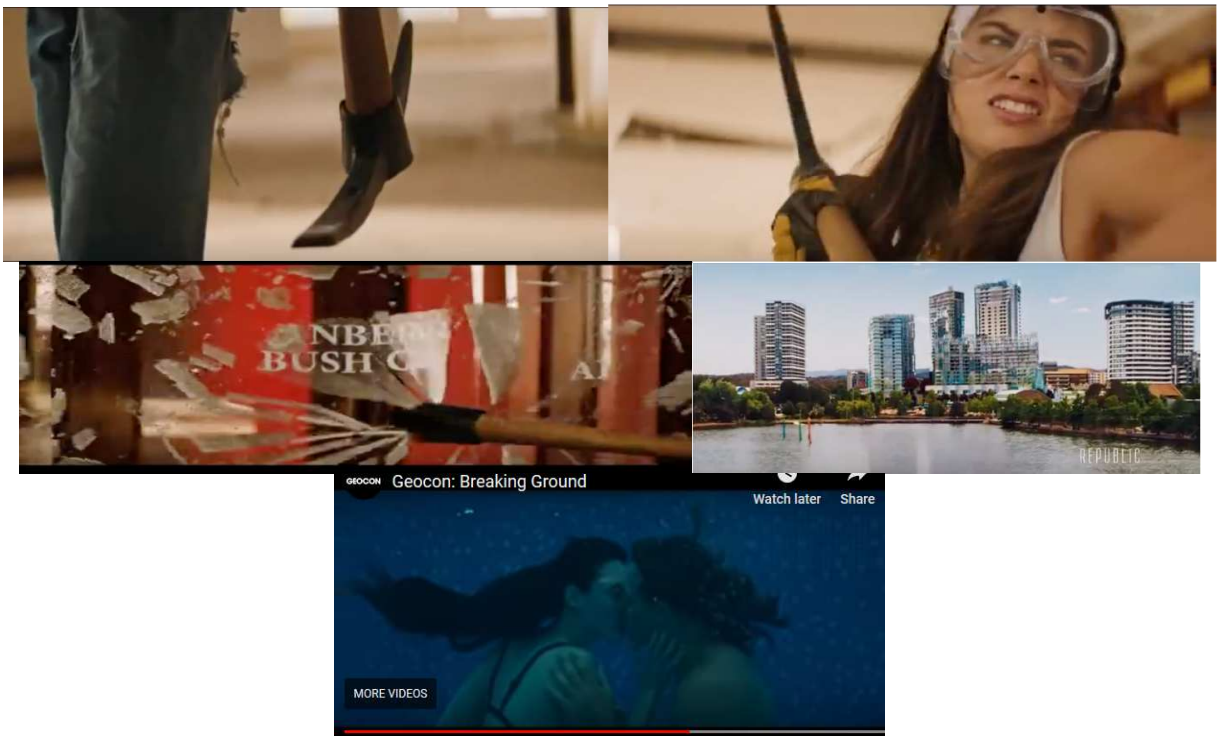
Remarkably aggressive strategies for re-branding the city and of transforming the image of Canberra from what is depicted as a boring garden city and 'bush capital' into an exciting metropolis of luxury high-rise apartments were set in motion in 2010 by a twitter campaign by the then Planning Minister Andrew Barr[19]. In this perspective, Canberra is depicted as the product of a quirky, out-of-date plan, an escapee from a Simpsons' Family cartoon, unfit for adaptation to today's challenges and defended only by senile locals above the age of 40 (incidentally Barr's age at the time).

Although internationally recognized as one of the great metropolitan plans of the 20th century[20], the 1911 design by Chicago architects Walter Burley Griffin and his wife Marion Mahony Griffin has locally been an object of cultural controversies and has been subjected to a remarkable mixture of iconic reverence, ridicule and crude exploitation as a real estate branding device.[21] While the competition drawings have been inscribed in the UNESCO memory of the world heritage, the endeavours to recognize the ACT as National Heritage as a necessary step for UNESCO world heritage, have been thwarted. Similarly, at the level of civil society, the success of community-based campaigns has remained limited. A case in point is the campaign to recognize the biophysical resources of the ACT as a UNESCO biosphere reserve. This was defeated by local commercial interests – a strategic defeat of the informed scientific basis of Canberra's society.[22]

The attacks on the Bush Capital image reached a climax in a 2019 video clip by one of the biggest real estate developers, GeoCon.[23] In the commercial, a young female athlete wielding a pick runs towards a sign inscribed "Bush Capital," her face contorted with disgust and anger. She smashes the sign. Immediately, the

[12] Gillingham et al 2017. https://climatefeedback.org/evaluation/commentary-australian-ignores-evidence-misrepresents-research-falsely-claiming-humans-not-responsible-climate-change-ian-plimer/
[13] Plimer 2019. https://www.theaustralian.com.au/commentary/lets-not-pollute-minds-with-carbon-fears/news-story/1a215e8b9d2d958f597654ea7b591bcc
[14] Fischer and Weirick 2014
[15] Fischer and Weirick 2018; Sinclair & Straw 2016
[16] Fischer and Weirick 2019
[17] Pegrum 1983
[18] Taylor 2006
[19] Barr 2010; Wensing 2013a
[20] Bacon: 'a statement of world culture'1968; Stretton 1970
[21] Stockland 2005; UDIA 2008, p. 79
[22] Wensing 2013b, Weirick 2018
[23] Geocon 2019

black-and white images of Canberra we saw before turn into technicolour; all around the lake, high-rise towers shoot out of the ground; sparsely dressed young people with champagne glasses in their hands jump in the pool to make love.



Above: screenshots from the GeoCon video "Breaking Ground" https://www.youtube.com/watch?v=rUJohv6hgEo below: Launch of Envie apartments http://www.canberratimes.com.au/story/5993525/snakes-alive-geocon-ups-the-ante-with-glamorous-launch-of-envie/]. Car: https://geocon.com.au/events-archive/high-society-vip-launch-event

The film sequence of the 'pick-runner' quotes the famous Apple Mackintosh commercial produced by Ridley Scott shortly after his film Bladerunner.[24] In Scott's 1984 spot, athlete Anya Major throws a sledgehammer into the screen on which Big Brother is giving a speech. Waking up, the moronic audience in front of the screen can now buy Apple instead of IBM computers.

[24] Apple 1984

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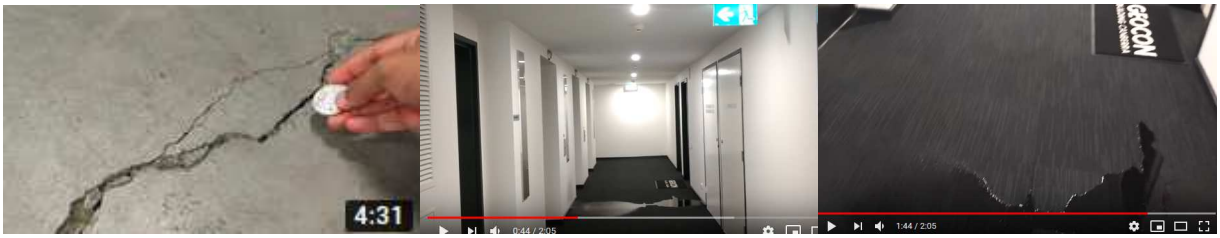
15 years on, people in Canberra wake up to realize that they need no longer listen to the fake news of the 24 hours news cycle as the gloomy voice of the narrator points out. GeoCon, so the film explains, have made their own market analyses and calculations. Thus the light rail introduced by the government in 2019, they were saying in another video, would connect GeoCon's Brave New World of luxury apartments in the nearby New Town with the City Centre in under ten minutes travelling time – in contrast to the transportation planners' assessment of a travel time of 25 to 30 minutes.[25] And the calculations appear simple and sure-fire: "When you buy off-the-plan at Metropol, you're buying today's prices; so in two years' time when it's finished, you've actually made money because the value of the property has increased."[26] The fact that it may not be wise to rely on such prognoses is evidenced by you-tube videos demonstrating that the newly erected luxury "Wayfarer" building was suffering from severe damage such as cracks in walls and floors and rain water leaks.[27]



These observations came at a point in time when the evacuation of the 35-storey Opal Building in Sydney was making headlines.[28] Shortly thereafter, structural damage in Sydney's Mascot Tower blocks sparked widespread concerns about new apartment buildings across the city. In Canberra, too, analyses indicated that "the overwhelming majority of high-rise apartment buildings… are likely to have major defects." With Canberra experiencing "its biggest housing boom since records began," it appeared that the territory's construction industry "had reached a crisis point."[29]

There is a close connection between high-rise development, real estate marketing, the transformation of the bush capital image, the (belated) introduction of light rail and the mode of financing the associated infrastructure. The inauguration of the first light rail line in 2019 was a success of sorts and was due in part to the new dynamic introduced in 2009 through a Labor-Greens political alliance. The results are nevertheless not broadly seen as the desired triumph of the persistent struggle for sustainability they might have been. The reasons lie in a combination of issues in the narrow field of transportation planning and the wider, more complex economic and urban development context.

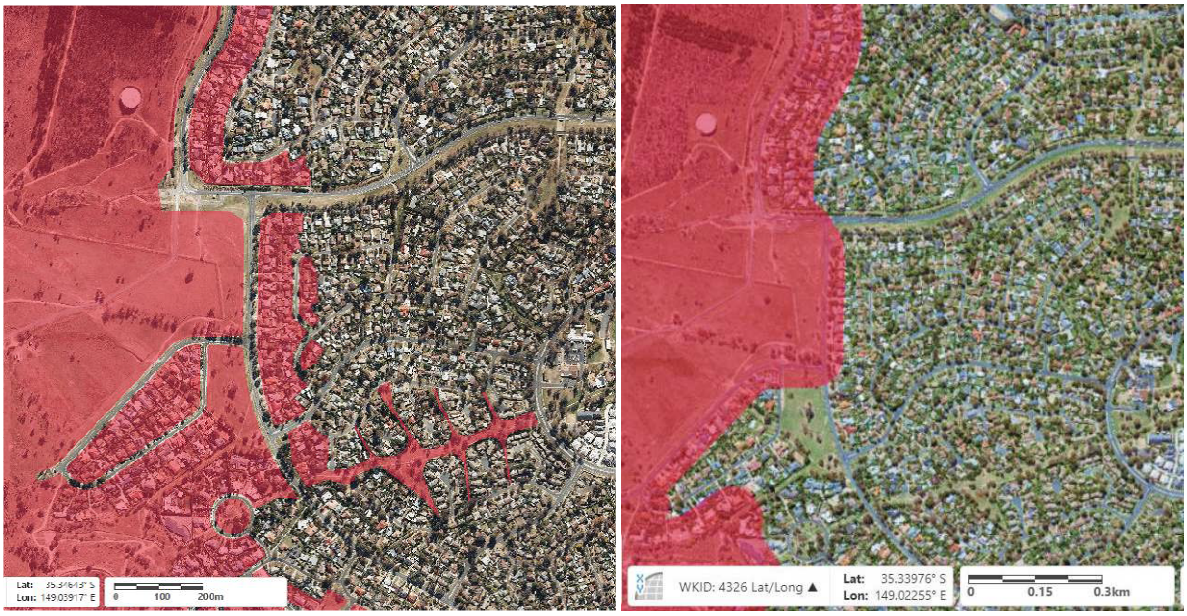
At the heart of this problematic lies the strategy of financing light rail infrastructure largely through the sale of government owned land occupied by public housing and through value capture from the new high-rise development, which will spring up on up-zoned properties along the light rail route. The focus on public housing land is not only a consequence of the fact that this is the major source of land over which the municipal government can dispose. Another important factor lies in a central (Commonwealth) government policy of rewarding the 'recycling of public assets' by awarding national subsidies. This is a major basis for financing light rail, which, as pointed out, is in turn a motor for urban renewal through high-rise tower blocks.

When the public housing tenants are relocated in the city, they are sent to locations not served by the light rail and in most cases badly served by buses, often far away from the inner city support structure in the form of job centres, help centres, cheap clothes shops etc. Among the locations where we find them are the edges of town, such as the city's western fire prone edge, exposed to the hot westerly winds, which carried the embers of the 2003 bush fires.

One of the sites we might look at was originally identified as definitely bush fire prone in the maps issued by the ACT Emergency Services. However, following the decision to relocate the public housing tenants to this

[25] Inman & Nowroozi 2019. https://www.abc.net.au/news/2019-05-20/canberra-geocon-apartments-light-rail-to-city-in-10-minutes/11128076. The video has since been removed from the web.
[26] Peppas 2017
[27] Trondhjem 2018 https://www.youtube.com/watch?v=Mnjqd0mYtx8
[28] Farrelly 2019. https://www.smh.com.au/national/welcome-to-the-faulty-towers-state-where-any-mug-s-an-engineer-20190117-p50s14.html.
[29] Jervice-Bardy 2019

area, the bush fire rating was changed. The public housing is now going to be behind a line deemed to be safe. It goes without saying that this did not convince the people concerned. One of the ironic comments was 'of course the fire knows it must not cross these lines. '[30]



These maps show the bushfire-prone rural area (pink) leading into the bushfire-prone suburban edge. The top image is from February 2017. The second image is the revised BPA[31] from June 2017. (Source: actmapi.act.gov.au)

In fact, the Canberra bush fires are magnifying the underlying conflicts and indeed highlight the way in which these are interrelated. While public protest about these issues is continuing, it is apparent that the public debate is far from uniform and reflects cultural controversies that have shaped the very specific situation of Australia's National Capital.

The following pages briefly sketch a selection of major cultural controversies in the history of Canberra to arrive at the current controversies and their expression in urban politics from the angle of the interrelated REALCORP themes addressed above. These controversies have had immediate and lasting consequences for Canberra's achievements as well as for the interrelated issues culminating in the fire disasters of the 21st century.

3.1 Cultural Controversies: The 'Bush Capital' between Pride and Parochialism

The need to establish the Federal Capital as a new city arose in part out of the Australian constitutional debates of the 1890s, but principally the need out of the competition between Sydney and Melbourne.[32] Rivalries among all parties concerned have fostered a negative image of the circumstances of Canberra's foundation. As historian Keith Hancock put it, 'Canberra was conceived not in generous national enthusiasm, but in the haggling of provincialism.'[33] Those cultural controversies concerning the nature and even the very necessity of the capital have played an existential role throughout much of Canberra's history. They shaped planning processes around 1900 as much as they do today; and in fact, the underlying dialectic of pride and parochialism has persisted until this very day.[34]

[30] Costin 2003. https://the-riotact.com/2003-revisited-the-canberra-firestorm-is-still-a-health-hazard/230099

[31] The BPA is a risk-based map that shows the area of the ACT that has been assessed as being at high risk to bushfires. Canberra's urban areas that are adjacent to forest and grassland are defined as BPA, as is the ACT's entire rural area. Currently, close to a quarter of all dwellings in the ACT are located in the area identified as BPA. ACT Emergency Services Agency 2019: https://esa.act.gov.au/cbr-be-emergency-ready/bushfires

[32] Fischer & Weirick 2014

[33] Hancock 1930:278

[34] During the twenty-first century, affirmations of the national commitment to the capital, culminating in the centennial celebrations in 2013, have contrasted with crippling budget cuts, political statements of disdain and eventually with plans for the transfer of national agency staff to smaller provincial cities in the electorates of responsible ministers. In 2017, Deputy Prime Minister Barnaby Joyce declared 'moving public servants out of Canberra [was] core business for

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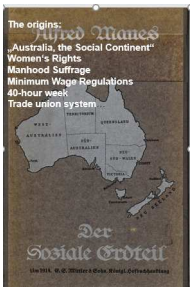
The 'haggling of provincialism' found an early expression in the site selection process, which became known as 'the battle of the sites.' Eventually, however, this led to the creation of Canberra as an inland city situated in the typical semi-arid savannah type landscape of south east Australia composed of grasslands with occasional trees and wooded hills – the Australian bush.[35] This is the origin of 'Canberra the Bush Capital.'

This notion of the Bush Capital was an object of conflicting sentiments, of different cultures to an extent. On the one hand, they reflected the 'Bush ethos' of the settler society as an ideological expression of nation building as well as romantic feelings associated with the typical Australian landscape.[36] On the other hand, the term was used in a derogatory way by public servants reluctant to leave the cultivated ambiance of the provisional capital of Melbourne and to move to what was derided as 'the Siberia of the Southern Tablelands.'

But there is an important other side, which lies in the realm of cultural aspirations and indeed achievements. From the beginning, Canberra's mission was to be more than an administrative capital. It was to become the prestigious symbol of a young federation, 'the finest Capital City in the World – the Pride of Time' in the words of Minister for Home Affairs King O'Malley.[37] As an expression of the will for nation building, these words were more than empty politicians' overblown political rhetoric. They rested on the economic optimism following the discovery of rich gold fields in Australia – arguably the beginning of a series of (intermittent) mining booms, which created the legendary wealth of 19th century Australia.[38]

Apart from this material background, early 20th century Australia was characterised by a social and cultural climate in which a strong will for democracy and egalitarianism led to the creation of legislation for women's rights, universal suffrage, the secret ballot, minimum wage regulations and the beginnings of a trade union system. It was a period in which Australian legislation was ahead of that of many older nations and in which the country found admiration in Germany as 'The Social Continent.'[39]



In one important respect, this political situation permitted Australia to learn from its bitter experience with the rampant land speculation in the early settlement years. This led to the adoption of a progressive policy of public ownership of for the capital. Canberra became an exemplar of an urban development process based on leasehold tenure.[40]

In a similarly commendable way, the task of assessing the qualities of the site involved leading scientific and professional figures of the day. These experts, together with the professional staff of the Commonwealth

the Turnbull government' (Canberra Times 2016. Available at: https://www.canberratimes.com.au/story/6044351/barnaby-joyce-needs-to-rethink-blatant-pork-barrelling-move; Massola & Towell 2017, Available at: https://www.smh.com.au/politics/federal/barnaby-decentralisation-is-core-business-and-there-will-be-more-of-it-20170322-gv3psz.html
12 September. Available at: http://www.canberratimes.com.au/comment/ct-editorial/barnabyjoyce-needs-to-rethink-blatant-pork-barrelling-move-20160912-gre5ir.html.

[35] From the first practical moves toward Canberra's establishment, principles of what we today consider as sustainability were central to the formation of the city. Beyond the principles of social and economic sustainability behind the land policy, principles of ecological sustainability, in particular in terms of a secure water supply, were paramount. This was particularly important because under Section 125 of the Constitution, the Seat of Government was to be located in New South Wales, no closer than 100 miles to Sydney and outside the range of naval bombardment. This suggested an inland location of the capital.

[36] Ward 1958

[37] O'Malley in 1911, quoted in Harrison 1995, p.6

[38] Blainey 1963, 2003

[39] Manes 1914; Fischer 2004

[40] Brennan 1971. The leasehold provisions still exist today as the land tenure system of the capital, although the land rent component was lost when the system was mutilated in the 1970s.

Department of Home Affairs, assembled impressive documentation on the geology, geomorphology, hydrology, soils, vegetation and climate of the Canberra site, together with comprehensive topographic plans. They formed the basis for the exceptionally comprehensive documentation for the international competition.

It was on this information that the Chicago architects Walter Burley Griffin and his wife Marion Mahony Griffin prepared their entry in the competition for the Australian Federal Capital, launched by the Australian Government in 1911. The Griffins' winning scheme was a synthesis of amazingly advanced ideas on town planning combining the approaches of the City Beautiful and Garden City movements, underpinned by the model of the American parks movement of the nineteenth century, the architectural philosophy of Louis Sullivan, the political economy of Henry George and the democratic ideals characteristic of the Progressive Era in the United States.[41] The central area was thus conceived as a physical expression of parliamentary democracy. Features of the metropolitan plan included: neighbourhood units (explicitly named as such in 1911) and diversified urban sub-centres connected by a tramway system 'borne at public expense' ('Nulltarif'); ideas on functional and social mix and – of great importance in the light of sustainability and bushfire issues – principles of water recycling, decentralised sewerage treatment, urban gardening and hydroelectric energy from nearby dams. This was of particular importance for the vision of the "Bush Capital' in its semi-arid setting.[42]

So far so good. The further course of events in the early 20th century, however, can be read as a clash of local cultures – that of the experts and that of the politicians who subsequently co-opted the competition. The politicians' decision to act as the adjudicators in the process led to the Royal Institute of British Architects recommending its members that they not participate. Locally, the problems culminated in a muddle in which several of the winners' plans were combined into a 'Departmental Board Plan' derided by Patrick Abercrombie in the editorial of the Town Planning Review as 'a hodge-podge conglomerate scheme… [for] a third rate luna park.'[43] Eventually the ignominious treatment of the competition winner by Canberra's administrators drove Griffin out of his job as Federal Director of Design in Canberra. Present-day historians cringe with embarrassment similar to that experienced in the case of Utzon and the Sydney Opera house in the 1960s.

These processes are an expression of the parallel co-existence of far-sighted perspectives with blatant incompetence and pragmatic compromise – something which persists to the present day (although this phenomenon is of course not restricted to Canberra nor in fact to town planning).

3.2 Cultural controversies between urban and suburban ideal concepts[44]

At a different level, the cultural controversies that have shaped Canberra reflect a range of attitudes found world-wide towards such as urban vs. suburban and traditional vs. modernist conceptions. Thus, the low-rise, medium-density scheme and the clearly urban character of the Griffin plan morphed into the suburban conception of a city of bungalows in the 1920s – not so much a Garden City as a city or gardens. This was partly due to the economic realities of the inter-war years. But it was also an expression of a cultural preference for suburbia as a way of life. As early as 1909, the British-Australian architect John Sulman had predicted in his advice for the competitors: 'The European boulevard with its street cafés would be unappreciated in Australia.'[45]

[41] Weirick 1988

[42] When the site for the Bush Capital' had been selected, a secure water supply for a large inland population was the determining factor. Therefore, the city was set in a large territory determined by the natural boundaries of river catchments. The Australian Capital Territory catchment gave the ACT a hinterland of high-value wilderness areas, which have been protected as national parks and nature reserves since the 1980s. The overall area of the ACT – 2,400 sq. km – is more than twelve times the size of Washington D.C., mostly comprising these mountainous forested areas, an impressive backdrop and hinterland – but bush fire prone, posing considerable problems for ecological management and sustainability of the city.

[43] Abercrombie 1913:, p.222

[44] Fischer 1984, 1989 The notion of 'ideal concepts in planning' and the ways in which the glance through specific 'windows' have influenced city making have been essential to the publications between 'Myths & Models' (1984) and 'Windows Upon Planning History' (2018).

[45] Sulman, 1911, p.606

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Following Griffin's dismissal in 1920, the skeleton of wide City Beautiful avenues was indeed merely fleshed out with 'mostly single storey, single family houses on generous allotments.' The City Beautiful avenues became automobile thoroughfares rather than settings for urban compositions. The rich semantic content of the plan was altered and impoverished.[46] The city entered an adolescent stage – seven pleasant but oddly proportioned suburbs in search of a city. Unified by the creation of Lake Burley Griffin in the centre in 1963, the garden suburbs developed in this period with their now mature trees have become much sought-after heritage real estate.

From the 1950s on, Canberra's development followed the growth patterns of British New Towns and the methods of US land use transportation planning. In 1957, after a long period of stagnation, Prime Minister Menzies – in many ways a close counterpart to Germany's Konrad Adenauer, created an exceptionally powerful new organization for planning and developing the capital. He ensured that the new National Capital Development Commission (NCDC) would have a large budget and that federal legislation and Parliamentary support would continue to give it a high degree of planning control on the basis of public ownership of land. Imbued by a sense of public responsibility, the NCDC's professional planners acted in the mode of benevolent dictator until their New Town model was firmly on the ground.

3.3 The tipping point: 1988

As a planned capital, Canberra was thus built and managed much in the manner of a government company town during the first 75 years of its existence. In 1988 then, completion of the new and permanent Parliament House was interpreted by Federal politicians as evidence that the Federal Capital was itself complete.[47]

So, the Commonwealth said, the time has come to talk of many things. If the city had come of age, it should henceforth fend for itself like other state capitals too. The Commonwealth would divest itself as far as possible of financial responsibility for the city beyond core capital city functions.

One authority would look after the associated Areas of Special National Concern and another municipal-style planning department at the territory level would be responsible for the rest of the city and the ACT.

However, what may have looked plausible at first sight, was associated with a range of problems at the interrelated levels of finance, governance, and urban structure.

First, finance: A 'city-state' like the ACT could not operate in the same way as the other state capitals by raising substantial revenue from mining, manufacturing and industry. It was therefore more dependent on Commonwealth government grants than these; and in a system set up with the intention of minimizing Federal funding, Commonwealth grants would always be a bone of contention.

Second: Finance and governance: One consequence of this arrangement was chronic underfunding of the agencies responsible for the planning and development of the capital. Creation of these authorities in 1988 was followed by almost never-ending turbulent administrative reform and a proliferation of governance arrangements and overlapping and conflicting plans.

Third: finance and urban structure: It soon turned out that the territory government could not afford paying for the city it had inherited from the Commonwealth on the basis of the revenue from rates and local taxes.

That city, the Canberra of 1988, was a perfect manifestation of Australian ideals of urban/ suburban living and could be seen as 'the perfectionist Garden City Metropolis. '[48] It was a city with high development standards across the entire urban area. At the same time, it was a problematic low-density, car-dependent urban conglomeration extending over a north-south length of 40 km with a population of 400.000 in 2016. This corresponds to the east-west extension of the urbanized core of Germany's Ruhr district with a population of several Million.

In order to continue paying for this city in the face of parsimonious Commonwealth contributions, the Territory Government resorted to a strategy of financing a significant part of its revenue through the sale of its principal asset, greenfield land.[49] This approach is of course unsustainable. It has resulted in a vicious

[46] Fischer 1989, p.168;
[47] Weirick 1989; Fischer & Weirick 2013
[48] Fischer 2013, p.ix
[49] Corbell, 2005; ACT Government 2005; Sansom 2009; Stanhope & Ahmed 2019

circle of further extending an already extended city and exacerbating the very costs of urban management it is seeking to defray. Among the consequences has been the constant encroachment on the City's greenbelt system. Even more critical in the light of the bushfire events, a new satellite district with a population of 50,000 was established on the area devastated in the major bushfires of 2003. This is further extending and exposing the western flank of the city in the era of climate change to fires driven from the wilderness areas by hot westerly winds from the deserts of Central Australia. Other suburbs on the edges followed suit.

3.4 The fires 2003 and 2019/2020

With all the complexity regarding what caused the ACT fires in 2003 and also 2019/2020, the connection between the dysfunctional division of responsibilities decided upon at self-government cannot be overlooked. At the time it seemed to make sense, at first sight, for the Commonwealth to focus its interest and responsibility on the Parliamentary Zone, the visually significant Inner Hills and the lakeside parklands. But in that process, the responsibility for the huge National Park that forms the backdrop of the ACT was shifted to the municipal-style agency which was not able to pay its way even in the city area. This arrangement was problematic to say the least.

As James Weirick put it in 2003, 'in this way, the National government became responsible for a city park, and a city government became responsible for a National Park. Here lay the seeds of tragedy.'[50] The new arrangements following self-government constituted a rupture and a tipping-point also for the practice of the National Park management. Due to the lack of resources, the complex hazard reduction programs preceding the new arrangements, which had involved back-burning in experimental programs by the CSIRO, were discontinued. Understaffed and under-resourced, the authorities were overburdened and inefficient in their reactions in 2003.

The dislocation and chaos which spread across the south-western suburbs of the city seemed to take on a surreal and terrifying intensity in inverse proportion to the planned perfection of Canberra's suburban landscape. Indeed, the elemental force of the firestorm mocked the very order and perfection which has distinguished the city since its inception.

While since then, improvements have been made to the park management system in the ACT, many questions remain. What difference the continuation of the back-burning practice would have made for the fires in 2003 and in 2019/2020 remain a complex issue hotly debated on technical as well as ideological grounds by science, politics and the public including individuals and bots in social media. The national debate over bushfire management is polarized between many groups including forester/farmer demands for large-scale prescribed burning and land clearing and conservationist concerns for the maintenance of biodiversity.

Since the firestorms of 2019/2020, a completely new dimension of the climate change and fire calamity has emerged. A phenomenon that was once considered a 'rare and unique' weather event seems to have become more common. The bushfires in Australia are creating violent weather systems that can spark new fires, conjure fire tornadoes and make fighting existing fires much more challenging. They can project embers up to 30 km ahead of the fire front. The rising heat from the intense bushfires creates massive, powerful clouds called pyrocumulonimbus, or pyroCb. These 'fire clouds' are created 'when fires lift enough heat and moisture into the atmosphere to produce a smoke-infused thunderstorm.'[51] The fires are creating their own weather, and at present, these firestorms cannot be modelled and their behaviour predicted.[52]

In other words, climate change in Australia is producing more extreme bushfires.

This uncontrollable situation has arisen during the decade of climate change denial in the Australian political sphere that is still destabilising national governance as Parliament House at the centre of the 'Bush Capital' disappears from view in choking clouds of bushfire smoke.

[50] Weirick 2003, p.3

[51] Cosgrove 2020. https://www.cnbc.com/2020/01/07/australia-bushfires-create-their-own-dangerous-weather-systems-experts-say.html

[52] Sanderson & Fisher: A fiery wake-up call for climate science. In: Nature Climate Change.

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4 CONCLUSION

This paper has looked at Australia's capital city though the window of the cultural controversies that have shaped its development – from conflicts between narrow-minded competitive thinking and the visionary perspectives that created one of the great planned capitals of the 20th century; the unique controversies around the Bush Capital image as well as the common controversies around urban vs. suburban ideal concepts; the crisis which emerged with the unfortunate dysfunctional arrangements at self-government in 1988 and which created the issues of governance and finance and urban management; on to the ensuing interrelated problematic strategies of urban and regional development in recent years.

It has identified the close connection between the necessity of subsidising the municipal household through unsustainable strategies such as the sale of greenfield land from its limited territory, the consequent loss of greenbelt land; the mechanisms of financing the light rail infrastructure through the relocation of public housing to make way for urban renewal through high-rise tower blocks – all embedded in aggressive strategies directed at a selective re-writing of history aimed at demolishing the traditional Bush Capital brand; and finally how the interlocked issues have contributed to the weakened response to the fires of 2003. Canberra has been lucky in the 2019/2020 fires, but on the basis of our current knowledge about the fact that the embers can travel up to 30 km ahead of the fire, we have to realise that it would only have taken a change of winds for large parts of Canberra to be worse affected than in 2003.

At the structural level, we can draw a connection between Canberra and the locus of our conference, the University of Aachen. The Canberra story in this paper provides a spotlight on a cultural dimension behind the discourse on 'the production of the city' as developed at the department of Planning Theory some 50 years ago.[53] What Harald Bodenschatz identified then as the 'block of interests' between local politicians, architects and the building industry in Berlin,[54] finds an echo in the Australian capital. At this point in time it is evident that following the withdrawal of central government from its responsibility for the Australian capital, local development interests have trumped the national and international concern for the meaning of Canberra to the world

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[53] Fischer 2018, Fehl & Rodriguez-Lores 1980
[54] Bodenschatz 1987

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Climate Urgency and Cities: Action and Reaction, Evidence and Reluctance

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1 ABSTRACT

The first section of the paper gives a brief critical overview of the situation of climate change strategies at the global level, from Kyoto to Paris, Madrid and Glasgow. It also discusses the measures taken by the European Union, and their level of implementation at selected member state and city levels. The impact of pressures groups such as extinction rebellion and the green movement are also examined, together with awareness raising actions such as films and documentaries demonstrating the tangible effects of man-made climate change.

The second section focuses on activists and environmentalists, their proposed solutions and selected proposed interventions in places which have been adversely affected by man-made climate change impacts, such as flooding or drought. It also briefly discusses the state of scientific knowledge and how it is dealt with by politicians, activists and climate change deniers.

The third section looks at the political evolution of climate change intervention at city level. It focuses on Madrid and London in the context of EU actions and respective national targets and examines the direction of travel of the two cities. It briefly synthesises the policies of lowering carbon emissions and proposed actions taken in 2008 in Madrid and London what actions have been taken between these dates and now and what effects they had on reducing carbon emissions, fuel consumption and air pollution. The paper finally compares these approaches with the current strategies for mitigating and adjusting to climate change in the latest city plans and offers critical comments.

Keywords: carbon emissions, green movement, policy, climate change, mitigation

2 BRIEF OVERVIEW OF CLIMATE CHANGE STRATEGIES AT GLOBAL AND EU LEVELS

Scientific evidence on climate change draws a complicated picture for the planet and the adoption of policy responses for this most important global phenomenon can only be global. It is difficult to be optimistic though about aligning national interests with a common global objective as they do not always coincide and are even opposed.

2.1 From Kyoto to Paris

The concern of scientists for human activity on the planet was visible at the Rio de Janeiro Summit in 1992. In parallel to the need to create sustainable environments, the urgency to reduce greenhouse gases (GHG) was one of the issues that led 194 countries, two observer states - Palestine and the Vatican City - and the European Union as a supranational body, to sign and ratify the United Nations Framework Convention on Climate Change (UNFCCC).

This convention assumed that global warming is a result of the increase of GHG in the atmosphere as a consequence of the formidable consumption of energy from fossil fuels. The convention promoted the implementation of an energy transition process towards the decarbonisation of national economies by using renewable energies to reduce these emissions produced by human activities.

The first annual follow-up meeting of the agreement, the Conferences of the Parties (COP) was held in Berlin in 1995, initiating a long process that, despite the difficulties, made it possible to reach various agreements, most notably in Kyoto in 1997 and Paris in 2019. The Kyoto Convention (COP 3) set the basis for the commitment on GHG emissions in industrialised countries and for the conditions of the carbon market.

The Paris Agreement (COP 15), which will replace the Kyoto Protocol from 2020, obliged countries to make cuts to their GHGs emissions so that the temperature of the planet does not to exceed 2ºC with respect to pre-industrial levels and, as far as possible, not exceed 1.5ºC. The Agreement also provided for periodic reviews of the results of the cut plans, the first in 2020, when targets would be set for 2030 and 2050, the final date for neutralising emissions.

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The regulation implementing these commitments was incorporated in Article 6, which refers to the trading of GHG emissions rights between countries and even between private companies belonging to the sectors obliged to make cuts, such as aviation companies. The treatment of accounting to avoid that the same right can exist in the balance sheet of two countries, as well as the terms of the inclusion of private companies in the market, was postponed for COP25.

2.2 From Madrid towards Glasgow

COP 25 was held in Madrid in December 2019 instead of the planned host Chile due to social unrest there in response to price increases of transport or fuels, similar to France, Iran and Ecuador.

The challenge facing COP25 was twofold: political and technical. It represented an opportunity to demonstrate the will of countries to avoid global warming and to complete the Paris Agreement by setting the criteria for implementing emissions markets postponed there due to disagreement between countries.

The summit took place among a dramatic lack of international leadership and weakening multilateralism to fight climate change. Trump had begun the process of getting the US out of the Paris Agreement, China showed no sign of cutting its greenhouse gases, Russia did not present a programme for reducing them, and the EU had failed to agree on a zero emissions target for 2050.

The conflicting position between national interests for the development of article 6 made the mission of COP 25 impossible. The reluctance of the major emitting countries to tighten up their plans for cuts - USA, China, Russia and India, together with Brazil, Australia and others where environmental concerns were not among their aspirations, prevented the adoption of the market rules proposed by the Paris Agreement.

The enormous investments that the transformations entail, the resistance of the economic and social sectors that would be affected in the short term and the lack of a supranational authority to guide the process and propose sanctions, highlighted the fragility of the international agreements. Even in the EU a difficult process was underway, due to the heavy dependence on coal of some countries, including Germany, and especially Poland, Hungary and the Czech Republic but ended in a compromise later.

Faced with the slowness of governments to address their adaptation and improvement plans and the lack of leadership among large emitting countries, other actors took the initiative. At COP25, the commitment of local and regional administrations to respect the agreement was achieved through effective and timely action plans. Likewise large companies showed their commitment by producing new products and services, generally related to the transport sector and urban services. The Spanish Group for Green Growth, which comprises almost 50 large companies, is firmly committed to the decarbonisation of the economy by incorporating available technology, thereby demonstrating the change in attitude of today's business world.

Agreement on changing the dominant production model by initiating an economically and socially viable transition was not achieved and the development of the content of the Paris Agreement postponed to COP26 scheduled in Glasgow in 2020.

3 FACTS, PLANS AND PEOPLE CONCERNING CLIMATE CHANGE AND ACTIONS UNDERTAKEN

3.1 What does science say?

Studies led by the IPCC - the Intergovernmental Panel on Climate Change, a group of experts that advises the United Nations- and other bodies linked to the UN warn that countries are not on track to meet the goals of the Paris Agreement. They must multiply by 5 their cut plans to achieve the 1.5º C target and by three for the 2ºC target. The concentration of GHGs in the atmosphere has not been reduced, they have only fallen during the crisis period (2008-2014) and in December 2019 they have increased by 1ºC and the forecast is that they will continue to increase until at least 2030. In this current situation it would be necessary to cut emissions by far more than 3 degrees foreseen in the current plans.

According to the World Meteorological Organisation, 2019 ended with maximum temperatures and carbon dioxide (CO2) emissions with 75% from fossil fuels. About half of the GHG go into the atmosphere, the rest into forests and the sea, which act as sinks. The acidification of the sea has increased by 26% since the beginning of the industrial era and extreme weather events, especially heat waves and storms, have increased.

The figures collected by the Global Carbon Project show that emissions are stagnating, but this is not enough to tackle the climatic crisis. In 2018 they grew by 2.1%, in 2017 by 1.5%. In 2019 by 0.6%, due to two factors: the fall in coal consumption in the USA and the European Union, linked to the increase in prices of this fuel, the fall in natural gas prices and overall economic slowdown. CO2 emissions in China are expected to increase by 2.6% and in India by 1.8%, while in the USA and the EU they are expected to fall by 1.7%.

According to the International Union of Public Transport (UITP), which unites more than 1,700 companies in the sector, only 35% of the countries that signed the Paris Agreement have included public transport strategies, even though experience shows that appropriate public transport systems demonstrate their effectiveness, displacing the use of private vehicles.

Globally, various pressure groups are studying global warming tipping points, points of no return and the change to positive feedback loops. The Climageddon Extinction Scenario is one of them.[1] Conversely the climate change deniers dismiss the imminent threat of climate change. Ten key ones are mentioned on the Before the Flood website[2] many of them connected with the fossil fuel industry and right wing media and political parties. The controversy between these camps was played out at the Davos 2020 meeting between President Trump and Greta Thunberg, the climate change activist where the mood of global leaders seem to have changed toward more attention to climate change.

3.2 What kind of plans?

It's impossible to think of decarbonised economies without tackling emissions cuts. At the moment, country-designed cutting plans are not sufficient to cope with the climate transition. Most political leaders do not act out of fear of social unrest since every transition has its victims. Climate agendas must help the most vulnerable sectors by adopting fair measures that accompany the losers. Politically, the energy transition cannot be at odds with economic growth, especially in developing countries.

A transformation of the economic and social model generates tensions and difficulties for vulnerable groups. Fossil fuel producing countries, whose fiscal revenues and GDP depend on this sector, run the risk of being trapped in the transition as they do not have the revenues to finance public policies. Conversely, for industrialised countries dependent on fossil fuels it is necessary to ensure transformation processes that accompany the economic and industrial reality of the affected areas.

Even the EU had not achieved consensus on a commitment to go carbon neutral by 2050 due to the reluctance of some countries until reaching a compromise position after COP25, exempting Poland from the 2050 zero carbon target. The European Green Deal's Investment Plan - the Sustainable Europe Investment Plan, SEIP - was presented on 14 January 2020 to start the transition to a green, competitive and inclusive climate-neutral economy. 1 trillion over the next decade will help unlock private funds through EU financial instruments, mainly the European Investment Bank. This bank, considered a "climate bank", will finance projects for the development of green energy and carbon capture and storage. A Just Transition Mechanism will provide financial and practical support to regions according to the degree of economic affection and transformation. Through the Just Transition Platform, the Commission will provide technical assistance to Member States and investors and ensure that affected communities, local authorities, social partners and non-governmental organisations are involved.

[1] Climageddon Extinction Scenario book. https://www.joboneforhumanity.org/climate_tipping_points
[2] Top Ten Climate Deniers https://www.beforetheflood.com/explore/the-deniers/top-10-climate-deniers/

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3.3 Public pressure

Citizen pressure is important for governments to take action and has played an important role at COP25: 800 organisations joined the parallel event, the Social Summit on Climate in Madrid. Thousands of people demonstrated to denounce the inaction of governments on climate change. Perhaps the most visible demonstrations globally have been organised by Extinction Rebellion with the cooperation of schools and young persons. Global environmental lobby Avaaz and many other NGOs are also achieving results.

Respected scientists are raising awareness with their TV documentaries. In the UK David Attenborough's Planet Earth TV programmes are widely viewed and his participation in public events such as the newly created Climate Change Citizens Assembly commissioned by 6 House of Commons select committees [3] to discuss how to meet the net zero carbon target by 2050 is influential.

Even if it is assumed that emissions are produced directly by everyone's activity, and indirectly by the energy consumed in the manufactured products used by everyone, the profile of environmental awareness and individual commitment has contradictory facets depending on the issue under consideration.

According to the European Commission, 93% of the population perceives warming as a serious problem. The survey carried out by the newspaper El País between 29 November and 4 December, in the middle of the COP25, refines the content of this global figure. The results indicate that 93.6% of the Spanish population recognise the existence of climate change; 59.5% consider that it is very urgent to take action, 31% that it is quite urgent; 65.1% are in favour of banning the use of gasoline and diesel cars and 53.4% would accept to pay special taxes (between 1 and 20 euros per month) to finance the fight against climate change. Reducing the consumption of animal proteins had less acceptance, despite Greenpeace pointing out that 14% of emissions come from intensive livestock farming.

4 POLITICAL EVOLUTION OF CLIMATE CHANGE INTERVENTION AT NATIONAL LEVEL: SPAIN & UK

This section looks at the political evolution of climate change intervention at national and city level. It focuses on Spain and the UK, and Madrid and London in the context of EU actions and examines the direction of travel of the two cities in respect to national targets. It briefly synthesises the policies of lowering carbon emissions and proposed actions taken in 2009 in Madrid and London, what actions have been taken between these dates and now and what effects they had on reducing carbon emissions, fuel consumption and air pollution.

It aims to critically evaluate progress or otherwise with climate change mitigation in Spain and the UK and in particular Madrid and London over the last ten years, in the context of other geo-political developments, such as trade wars and political upheavals in many parts of the world. Rising populism, often supporting climate doubters and protectionist trends also contributed to climate change challenges.

The climate change debate attracted prime political attention at global as well as national, city and even neighbourhood and individual level. The argument that actions undertaken by individual countries or cities were too negligible to make a difference and might hamper their competitiveness were countered by increasingly active pressure groups, often supported by very young persons who see their future at stake. Over the last ten years more countries and cities have not only set stringent targets for adverse impacts on climate change but taken action [4] to implement them at national and city level.

4.1 Climate change strategies and targets at national level in Spain and the UK

4.1.1 Population issue

Since 2009 many threats to climate change have not waned. Rapid urbanisation especially in the global South and relentless population growth are acerbating the climate change challenge. Although slowing down, population increases in both Spain and the UK (as well as in Madrid and London) are forecast to continue over the longer term and will add to their climate change pressures.

[3] https://www.ft.com/content/7288bfd6-3fb6-11ea-a047-eae9bd51ceba
Financial Times, 25 January 2020. Burning questions at first UK climate change citizen assembly in Birmingham 24-26 January 2020. https://www.climateassembly.uk/?gclid=EAIaIQobChMIxsDXmOmj5wIVAbDtCh2EMgP5EAAYASAAEgLYCPD_BwE

[4] E.g Finland and Helsinki in particular

'Is State'	Spain	UK	Madrid	London
Population (2009 paper) % migrants & ethnic population	46,157,822 (2008) 5,268,762 (2008)	60,975,000 (2007 est) 6.3 million (2004 est)	3.273.006 (2008) 571,864 (2008)	7.56 million (2007) [13% UK] 162,000 [2.14%] [39% of E&W] 8,787 million (2016)
Population (2020 latest stats) Forecasts	47,100,396 *2019) -11% by 2050	66,436,000 (2018 est ONS)	3,266,126 (2019)	9.3 million (2020 est) * 10.8 m (2041)**
GVA (gross value added, workplace basis) (2009 paper) GVA per capita (2009 paper)	GDP PPP 1.378 trillion US$ (2008 est.) GDP PPP per capita $34,600 (2008 est.)	GDP PPP 2.231 trillion US$ (2008) 1.358 trillion £ GDP PPP per capita 36,600 US$ (2008)	114,906,801 (2006) 30,094 (2006)	£ 251 billion (2007) [21% of UK total] = 66% above UK average but 3rd deprived region
GVA (2020 latest stats) GVA per capita		GDP PPP 2.925 trillion US$ (2017 est) GDP PPP per capita US$ 44.300 (2017 est)	GDP 140,608,809 € (2018) GDP per capita 43,722 € (2018)	GVA (2015) £ 378. 4 billion GVA per capita £ 43,629

Comparative Table: population and GDP Spain – UK, Madrid – London. Sources: Madrid: National Institute of Statistics, List of Inhabitants, Madrid City Town, Madrid Institute of Statistics of the Community of Madrid. London: * CIA World Factbook, London: Government statistics and inventories. ** Draft London Plan, 2017, London Mayor's Transport Policy 2018.

4.1.2 Decarbonisation strategies

In 2009,[5] Spain and the UK were among the leading countries to take positive actions towards their climate change problems and chose to play a global role, arguably because they were aware of their high pollution levels owing to their prolific energy consumption.

	Spain	Spain	UK	UK
overall energy consumption in mt/ktp oil equivalent/pa	147 *(2007)*	3, 261 ktp (2017)	240 *(2001)*	*143 (2018)*
overall CO2 emission in mt/kt CO2 equivalent/pa	330,497 (2004) 349m230 (2017)	10.769 kt CO2 (2017)	587,261 (2004)	364 (2017) 373.2 (2017)*

Comparative Table. Is-state: national - city energy consumption and CO2 emissions (2009 – 2019). Sources: Spain: National Greenhouse Gas Inventory Report 2019. Ministry for Ecological Transition; Madrid Energy Balance of the Municipality of Madrid, Report 2017, Madrid City Hall. UK: Climate Change Committee 2019, Carbon Brief (190204), 2017 UK Greenhouse gas emissions, final figures, statistical release, national statistics, DBEIS 2019

Spain and the UK set stringent targets for CO2 emission reductions, allocated funds for mitigation and adaptation, and acted on what was in their direct control, e.g. improving energy efficiency of their own buildings and decarbonising their transport vehicle fleet, besides awareness raising campaigns to change consumer behaviour. Ten years on, the effects of these measures are real and both countries as well as their capitals remain committed to a carbon neutral future by 2050. Although the target to reach zero carbon emissions by 2050 was agreed by COP25 in Madrid in 2019, it has been adopted by the EU in 2019 (albeit without Poland), as well as by both Spain and the UK, and London in 2017 [6] (labour) and Madrid in 2019 [7] (socialist).

National level	Spain *(base 1990)* *2009 is state*	Spain (base 1990) *2020 is state*	UK *(base 1990) 2009 is state**	UK (base 1990) *2020 is state*	EU (base 1990)
	- 37 % by 2012	-17% by 2020	- 20% by 2010	- 43% by 2020**	
		-20% GHG by 2030	- 26% by 2020	- 51% by 2025***	
		-90% GHG by 2050	- 60% by 2025	- 57% by 2030****	-40% GHG by 2030 new aim = 55% by 2030
		target: 100% non-renewables by 2050 70% by 2030	- 80% by 2050	- 100% by 2050*****	-100% by 2050 (2019 - except Poland) 20% renewable energy by 2020

Comparative Table: National CO2 emission reduction targets (2009 – 2019). Sources: Spain: National Integrated Energy and Climate Plan, 2021-2030, (2919); CarbonBrief, Euractiv 2018. UK: * Climate Change Act 2008. **3rd carbon budget 2018-22; ***4th carbon budget-2023-2027; **** 5th carbon budget 2028-2032; ***** update Climate Change Act (in 2019)

[5] Compare current situation with that in 2009. Judith Ryser & Teresa Franchini. Towards Low Carbon Cities: Madrid and London, Isocarp congress 2009.

[6] London Environment Strategy, GLA 2017

[7] In September 2019 the government of Madrid reached a political consensus on the climate emergency, which was rejected by the extreme right.

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Since 2009 the policies for CO2 reductions per sector have evolved and changed, influenced in part by the results of measures achieved as well as by the various sectoral lobbies. At state level, the commitment to overall CO2 emissions reductions remains firm, as well as the commitment to act on own estates and transport fleets. However, the pressures on other sectors by lobbies have impacted on targets and measures.

4.2 Spain: current situation

The challenge of climate change for Spain is particularly challenging, due to its geographical position and socio-economic conditions. While the planet increased its global temperature by 1.1ºC since the pre-industrial period, in Spain the temperature has risen by 1.7ºC.[8] 70% of Spain's surface area is at risk of desertification, and the coasts of the Mediterranean, the Balearic archipelago and the Canary Islands are especially vulnerable to rising sea levels.

The report "Climate Emergency in Spain", prepared by the Spanish Sustainability Observatory for COP25, details the effects of climate change in the country at present, which in brief are:

- the country's average temperature increased by 1.57 ºC in just 57 years, rising from an average of 14.0 ºC between 1970-1979 to 15.7 ºC between 2010-2019
- the average temperature in the provincial capitals has increased by one degree in the last 30 years. In some cities such as Madrid, Barcelona and Alicante the increase is more than 2 ºC
- the current summer is 5 weeks longer than at the beginning of the 1980s
- the surface temperature of the Mediterranean has increased by 0.34ºC per decade since the beginning of the 1980s
- the increase in the level of the Mediterranean is estimated at 3.4 mm per year from 1993 to 2017
- the increase of CO2 concentration in the atmosphere is 1.9 ppm per year since 1984
- 33 of the 52 glaciers that existed in 1850 have disappeared, most of them after 1980
- the effects on biodiversity are reflected, among other phenomena, in the distribution of species and migrations, in changes of habitats, behaviour and food
- GHG emissions fell by 2.3%, but increased by more than 15% in 2018 since 1990. Spain is the EU country that has increased its GHG emissions the most since 1990: in 27 years they have increased by 17.9% while in Europe as a whole they have decreased by 23.5%
- the ten dirtiest companies release 62% of the fixed emissions and 25% of those of the whole country
- in certain areas there have been unprecedented levels of rainfall in the last 100 years and floods have caused losses in the millions
- the last decade has seen more, larger, more intense and longer heat waves than in previous decades
- the longest, most extensive and lowest temperature cold waves were recorded in the 1980s and only one in the early the 2000s
- in 2019, 80,000 hectares of forest were burnt[9]

The solution before the damage becomes irreversible is to achieve climate neutrality by 2050, as scientists have been advocating since the 1970s.

4.2.1 National Strategies: from Kyoto to the “climate emergency" declaration

As a result of the Kyoto Protocol Agreement, Spain committed itself to limiting the increase in its emissions to 15%. The path that began in 1997 developed irregularly, associated with the political will of successive governments and the economic fluctuations of the national and international scene.

In 2004 the European Commission sent the first air quality warning to Spain - along with Austria, France, Germany, Ireland, Italy, Luxembourg, Portugal and the United Kingdom - urging it to intensify its efforts to reduce air pollution, particularly in their urban areas.

[8] according to the Spanish Meteorological Agency in December 2019
[9] "Climate Emergency in Spain", prepared by the Sustainability Observatory for COP25.

The actions adopted during the socialist government's term of office (2004-2011) were numerous, including the promotion of renewable energies and the approval of a wide range of legal instruments: National Plan for Adaptation to Climate Change 2006, Technical Building Code 2006, Spanish Air Quality Strategy 2007, Spanish Strategy for Climate Change and Clean Energy, Horizon 2007-2012-2020, derived from the Spanish Strategy for Sustainable Development 2007, Plan for Urgent Measures, Action Plan E4 2008-2012, Renewable Energy Plan 2005-2010, National Emission Rights Plan 2008-2012.

The inactivity of the subsequent conservative government (2012-2018) in environmental matters was limited, since the measures of the National Air Quality and Atmosphere Protection Plan 2013-2016 did not give the expected results and the concentrations of the main pollutants continued to increase, while the next Plan for the period 2017-2019 was not executed. During these years, affected by the severe economic crisis that devastated the country's productive base, the lack of support for renewable energies, the maintenance of coal-fired power stations and the scant attention paid to reducing polluting vehicles exemplify the absence of political interest in global warming. Faced with inaction by the central government, actions were taken by some city and regional governments. One of the main environmental organisations, Ecologistas en Acción (Ecologists in Action), highlights the dismantling of a good part of the existing environmental legislation between 2011 and 2015 - Coastal Law, Forestry Law - and the blocking of initiatives by other groups, which have prevented significant advances in environmental protection.

The results of these actions were insufficient and during these almost 20 years, the Kyoto Protocol ended up being fulfilled due to the purchase of emission rights from surplus countries and the sharp fall in emissions due to the economic crisis. Even so, Spain was warned by Brussels on numerous occasions about air quality, especially in Madrid and Barcelona, where nitrogen dioxide (NO2) limits had been exceeded for almost a decade.

According to the European Environment Agency, Spain was the European Union country where greenhouse gas emissions grew the most in absolute terms between 1990 and 2017. During this period, they increased by 51.7 million tonnes, which is 17.9%. This figure contrasts with the EU as a whole, which reduced its emissions by 23.5% in those 27 years while GDP grew by 58%.

For the socialist government elected in 2018, the climate change problem became a state issue. The creation of the Ministry for Ecological Transition (MITECO) in the same year was intended to meet the objectives set by the EU for the 2050 horizon.

The 2017 data provided by the National Greenhouse Gas Inventory Report, 2019 edition, prepared by MITECO, confirmed the seriousness of the situation: total GEI emissions amounted to 340,230.88 kilotons of CO2, which represented +4.24% compared to 2016, +17.9% compared to the base year 1990 and -23% compared to 2005. The sectors with the highest level of emissions were transport (26%), electricity generation (20%), industrial activities (19%) and agriculture (12%). The main reductions were in the commercial and residential sector (-3.3 %) and in the use of fluorinated gases (-17.2 %). Emissions covered by the Emissions Trading Scheme (40.1 % of total) increased by +10.3 % compared to the previous year.

This situation was slightly reversed in 2018. According to data provided by the National Statistics Institute (INE), GHG emissions fell by 2.3% over the previous year, making it the fourth lowest level in the last ten years.

4.2.2 National Strategies: from Kyoto to the “climate emergency" declaration

Spain officially declared a climate emergency in the country on 21 January 2020, in line with the approach taken by other countries - Ireland, Canada, France, Austria, Argentina, Malta, Bangladesh and Andorra - and many cities and regions. The fight against climate change as one of the main objectives of political action of the socialist government established in 2018.

This initiative will implement 30 lines of action, some of which are priorities:

-drafting of the climate change and energy transition act to guarantee the country's decarbonisation by 2050, using a 100% renewable electrical system, emission-neutral vehicles and a non-polluting agricultural system

-drafting of the second national adaptation plan, including the national climate observation system and the development of impact indicators

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-creation of the citizens' assembly on climate change, a participation mechanism that strengthens cross-cutting and equal representation of the civilian population

-promotion of productive transformation, to encourage the transformation of the industrial model and the service sector through just transition agreements, to favour the sustainability of economic activities and the creation of quality jobs

This initiative affects many aspects: circular economy, sustainable tourism, demographic challenge, fight against desertification, waste treatment, sustainable mobility, financing of public transport, establishment of low emission areas in municipalities with more than 50,000 inhabitants, improvement of forestry activity, increase of protected marine areas, rural development, protection of biodiversity, opportunities for energy transition and generation of green jobs.

The Climate Change Act includes investment of more than 200 billion euros for the decade 2020-2030. The first step will be to draw up a National Sustainable Finance Action Plan and a programme for the issue of green bonds by the Public Treasury. The fiscal policy will integrate the climate change variable by generating a "green taxation" that will set dissuasive taxes and fiscal incentives to drive the transformation of the productive sector. Subsidies and tax benefits for energy products of fossil origin will be eliminated, except in cases justified by social or technological reasons, and no applications for exploration, research permits or concessions for the exploitation of hydrocarbons or fracking activities will be authorised. This is the beginning of a new path at state level, the results will be seen during the march.

4.3 United Kingdom: current situation

In the UK, more extreme weather conditions since 2009, fiercer storms, recurrent flooding, hotter and drier summers and coast erosions have risen public awareness of climate change and its impact on people's wellbeing. Consumer movements have started to demand more action from commerce and industry to curb adverse effects. Among public requests are to reduce the use of plastic in packaging, inbuilt redundancy in products, lower meat and dairy product consumption and curbing travel by air and by car, while turning more to cycling and walking.

Besides aiming at carbon neutrality by 2050, the UK has upgraded several sectoral targets as regards climate change since 2009. In 2019, UK renewable energy targets were updated to 20% by 2020, up from 15% from base line 2008 and the Climate Change Committee advised for 30%-45% renewables by 2030. However, this includes a large % of nuclear energy which needs new generation plant, while nuclear waste issues are not addressed. The transport GHG and CO2 emission targets were also updated.

sector	1990	2000	2010	2015	2020	2025	2030	2035
agriculture	58.9	54.8	48.6	49.1	46.6	44.8	44.4	44.3
residential	80.1	88.7	87.5	66.3	66.4	67.3	71.3	74.9
transport	121.9	126.7	120.1	120.0	116.4	112.2	109.1	107.6
en supply	277.9	220.9	206.7	144.1	86.0	67.7	74.0	76.0
business	114.4	116.2	94.8	84.6	75.9	66.4	59.7	57.2
industry	60.0	27.1	12.7	12.7	10.0	9.4	9.0	8.8
waste m	66.6	62.7	31.7	18.2	13.7	12.0	11.0	10.5
public	13.5	12.1	9.7	8.1	7.0	6.9	7.5	7.9
land forest	5.7	0.5	-5.8	-7.4	-1.2	-9.0	-6.8	-5.3
total	799.0	709.7	605.9	495.7	410.9	377.6	379.2	382.0

UK Greenhouse gas emissions by selected source, MtCO2e (2019). Total net GHG emissions. Source UK NECP, 2019 (p 99), Updated Energy and Emissions Projections 2017. https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2017

However, despite UK targets for transportation air pollution reductions road traffic increased in Great Britain from 255 billion miles travelled in 1990 to 328 billion miles in 2018, an increase of 29%. While total fuel used for road transport in the UK remained relatively stable from 1990 to 2017 diesel use overtook petrol use in 2005. Greenhouse gases increased and made up 21% of UK total GHG emissions in 2017 while those from other sources had decreased. Nevertheless, due to more stringent exhaust emission limits, the most damaging pollutants to health decreased (CO, particulate matter, NOx), but in 2018 only 0.5% of all licensed vehicles were ultra-low emission vehicles. [10]

[10] In-Depth Q&A, the UK climate change projections 2018, CarbonBrief 190917, https://www.carbonbrief.org/in-depth-qa-the-uk-climate-projections-2018

It should be noted that changes of consumer behaviour had some impact on the government, together with the latest Climate Change Scenarios for the UK (UKCP18) which show that the trend to drier summers and hotter wetter winters in increasing, together with sea level rises. The government has introduced some measures toward some of these requests and updated its climate change related legislation generally.

4.3.1 Legal position

The main updates of UK legislation and strategies since 2009 are:

- the UK's Integrated National Energy and Climate Plan, 2019 (NECP)
- the National Planning Policy Framework, updated in 2019 (NPPF)
- the Energy Act, 2011
- UK Building Regulations Part L, 2013
- Clean Air Strategy 2019
- Lean Growth Strategy
- Climate Change Scenarios, UKCIP 02, 09 and 18
- UK 5 Carbon Budgets (latest 2028-2032, -57% by 2030, 1,950 MtCO2e).

Some competences related to climate change are devolved to the UK nations, Scotland, Northern Ireland and Wales. Despite new national legislation and recent government interventions, pressures on industry and commerce as well as on farming remain moderate. This points to a growing discrepancy between political objectives and changing wishes of the population as awareness of the climate change stress has entered the social media and public debate. An illustration of this are the disruptive demonstrations of Extinction Rebellion which were tolerated by the inconvenienced public but are under threat to be outlawed in London, despite the civil right enshrined in UK legislation to demonstrate peacefully. The frailty of climate change measures remains a crucial issue as they are subjected to sudden reversals when opposing executive political powers obtain majorities at state and city level.

5 POLITICAL EVOLUTION OF CLIMATE CHANGE INTERVENTION AT CITY LEVEL: MADRID AND LONDON

A defining issue is that implementation of state legislation and measures is bound to take place at lower levels: in regions and cities, by civic pressure groups and even individuals. Moreover, climate change issues range across traditional functional sectors and their respective competences. This points to the need of horizontal and vertical cooperation rather than confrontation driven by political self-interest which hampers progress also at global level. Furthermore, Implementation tends to stand a better chance with genuine devolution of operational competences and related budgets.

5.1 Madrid

Madrid is aware that the prevention of climate change is one of its main challenges, since the conditions of its geographical location aggravate the effects of emissions produced by urban activities and give rise to periods of dangerous levels of contaminants.

5.1.1 Air pollution

The city of Madrid adopted the first Ordinance on air pollution control in 1968. In 1978 the Automatic Pollution Monitoring and Control Network was created and in 1982 the Atmospheric Sanitation Plan was drawn up, leading to the first emissions inventory. The incorporation of Spain into the EU in 1986 meant the transposition of Directive 80/779/EC and the setting up of the reference framework for air quality assessment. The city council's actions in this respect in the 1990s focused basically on the replacement of coal-fired boilers.

The high level of air pollution recorded in the first decade of 2000 led to the approval of the Local Air Quality Strategy 2006-2010. Its action programme addressed several aspects - transport, fixed sources of pollutant emissions, urban waste - and even the need to act against climate change in response to the Kyoto Protocol. While the plan succeeded in reducing pollution levels, the Air Quality Plan 2011-2015 recognised the difficulties of meeting the targets set by the EU, in particular those produced by urban traffic which

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accounted for 65% of NOx emissions in 2009. The main objectives of this plan were to discourage and restrict the use of private motorised vehicles and to promote public transport and alternative modes of mobility. The most relevant urban development action was the delimitation of a Low Emission Zone in the city centre, a proposal that was never implemented. The actions were limited to the pedestrianisation and tempering of some streets and the delimitation of four Residential Priority Areas in which access to non-resident vehicles was restricted.

In parallel to these measures, critical air conditions at certain times of the year due to a combination of meteorological factors and pollution levels, led to the adoption in 2016 of the Protocol of measures to be taken during episodes of high nitrogen dioxide pollution, activated since then every December, with the exception of 2019.

Nevertheless, these measures were not sufficient to meet the objectives of national and European legislation despite successive EU warnings. The left-wing municipal government which took office in 2015 drew up Plan A, proposing a set of measures organised into four lines of action: sustainable mobility, urban regeneration, adaptation to climate change and citizen awareness-raising.

5.1.2 Territorial and design measures

The most outstanding action of Plan A was the delimitation of the Central Zero Emissions Area, 472 hectares free of vehicles and with new spaces for pedestrians, bicycles and public transport. This measure included the reform of the main access roads to the city centre, especially the Gran Via. Despite the fierce reaction of the political opposition party, previously in municipal power, and certain social factions which were reluctant to eliminate vehicle traffic, the proposal was carried out between 2017 and 2018. The implementation of Madrid Central and the reform of the Gran Vía not only meant the reduction of pollution levels in the city centre but also the most important urban transformation developed by the city council during the last decades.

The first action of the conservative government that won the municipal elections of May 2019 was to eliminate Madrid Central due to its alleged lack of effectiveness, allowing vehicles to enter the area again. The intervention of Ecologistas en Accion, Greenpeace and the Plataforma en Defensa de Madrid Central (Platform in Defence of Madrid Central) led to the Madrid courts alleging health and environmental reasons for not eliminating the entry of vehicles into the capital's low-emission area.

5.1.3 Revision of GHG emission targets

The proposal of 2019 includes the design of a specific plan and initiatives, political as well as economic, to guarantee the progressive reduction of greenhouse gases in order to reach zero net balance no later than 2040 and, if possible, before 2035.

The response to this legal setback was the presentation in January 2020 of a new plan that will replace the current one: Madrid 360. The new plan aims to be the tool with which Madrid city council will definitively comply with the air quality limits established in Directive 2008/50/EC of the European Parliament and of the European Council of 21 May 2008. It intends to reduce nitrogen oxide emissions by 15% more than what was proposed in Plan A, as it provides for a 20% reduction in NOx by 2023.

5.1.4 New measures

One of the most unique measures included in Madrid 360 will be the pedestrianisation of the Puerta del Sol square and its surroundings with the aim of turning it into a true zero emissions zone. Another flagship measure is the Zero Line, zero emissions and zero cost for users, formed by two bus lines to move across the Centre district. In addition, another low emission perimeter line is proposed around the Central district, for a fee. All the buses of the Municipal Transport Company will also be renewed, incorporating electric vehicles.

With regard to traffic restrictions, they will depend on the environmental marking of each vehicle and no non-resident may park on the surface. Unlike the previous plan, vehicles belonging to shopkeepers in the area and those occupied by more than two people will be allowed to circulate freely, a measure that has already been contested by environmental groups that are committed to the total elimination of traffic. To facilitate the decarbonisation of the city, economic aid is planned to replace polluting vehicles with technologically advanced ones.

It is hoped that the actions taken by the new administration will fulfil their mission, since at the end of 2019 the Madrid City Council, in line with the EU, declared a climate emergency.

5.2 London

Over recent years, the Greater London Assembly and the Mayor of London have acquired a number of new competences, but only few related to climate change issues, and their tax and fund raising powers remain very limited and tend to be ultimately under the control of central government.

5.2.1 London climate change strategies and targets under changing governance

Regarding London's environmental policy, the political position of climate change has altered in London since the inception of its own government, Greater London Assembly and directly elected Mayor in 2000. The fist mayor of Greater London Ken Livingstone (labour, 2000-2008) had a very progressive approach to the environment. He had commissioned scientific studies and projection methods to establish London's is state and what targets and measures were needed to curb environmental pollution.

This was not least due to his lobbying that under the Greater London Authority Act 2007 the mayor has a new statutory duty to contribute towards the mitigation of, or adaptation to, climate change in the UK and to produce statutory strategies for climate change mitigation and energy and for adaptation to climate change in London. In 2008 this included retrofitting existing buildings which contributed 73% of CO2 emissions and make fuller use of Combined Cooling Heat and Power (CCHP) technologies. [11]

The subsequent mayor Boris Johnson (conservative, 2008-2016) had other priorities but did not alter the environmental policies of the previous London Plan significantly. He did not rock the ecology boat because it was in his political interest, not for reasons of continuity. Reaping the fruits of the Olympics to London brought to London by the previous mayor gave him greater political gains.

The current mayor Sadiq Khan (labour, 2016-2020) continues to support climate change mitigation actions but with a less firm approach as his priority is with social housing provision (which is not happening though, due to the structure of the neo-liberal housing market system in the UK, the vested interests of land owners and property investors, including unchallenged global ones and lack of mayoral competence in this field).

5.2.2 The new Draft London Plan 2017 and updates

Mayor Sadiq Khan considers his "Replacement Plan" as different from its predecessors with its declared focus on sustainable development. Climate change holds a modest role in the mayor's concept of "Good Growth" - socially and economically inclusive and environmentally sustainable - which is underpinning his new statutory draft London Plan 2019. Policy GG6, "Increasing efficiency and resilience", seeks to improve energy efficiency, support move towards a low carbon circular economy, contribute to London becoming a zero carbon city by 2050 and ensure that buildings and infrastructure are designed to adapt to a changing climate.

His broad environmental goals, climate change targets and actions are laid down separately in non-statutory documents: The London Environment Strategy, 2017[12] (for public consultation), The Climate Action Plan, 2018[13] where the overall CO2 reduction target is set at 40% to be reached between 2018-2022, 50% between 2023-2027 and 199% by 2050 and the Zero Carbon London, A 1.5C Compatible Plan, with its amendments in December 2018.

In 2014, London's GHG emissions were estimated at around 38 MtCO2e, 7% of UK's total emissions. They have fallen by 26% since 1990, largely due to reduced gas consumption and decarbonisation of the national electricity grid. In 2014 35% of emissions were estimated generated from homes, 42% from workplaces, and 23% from transport. Measures will include retrofitting existing buildings and higher insulation standards for new build. The London Environmental Strategy shows how reaching the 2050 is expected to be achieved through combined electricity and gas grid decarbonisation and local action, the latter subject to funding.

[11] London Mayor's Climate Change Action Plan 2007
https://www.iema.net/news/2016/01/08/Mayor-unveils-London-Climate-Change-Action-Plan/
[12] Mayor of London, London Environment Strategy, Draft for public consultation, August 2017
[13] Mayor of London, 1.5C Climate Action Plan, GLA 2018, amended December 2018.

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London electricity demand accounts for almost half of total CO2 emissions which are decreasing with increasing use of renewable electricity generation (25% of total UK generation, to reach 59% by 2030 included nuclear energy). Unfortunately, no similar actions are taken to decarbonise gas which amounts to about half of total energy consumption in London, contributing 30% of London's total GHG emissions.

Energy consumption is to be reduced by reaching 15% of renewable district energy supply by 2030. Measures are local zero emission zones and increasing numbers of ULEZ (Ultra-Low Emission Zones), zero emissions of own car fleet by 2025, of heavy vehicles by 2030 and of buses by 2037. As regards buildings all new building should be zero carbon by 2019, and minimum energy performance standards introduced in all rented properties. Smart meters should be installed in every home by 2020 and lofts and cavity walls insulated by 2020, as well as gas boilers replaced by high efficiency models. By 2030 there should be wide deployment of low carbon heating like heat pumps. London carbon budgets show the required energy efficiency levels for housing, non-domestic and transport to meet these targets.

London produced 18 mt of waste in 2015 (3.1 mt household is 17%, 5.0 mt commercial industrial is 28%; 9.7 construction demolition excavation is 54%). Direct GHG emissions from waste represent 2% of London's total. Only 52% is recycled and the target is to increase recycling to 65%, reduce food waste by 20% by 2025 as well as single use packaging waste and to generate low carbon energy from residual waste, leaving very little to landfill. This is estimated to save 101,000 t of CO2 in 2021, 169,000 t by 2025, and 535,000 tCO2e by 2031.

A number of policies consolidated in Chapter 9 "Sustainable Infrastructure" contribute to the mayor's commitment to London becoming a zero-carbon city by 2050. They are: [14]

Policy SI1 improving air quality, Policy SI2: minimising greenhouse gas emissions, Policy SI3 energy infrastructure, Policy SI4 Managing heat risk, Policy SI7 Reducing waste and supporting the circular economy.

[14] Policy SI1 improving air quality
Reference to Air Quality Focus Areas. Large developments should use Air Quality Positive approach, and others should be Air Quality Neutral, and comply with the Non Road Mobile Machinery Low Emission Zone (reduce emissions from demolition and construction). Air Quality Assessments -AQAs should be submitted with new developments. Onsite reduction is preferable but offsite equivalent provision is possible. Measures to reach Air Quality Positive could include with low or zero emission heating and energy, improvement of public transport, walking and cycling infrastructure, avoid street canyons which prevent effective dispersion of pollutants, use sensors. See GLA's LAEI: the London Atmospheric Emissions Inventory. See also Air Quality Focus Aras (AQFA) map, 2017. Key performance indicators and measures: air quality. Positive trend in approved referable development applications demonstrating that they meet at least air quality neutral standard for emissions (based on a rolling average).
Policy SI2: minimising greenhouse gas emissions
A major development should be net zero carbon (reducing CO2 emissions from construction and operation, minimise annual and peak energy demand. Major developments should include besides an Environmental Impact Assessment a detailed energy strategy to demonstrate how the zero carbon target will be met within the framework of the energy hierarchy (see diagram: reduce energy use, clean through energy efficiency, green through renewable energy, offset) and be monitored, re energy performance. A minimum of 35% of on-site reduction beyond building regulations 2013 part L is expected (10% for residential, 15% non-residential through energy efficiency measures). London Boroughs to use BREEAM measures and targets in local plans.
BUT in lieu: cash to borough carbon offsite fund and/or offsite alternative proposals are possible but should be minimal by using carbon offset price mechanism. Maximise onsite electricity and heat production (using solar, photovoltaic, thermal, innovative building materials, smart technology. More in London Environment Strategy.
Policy SI3 energy infrastructure
Produce energy masterplans for large scale developments (establishing most effective energy supply options)
Development plans should identify suitable sites for necessary energy infrastructure requirements and upgrades of existing ones.
Large scale developments within heat network priority areas should have a communal heating system following the heating hierarchy (e.g. decentralised heat pumps, heat from zero emission sources, fuel cells, low temperature networks, low emission CHP, low NOx gas boilers, secondary heat sources, connected to existing heat networks where feasible, facilitate new connections.
See map heat network priority areas. Increase use of renewable energy sources and CHP.
Policy SI4 Managing heat risk
Developments should minimise internal heat gain and impact on urban heat islands, reduce potential overheating and reliance on air conditioning.
Policy SI7 Reducing waste and supporting the circular economy
Increase recycling and reuse, produce low carbo energy from waste (65% by 2030 from municipal waste, 95% by 2020 from construction and excavation waste). But waste bags are littering London streets inordinately which are a health hazard, an environmental pollution risk and an image problem.

5.2.3 Sustainable transportation policies and GHG emission reductions

GHG emissions from transport were around 8.6 MtCO23 per her in 2914. They aim is to reduce it to 1.5 MtCO2e a year by 2050. The Mayor's Transport Strategy aims to reduce CO2 emissions from road, rail and shipping by 72% by 2041. Aviation which contributes 2,5% of GHG in London (around 950,000 tVO2e per year) and curbing them appears difficult. Heathrow expansion is likely to increase them by 1/3.

The mayor's key London transport strategy is that 80% of all trips in London will be made on foot, by cycle or using public transport by 2041. Towards this aim he has developed a walking action plan, a cycling action plan.

London's congestion charge was conceived by the first London mayor and implemented. The next conservative mayor revoked the planned extension of the congestion zone in central London (in the richest borough), while the current labour mayor introduced ULEZ, Ultra low Emissions Zones in central London in 2018 and plans to extend them to the outer ring road (North and South circular) In 2011, the congestion charge cut CO2 emissions by 16% (100,00 t) = -1% of London's total road traffic in 2011. Half was due to 75,000 fewer vehicle daily, and half to remaining traffic experiencing less congestion. [15] Since then, car traffic has increased again in the congestion charge area but no monitoring data is available. ULEZ has reduced emissions of nitrogen oxides (NOx) by some 29% in January 2020 since its inception in April 2019.

The London Plans put more emphasis on cycling, A hire cycle infrastructure was provided with sponsorship from banks. Cycle superhighways were constructed across London and are planned to extend to outer London. Where lanes were established it is estimated that cycling has increased by up to 53%. Total daily distances cycled have reached 4 km in 2018-2019. [16] Car pool companies obtained licenses to operate in London. Charging infrastructure was gradually provided for electric cars but the uptake is slow and the charging facilities considered insufficient and too slow. Walking is advocated but facilities are hampered by prioritising traffic flows, although they average only 11 miles in central London during rush hours and idling engines are a pollution problem. The cycle highways have attracted or catered for increasing numbers of cyclists (commuters) in London, but the reason for this increase may also be extensive commuter train strikes and steep fair rises of rail and regional and local transport. The aim of the current mayor is to shift transport modes toward cycling, walking and public transport.

In the London Mayor's Transport Policy 2018 the target of mode share is in 2041: 20% car, taxi, private hire vehicle - 80% walking, cycling, public transport for 33 million day trips, from 2015: 37% car, taxi, private hire vehicle - 63% walking, cycling, public transport for 26.7 million day trips

5.2.4 Energy strategy, consumption reduction targets and energy efficiency measures

The London Energy and Greenhouse Gas Inventory (LEGGI) presents the factual situation of energy consumption and level of carbonisation of London for all sectors (homes, workplaces and transportation from 2008 to 2017.[17]

London's energy consumption was 134,653 GW in 2017 in total (54,829 GW domestic, 47.727 GW industrial and commercial, 32,098 GW transport). This compares with 149.388 GW in total in 2009 (63,462 domestic, 54,413 industrial and commercial, 32,479 GW transport). [18] London's CO2 emissions from energy use were 30.3 mt, a 30% reduction on 1990 levels, and a 40% reduction since peak emissions in 2000. This is despite an increase of population by nearly 30% since 1990. London's per capita emissions are estimated at 3.4 t of CO2e in 2017, down from 3.5 of CO2e in 2019.

London's energy strategy includes measures to reduce electricity consumption,[19] decentralise energy generation, decrease fossil fuel use and increase renewable energy use. Energy consumption has indeed declined in London since 2009, but for various reasons and efficiency measures are among them. The Draft London Plan is poor in is-state data on energy consumption, CO2 emissions, energy status of building stock, etc. not least because sources of information are fragmented and often privatised. This may pose a problem

[15] . source: C40 Cities, 111103. https://www.c40.org/case_studies/londons-congestion-charge-cuts-co2-emissions-by-16

[16] Evening Standard, 180701. Cycling in London at record levels.

[17] LEGGI, London Energy and Greenhouse Gas Inventory.2008-2017 https://data.london.gov.uk/dataset/leggi

[18] Source LEGGI, https://data.london.gov.uk/dataset/leggi

[19] London's electricity consumption in 2013 was 39,337 GWh (source: London Environmental Strategy, 2018 GLA), as opposed to 14.000 kt oil equivalent (see 2009 table).

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for proper monitoring of the effectiveness of the targets. Natural gas consumption has decreased in London by 25% since 2000, according to the London Energy and Greenhouse Gas Inventory (LEGGI).

A key problem with all these targets is that the Greater London administration does not have the competence of implementing most of them and has to rely on the London Boroughs to act upon their own housing stock and transport fleet, and mainly on the private sector which owns and supplies the bulk of London's built environment. Nevertheless, the Mayor of London has competences over a number of specialised agencies: Transport for London, the London Development Agency (Olympic site), the London Fire and Emergency Planning Authority, the Metropolitan Police. He can influence their operational actions directly and make them lower adverse effects on climate change in the Framework of the London Plan. The London Plan has also certain powers to influence the London Boroughs, through guidance toward lowering adverse climate change impacts and reducing GHG emissions. The key actions focus on transportation, retrofitting existing building stock and standards for new build.

It has to be stressed that targets are not reality, and measures to implement them are of the essence at all levels. Monitoring results show that most of these targets are not met within the prescribed timeframe. Nevertheless setting targets it useful to mobilise public opinion and change behaviour.

Overall, the current mayor has adopted the 2050 zero carbon target for London in 2016 and laid down implementation objectives in his Draft London Plan. Quite a few actions can be undertaken by the Greater London Authority itself and the agencies under the Mayor, in particular Transport for London, but the majority of its targets will need to be pursued by lower tier authorities, the London Boroughs and the private sector which owns the energy utilities and some transportation networks in London.

However, while targets have been made more ambitious, their realisation lags behind when measured at interim periods which would require increasingly stringent actions to achieve a carbon neutral state in 2050. It means also more efforts to reach consensus and cooperation from all stakeholders who will weigh up how achieving these targets will affect their habits, living standards and aspirations against saving them and the planet from climate crisis.

6 CONCLUSIONS

Environmental concerns are not new and have evolved over time. A major wave of environmental awareness occurred in California in the 1960s, followed and sustained elsewhere. The language was different then. Activists talked about environmental protection, ecological footprint reduction and balancing the eco-system. In the 1970s the Gaia hypothesis (Earth System Science in the USA) of perpetual conditions for life became popular. [20]

The discussion shifted to global warming in the 1980s and to climate change in the 1990s. Greenhouse gas emissions from energy production and use were already mentioned as harmful in the 1950s and NASA studied their evolution from the 1970s to today. Global warming became a political issue with governments which were setting targets and promising action. In the 21st century the discussion moved to the green economy combined more recently with the circular economy. In 2020, climate change gained political and market attention at the World Economic Forum in Davos. Safe on the benefits of trees, little consensus transpired on a way forward though. The UN was and remains actively involved in curbing adverse climate change effects, but as a voluntary intergovernmental agency it has little power over global action.

At national level, politicians have more control over their commitments and actions than international agencies. Both Spain and the UK have signed up to the Paris Agreement, and introduced a target of zero carbon emissions by 2050. Moreover, they have introduced strategies for practical measures to achieve these goals.

Implementation however is mainly in the hands of lower tier administrations and in market economies in those of the private sector, besides individual behaviour change. Clearly, operational interventions are mainly carried out by regional and city governments and private industry. Community groups and individuals also play a role by both realising local schemes and exercising pressure as consumers which can influence industry and commerce. Indeed, large corporations have started to rethink their attitudes and even take measures toward climate change concerns, while some investors have moved their assets out of fossil

[20] James Lovelock. Gaia, a new look at life on earth, 1979, Oxford Landmark Science.

fuels. Company accounting standards for climate related risks and a price on carbon may accelerate that, although many firms still resort just to 'greenwash'.

Looking back at two decades of climate change and its responses in Spain and Madrid and the UK and London, what are the lessons to be learnt? A number of overarching issues seem to emerge from the empirical data and the changing debate on the future of the planet.

6.1 Climate change targets

Ambitious climate change targets have been set at both the state and city levels, but their materialisation seems very unlikely. So the question is, should their decision makers abandon targets or reduce them to more doable levels or should they tag their visions high as an incentive for others to follow?

Despite tangible effects of climate change any consensus on what goals to adopt and what actions to undertake seems to be difficult to achieve both at city and national level, and even more so by the international community at global level.

A major impediment to climate change mitigation and adaptation which by nature are long term is the political system with its short term cycles and its often abrupt swings between opposite parties. In this complex game key players make their moves at their convenience, but subject to specific rules: the international level dependent on national interests, the European Union as guarantor of collective compliance, the nation states dependent on the economy and the political constellations, the municipalities dependent on votes, and civil society according to their beliefs and prejudices. Moreover, at all levels the players are divided between those who believe that the planet has reached its limits and those who let others make the sacrifices.

6.2 Political power swings

The paper corroborates that every democratically elected swing of political power tends to reverse previous directions of travel and seriously undermine long term progress of combating adverse effects of climate change, despite some efforts at both national and local levels of future proofing such actions. Only a multiparty adoption of remedial objectives stands a chance of realisation. Similar differences of opinion permeate the private market and sometimes civil society, in particular opposing protagonists of the circular green economy to those who believe in purely technological fixes which would enable them to continue with business as usual.

6.3 Actions by civil society

Increasing consumer pressure for sustainable products and services may influence the corporate world, but dependence on energy and fear of declining living standards may overrule such change also among consumers. International 'green' pressure groups requesting sustainable alternatives to current practices and their detrimental impact on global warming, as well as local communities which undertake measures to curb global warming may draw attention of the media but do not command the necessary critical mass to enforce radical change. Not surprisingly in a world where global corporations are often more powerful and wealthy than sovereign countries even in representative democracies the electorate does not necessarily obtain actions to mitigate greenhouse gas emissions promised in political manifestos.

6.4 Who is leading climate change action of the future?

The question remains of where the combat against global warming is going from here, and who will be responsible to lead it in the future? The last word ought to remain with the very young who will have to live with the consequences of the rapid march to global warming. The deserve all the support of those who try to understand the phenomenon and are searching for practical solutions.

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🏆 *reviewed paper*

Co-Creation and Sustainable Urban Planning: Who Co-Creates Sustainable Mobility Solutions at the Neighbourhood Level? Experiences from the Horizon 2020 Project "Sunrise"

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1 ABSTRACT

Co-creation is applied as a key concept to develop, implement, assess, and facilitate learning about new ways to address urban mobility challenges at the neighbourhood level in the HORIZON 2020 project SUNRISE[1] ("Sustainable Urban Neighbourhoods - Research and Implementation Support in Europe"). SUNRISE's objective is to contribute to sustainable urban development by stimulating co-creative processes and problem solutions in neighbourhoods in the field of new mobility concepts and new forms of mobility. Towards this aim, six cities (Bremen, Budapest Jerusalem, Malmö Southend on Sea, Thessaloniki) are fostering comprehensive collaborative processes with various actors in specific neighbourhoods with the explicit mandate to implement sustainable mobility solutions.

The involvement of different actors is an important aspect and a challenge for co-creation processes. On the one hand, the involvement of residents and other stakeholders in sustainable urban planning is seen as promising. in terms of achieving better results to improve the adaptability of socio-ecological systems. On the other hand, there are often questions such as: "who is participating?", "how can different actors be reached?" and "what results can be achieved with co-creation?". This paper provides answers to these questions based on experiences from co-creation processes in the SUNRISE project. After defining and embedding the term co-creation in planning theory, this paper gives an overview of the involved actors in the co-creation processes in SUNRISE, the co-creation activities carried out, and the mobility solutions developed on the neighbourhood level. Finally, the challenges of involving various actors in co-creative processes and the opportunities for co-creation when planning sustainable mobility solutions on the neighbourhood level will be discussed.

Keywords: Sustainable Mobility, Mobility Planning, Participation, Co-Creation, Neighbourhood

2 INTRODUCTION

New calls for transformational development processes and fresh urban planning agendas are being fuelled by the effects of climate change, discussions about necessary shifts in energy and transport, as well as the demand for liveable cities. In urban planning, participation is considered an important element in promoting sustainable spatial development (Zimmerman & Höflehner 2016: 1). In participatory planning, residents and other stakeholders are invited to participate in planning or decision-making processes with the idea that participation can influence the content of planning (see Healey, 1997; Innes, 1998; Innes and Booher, 1999). The involvement of residents and other stakeholders in urban planning is seen as promising, for example to achieve better results and improve the adaptability of socio-ecological systems (Healey, 1997; Innes and Booher, 1999; Olsson et al., 2004).

Participatory planning allows for integrating the needs and requirements of local stakeholders into urban planning and is often seen as a good lever to solve urban challenges (Zimmermann & Höflehner 2016: 1). Nevertheless, existing participation practices in urban development are partially insufficient to address new demands and needs arising from these urban problems creating dissatisfaction among stakeholders. Furthermore, participatory planning processes are often criticized for inefficiency. Residents and other actors are disappointed with the lack of opportunities to have an influence on the planning process while planners remain uninformed about residents' concerns, experiences, and the local conditions (Reed, 2008; Grönholm, 2009). Therefore, urban planners, policy makers, and citizens are experimenting with new collaborative approaches like co-creation to tackle persistent urban issues, such as climate change adaptation, quality of life, and urban inequalities (Puerari et al. 2018: 1).

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In the HORIZON 2020 project SUNRISE, co-creation is the key concept applied to the development, implementation, assessment, and facilitation of learning about new ways to address urban mobility challenges at the neighbourhood level. SUNRISE's objective is to contribute to sustainable urban development by stimulating innovative, participatory, and problem-solving processes in neighbourhoods in the field of new mobility concepts and new forms of mobility. Towards this aim, six cities including Bremen, Budapest, Jerusalem, Malmö, Southend on Sea, and Thessaloniki apply comprehensive collaborative processes in specific neighbourhoods. Their explicit mandate is to foster and implement innovative solutions for and with their residents and other actor groups.

The involvement of different actors is an important aspect of and challenge for co-creative urban planning processes. On the one hand, the involvement of residents and other stakeholders in sustainable urban planning is seen as promising, like to achieve better results and improve the adaptability of social-ecological systems. On the other hand, there are often questions such as: "who is participating?", "how can different actors be reached?" and "what results can be achieved with co-creation?". This paper provides answers to these questions based on experiences from SUNRISE co-creation processes for planning sustainable mobility solutions on the neighbourhood level. After defining and embedding the term co-creation in planning theory, this paper gives an overview of the involved actors in the co-creation processes in SUNRISE, the co-creation activities carried out, and the mobility solutions developed on the neighbourhood level. Finally, the challenges of involving various actors in co-creative processes and the opportunities to co-creatively plan sustainable mobility solutions on the neighbourhood level will be discussed.

3 CO-CREATION AS NEW FORM OF PARTICIPATORY PLANNING IN SUSTAINABLE URBAN DEVELOPMENT

3.1 Co-Creation: A new term in urban planning

In urban planning, participation is an important element in promoting sustainable spatial development. New participatory concepts like co-creation are developing and spreading worldwide, with the aim of supporting sustainable urban transition and transformation. Originally conceived in the 1990s as a new business strategy for customer engagement (Leading Cities 2014: 1), co-creation is an increasingly common concept in the context of urban planning today integrating various actors in planning processes to create something together (Schönfeld et al. 2019: 1). However, the concept of co-creation in urban development is by no means clear and well-defined (Leading Cities 2014: 3; Lund 2017: 29; Puerari et al. 2018: 4).

In the program "ERA-NET Cofund Smart Urban Futures", the European Commission defines co-creation as "an approach where heterogenous actors collaborate to produce knowledge, instruments, technology, artefacts, policy, know-how, etc." (JPI Urban Europe 2016: 52). Schneidemesser et al (2019: 3) add a processual aspect and define the concept of co-creation based on the following three dimensions:

- In a social dimension, co-creation describes a reciprocal exchange-based collaboration between heterogeneous actors.
- In a material dimension, co-creation describes how the interaction of different perspectives generates something unexpected, which the involved actors can use.
- In a temporal-spatial dimension, co-creation describes those processes that enable relatively autonomous actors to exchange ideas or to create values together.

From this perspective, co-creation is a form of collaboration in which knowledge, instruments, technology, artefacts, policy, know-how, plans etc. are created through an ongoing process among heterogeneous actors (Schönfeld et al. 2019: 3). The research group Leading Cities (2014: 3) identify the heterogenous actors and define co-creation as "the active flow of information and ideas among five sectors of society: government, academia, business, non-profits, and citizens - the Quintuple Helix - which allows for participation, engagement, and empowerment in developing policy, creating programs, improving services, and tackling systemic change with each dimension of society represented from the beginning".

In summary, co-creation is characterized by the fact that heterogeneous actors from different sectors are mobilized in a collaborative process to create something together. Based on the definitions above, Haufe & Franta (2019: 55) understand co-creative urban planning as the set of interconnected processes in which heterogeneous actors mutually interact and work together to develop answers to urban challenges in the form

of knowledge, instruments, technology, artefacts, policy, know-how, and plans, etc. (Haufe & Franta 2019: 55).

In contrast to traditional participatory practices in urban planning, which still often only aim at engaging citizens, the inclusive nature of co-creation provides the public, private, non-profit and academic sectors as well as citizens themselves the opportunity to serve as equal stakeholders. In co-creative processes, new forms of cooperation and mutual learning processes emerge between actors among different sectors of society (Zimmermann & Höflehner 2016: 1-2). In order for this to happen, it is necessary to socio-culturally (open of diverse group of participants), strategically (thematic openness, open-ended results, open structures) as well as operationally (open flow of information, knowledge and ideas) open up the processes (Raffl et al. 2014: 47). Doing so provides the opportunity for everyday and expert knowledge to work together to solve problems and to develop ideas (Petrin 2016: 163). Co-creative urban planning thereby focuses on integrating different forms of knowledge into urban processes in order to create innovative solutions for complex urban problems (Haufe & Franta 2019: 58).

What further distinguishes co-creation from other participation initiatives is the involvement of the various stakeholders from the beginning to the end of the planning process. Rather than ask people to “plug into” existing pre-determined programs, initiatives, or campaigns, co-creative approaches should help people form and promote their own decisions, create new stakeholder maps, and develop open-ended processes (Leading Cities 2014: 5). Co-creation is ideally an endless process and can be understood as an overarching development philosophy (Davis & Andrew 2016: 653). Therefore, co-creation focuses primarily on long-term culture change, rather than on short term outcomes, issues, or achievements, and includes a cross-section of entire communities rather than parts of them (Leading Cities 2014: 5). In this sense, co-creation is not only an approach for creating product or service innovation, but also a way of creating social innovations such as the intentional reconfiguration of social practices like collectively shared values, knowledge etc. (Puerari et al., 2018: 5).

In recent years co-creation has become a buzzword in urban planning and is often also seen as a new concept in planning. However, as a form of collaboration among multiple actors, the concept of co-creation in planning is based on participatory literature of previous decades. The following section shows that co-creation is not a new concept but rather a concept based on the communicative and collaborative planning theory developed within the last four decades.

3.2 Urban planning as collaborative practice

In response to the growing crisis of technocratic planning in the 1970s, various planning approaches in the 1980s and 1990s focused on the stronger involvement of different actors in planning processes. With the realisation that expert knowledge alone did not achieve the ‘optimal’ solutions for spatial development, a new paradigm of planning developed, which defined planning as a communicative practice (e.g. Forester 1989, Healey 1992, Innes 1995, Selle 1996). This new planning paradigm is based on an understanding which recognises the diverse ways of living that exist in pluralist societies. In comparison, traditional planning focuses on scientific rationalism in a culturally homogeneous community with a public interest (Healey, 2006). In planning literature, this change is also called "communicative turn" or "argumentative turn" (Forester 1989, Healey 1992, Healey 1996). Several scholars (Innes and Booher 1999; Margerum 2002; Healey 2003; Maginn 2007; Lofgren and Agger 2008) have also defined this new planning paradigm as collaborative planning.

Patsy Healey, one of the main proponents of collaborative planning, outlines that a city its residents identify with requires the inclusion of the diverse urban actors and the actors’ various interpretations of the city in the planning process (Healey 2002: 1778). The collaborative understanding of planning assumes that common solutions to planning problems can be found only through participation of all relevant actors, the consideration of their life worlds and the creation of political communication and cooperation structures (Healey 1997). The focus is on negotiating a consensus that represents the best possible solution for all involved (Streich 2005). Collaborative processes thus include the articulation of different interests, the critical questioning of expert opinions, the agreement on relevant topics and content, the formation of opinions and a final decision, which everyone can agree upon (Innes 1996). The aim is to overcome one-sided communication between government or experts and the population by initiating active exchanges

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between all state, economic, and civil society actors (Innes and Booher 2004) to establish a common understanding for future planning (Healey 1992).

Collaborative planning theory approaches operate at the intersection between planning bureaucracy and actors in society (Ipsen 2010: 238). These collaborative planning approaches question both, the hierarchical relationship between bureaucracy and societal actors, and the role of state-sovereign planning as the only planning authority. Instead, a consensus-oriented planning process is designed in which the legitimacy of planning practices only can be produced by negotiating with various public and private actors (Gribat et al. 2017: 10). According to communicative planning perspectives, participation is at the root of planning (e.g. Friedman 1987 & 1989, Healey 1992, Innes 1995). To plan according to this view is to communicate, argue, debate, and engage in a discourse for the purpose of aligning attention and defining the possibilities for action (Puerari et al. 2018: 4).

Habermas' theory of communicative action (1981) and his discourse ethics (legitimacy, truth, accessibility, argumentation logic) provided the basis for communicative and collaborative planning (Ipsen 2010: 238). Healey described collaborative planning as "a new form of planning, a respectful argumentative form of planning through debate, appropriate to our recognition of the failure of modernity's conception of 'pure reason', yet searching, as Habermas does, for a continuation of the Enlightenment project of democratic progress through reasoned inter-subjective argument among free citizens" (Healey 1992: 160).

The distinguishing feature of collaborative planning to technocratic planning is that it delegates the responsibility for planning directly to involved actors (Gunton & Day 2003: 6). It encourages people to engage in a dialogue in a situation of equal empowerment and shared information, to learn through mutual exchange, to create innovative outcomes, and to build institutional capacity. The dialogue promotes sharing information, understanding the perspectives of other partners, and creating innovative results. Institutional capacity, which is considered a combination of social, intellectual, and political capital, proliferates through networks of mutual trust and makes civil society more competent (Innes and Booher, 2004; Healey, 2006). The collaborative process is a cycle that includes dialogue, trust building and commitment, shared understanding, and (intermediate) outcomes (Purbani 2017: 138).

Co-creation is a form of collaboration in which knowledge, instruments, technology, artefacts, policy, know-how, plans etc. are created through ongoing process among heterogeneous actors (Schönfeld et al. 2019: 3) This section showed that co-creation is not a new concept but is rather based on the communicative and collaborative planning theory developed in the last four decades. Nevertheless, co-creation has become a buzzword in urban planning because urban planning today is based on the assumption that urban spaces have a social significance that cannot be met by technocratic planning alone. The increasing demands on the city require an approach that takes the needs and perspectives of different actors into account in an inclusive and democratic manner. For this reason, it is important to keep an eye on the diversity of urban society in order to ensure constructive development of topics and processes that are difficult to predict (Grünzel 2014: 75).

When arenas for mutual exchange and collaborative planning are created, the focus is on questions such as "Who is participating?", "How can different actors be reached?", "What is being negotiated?". With the Horizon 2020 project SUNRISE as an example, the following section will analyse the implementation of co-creative processes with local actors for finding sustainable mobility solutions at the neighbourhood level.

4 CO-CREATION IN PRACTICE - THE HORIZON 2020 PROJECT "SUNRISE"

4.1 Development of sustainable mobility solutions at the neighbourhood level: The Horizon 2020 project SUNRISE

Since the Paris Climate Accord of December 2015, it is clear global carbon dioxide emissions will have to be dramatically reduced if global warming is to be limited to 1.5 degrees compared to the pre-industrial era. For the mobility sector, this means the need for (infra-)structural and behavioural changes in addition to the phasing out of fossil fuels also at city level. In 1989, Newman and Kenworthy were able to determine in an international comparative study of urban regions that the use of cars, the volume of traffic, and the energy requirements of transport negatively correlated with the density of settlements. These results are an argument for compact, mixed-use neighbourhoods, which not only helps to reduce greenhouse gas emissions, but also offer great potential for the attractive design of cities and neighbourhoods (Neumann 2010: 207). Therefore,

neighbourhoods are increasingly becoming the focus of sustainable urban development (Roselt, 2016: 1). For co-creation, neighbourhoods may be ideal "real-life laboratories" to experiment, learn, and advance transformation which ideally has a positive impact on the entire city (Brocchi 2019: 250).

In the HORIZON 2020 project SUNRISE ("Sustainable Urban Neighbourhoods - Research and Implementation Support in Europe"), co-creation is the key concept to develop, implement, assess and facilitate learning about new ways to address common mobility challenges at the neighbourhood level. Towards this aim, six SUNRISE cities (Bremen, Budapest, Jerusalem, Malmö, Southend on Sea, Thessaloniki) are fostering collaborative processes in specific neighbourhoods as "Neighbourhood Mobility Labs" with the explicit mandate to implement innovative solutions for and with their residents and other actors.

All SUNRISE activities are structured along the phases of the innovation chain and based on co-creation. In a multi-stage process, actors from different sectors of society jointly identify mobility-specific problems in the neighbourhood and cooperatively develop mobility solutions. These mobility solutions will be jointly implemented as part of the SUNRISE project. Continuous monitoring and evaluation accompany the co-creation process in SUNRISE as well as dissemination and learning activities.

The co-creation processes in each SUNRISE neighbourhood are initiated by local city partners from administration, community management or by integrated planning offices. A steering committee called "Core Group", composed of different local actors representing their neighbourhood, steers the co-creation process. For the collaborative planning processes, each SUNRISE action neighbourhood combines various methods and tools to bring together citizens and other stakeholders to learn from each other in order to address urban challenges in transforming neighbourhoods and cities.

By halfway through the project duration (05/2017 to 04/2021), all SUNRISE neighbourhoods have completed the phase of problem identification and measure development. Reaching such a milestone calls for reflection upon several aspects of the SUNRISE project such as involved actors, the methods and tools of collaboration applied and the outcomes of the co-creative processes so far..

4.2 Actors in the process of problem identification and mobility solution development

In general, co-creation is characterized by the fact that heterogeneous actors from different sectors are mobilized in a collaborative process to create something together. The research group Leading Cities (2014: 3) delineate the different actors and define co-creation as "the active flow of information and ideas among five sectors of society: government, academia, business, non-profits, and citizens - the Quintuple Helix - which allows for participation, engagement, and empowerment in, developing policy, creating programs, improving services, and tackling systemic change with each dimension of society represented from the beginning."

The SUNRISE mission is to develop, implement, assess and facilitate co-learning about new, collaborative ways to address common urban mobility challenges at the urban neighbourhood level. The conceptual key-term of this project is the idea to "co-create" a more sustainable mobility future. Therefore, local actors and other stakeholders should be involved in all phases to live up to SUNRISE's "co-creation" spirit. By means of regularly-updated stakeholder mapping exercises, relevant actors for co-creating sustainable mobility futures were identified collaboratively in each partner city, showing a diverse actor composition unique for each neighbourhood. Table 1 shows the actors that took part in defining mobility problems and developing and selecting measures across all SUNRISE neighbourhoods.

Despite the broad range of actors in the SUNRISE processes, government, academia, business, NGOs, citizens and media rarely collaborate directly in physical space. Rather, these local initiators of the co-creation processes collect the information, ideas, and solutions proposed by the individual groups of actors and pass them on to other groups of actors.

Central aspects of the concept of co-creation is the openness for diverse groups of participants, the thematic openness as well as open flow of information, knowledge and ideas (Raffl et al. 2014:47). Co-creation focuses on an ongoing and iterative collaboration (Davis & Andrew 2017: 653), but as every open planning process, co-creation also needs shared information in order to achieve innovative outcomes (Haufe & Franta 2019: 57). Therefore, SUNRISE shows that beyond the Quintuple Helix (government, academia, business, non-profits, and citizens), the media sector is an important actor for promoting the flow of information

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including knowledge of and ideas from the co-creation processes. In the SUNRISE neighbourhoods, the local newspapers were particularly important to inform the actors of the different sectors of society about the current status of the co-creation processes and the opportunities for participation. Local newspapers also spread mobility-related knowledge about the developed ideas to the wider public.

Sectors of Society	Actor Groups
Government	district administration, district development agency, members of the district parliament, district mayor, departments of the city administration (environment, transport, urban planning, education, work, social affairs, tourism, business development, communication)
Academia	universities
Business	local businesses, real estate / housing companies, business associations, tourism associations, representatives from planning, architecture, participation, industrial design
Non-Profits	cultural associations, traffic associations, representatives of the police, the fire brigade, healthcare, mobility providers, educational institutions, schools, youth centres, cultural centres
Citizens	residents, citizens' initiatives, citizens from other neighbourhoods, seniors, youth, students, parents
Media	local newspapers

Table 1: Actors of the co-creation process in SUNRISE (adopted from Haufe & Franta 2019: 66)

In collaborative planning processes like co-creation, residents and other actors are invited to participate in planning or decision-making processes with methods such as questionnaires, web forums, public meetings, and field trips, with the idea that participation can influence the content of planning (Faehnle & Tyrväinen 2013: 332). In diverse actor settings (see Table 1), specific attention has to be paid to methods and tools in order to be able to target each actor according to their needs. Methods which were used for the co-creative problem identification and mobility solution development in SUNRISE and actors which were reached with these methods will be covered in the next chapter.

4.3 Methods for the co-creative problem identification and mobility solution development in SUNRISE

A co-creation process has specific requirements which define the successful, purposeful, and inclusive involvement of heterogeneous actors. Therefore, selecting suitable methods and tools out of the plethora of participation formats available is an important aspect. The local actor setting needs to be taken into account for defining and selecting suitable methods and tools for co-creation. In principle, a method or tool may be aimed at the general public and thus to all interested actors in order to reach as many potential actors as possible. A method may, however, also target a selection of representatives from different interest groups or to all those directly affected by a particular topic or the subject-matter of the participatory procedure. In order to address various target groups in co-creation processes, it is useful to apply a mix of methods. A good mix consists of different, complementary methods (Senatsverwaltung Berlin 2011: 160) that promotes dialogue in a situation of equal empowerment and shared information in order to enable the exchange of mutual learning, to create innovative outcomes, and to build institutional capacity.

Every co-creation process and every single method of participation needs to take local culture, customs, and socio-spatial context into account. Spaces and places in the neighbourhood are needed not only because they provide the relevant conditions to facilitate interaction among and access to actors, but also because they bring innovative ideas and resources which catalyse interactive learning and innovation (Puerari et al. 2018: 6). Therefore, in order to reach the different target groups in the SUNRISE neighbourhoods, people were addressed in their everyday life spaces (markets, subway stations, squares, etc…), in "learnt" spaces (schools, museums, community centres, etc…), and local networks (sports club, folklore groups, etc...). Given the trend of digitization, the importance of digital tools in developing urban solutions is growing, especially if urban planning is understood as a collaborative societal effort. Digital tools also create options for integrating local actors into decision-making and implementation processes relevant to urban development (Dübner et al. 2018: 141). Therefore, the SUNRISE action neighbourhoods combine a blend of offline and online methods to bring together heterogeneous actors around shared information, to learn from each other and create new mobility solutions.

An important aspect at the beginning of the co-creation processes in SUNRISE were public events in the neighbourhoods. The objective of these public events was to inform as many people as possible about the process and encourage them to participate. Citizens and other stakeholders were invited to SUNRISE-specific events like the public meeting, but also market-type stands at public street festivals or other events in the neighbourhood where informational material and plans were shared to involve the visitors in the SUNRISE process. At the beginning, the public events were used to advertise the co-creation process and spark interest in participating. During the process, these formats were also used to inform about the current status of the SUNRISE process. Depending on the type of event, different groups of actors can be reached. These public events in SUNRISE were aimed mainly at "citizens", but actors from government (district mayor, district and city administration, members of the district parliament), business (local businesses, business association, tourism association) and the "non-profit "sector (representatives from cultural associations, healthcare, youth / cultural centres from the neighbourhood) also participated at these events. From the sector of media, representatives joined the public meetings to report on SUNRISE. In addition, an often-used method to involve the wider public was an on-tour series of smaller activating events where problems, needs, and ideas are collected via mobile stands in various highly-frequented locations in the public space (streets, market places, shopping centres, cultural centres, train stations, schools, universities etc.). The mobile stands at different locations can reach a large number of people on the one hand and specific user groups on the other by visiting places where these groups can be found. Through the direct exchange, this method can not only be used to share information, but also to learn from each other and to create innovative outcomes. This can happen through a more extensive exchange by discussing ideas together, negotiating advantages and disadvantages and discussing further cooperation especially when smaller groups meet at the mobile stands and engage in a conversation. Different groups of actors can be reached with the mobile stands. In SUNRISE, this method enables reaching a wide range of interested citizens from the neighbourhood and from other neighbourhoods who work, shop or have any other business in the neighbourhood as well. Especially if set up near schools, playgrounds or parks, specific sub-groups of the sector citizens like pupils, youth, parents, and seniors could be reached via these mobile stands. Also, in some SUNRISE neighbourhoods, information points have been created as a point of contact for residents and local actors. In order to operate information points in a way that conserves resources and at the same time intensifies the network of the project within the neighbourhood, cooperation's with local associations, community centres or other NGOs were established. Embedding the information centres in this way through cooperation's allows multiplier effects to be used in the neighbourhood and to build institutional capacity. The visibility and perception of SUNRISE was also increased by various public relations activities (flyers, posters, press releases, etc.) in the neighbourhood. Mainly local actors (citizens, non-profits, businesses) in the SUNRISE neighbourhoods could be reached with these methods.

Furthermore, the SUNRISE cities used methods for co-creation that are based on a selection of representatives from different interest groups or to those directly affected by a particular topic. An important part of the co-creation process in SUNRISE was an entity called "Core Group", which was formed with the aim of serving as a steering committee to accompany the whole process. The Core Group consists in most neighbourhoods of a stable group of 5 to 10 committed people, some of whom operate on an honorary basis while others are members of the city administration or from local politics. The main purpose of the Core Group is to guarantee transparency for the process and its contents internally and externally. Through regular updates, the core group ensures the flow of information in the processes, advises and reflects on the process, and communicates transparently to the wider public, media etc. In most neighbourhoods, the Core Group was also consulted when decisions had to be made, whether of a substantive or procedural nature. In this way, the Core Group served as a co-creation method, not only to promote dialogue in the process, but also to learn from the process through reflection and to advise and co-validate decisions.

A central aspect of the co-creation processes in the SUNRISE neighbourhoods were workshops in which a selection of representatives from different interest groups could participate in defining the problems and developing the measures. Playful approaches with building blocks or other materials in combination with maps or orthophotos have greatly promoted the exchange and creativity among the participants. In the phase of measure development, the workshops proved to be fundamental: design workshops, mini-future workshops or similar activities were used in the SUNRISE neighbourhoods to elaborate the content of the mobility solutions and to locate them in the neighbourhood. In addition to the development of measures, the

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workshop formats also offered the opportunity to discuss, adapt, and select specific measures. Therefore, workshops in SUNRISE offered the generation of information, dialogue but above all collaboration between selected interest groups to create innovative outcomes. The workshop formats in the SUNRISE neighbourhoods allowed the involvement of different groups of actors, for example, citizens (residents, pupils, youth, seniors), government (district and city administration), businesses (housing companies, local businesses, business association, tourism association, representatives from architecture, planning, industrial design), and non-profits (cultural associations, traffic associations, fire brigade, police, educational institutions, youth centre, mobility provider). In general, actors from academia rarely took part in the SUNRISE processes. Only in workshops did academic partners from within the SUNRISE project (representatives from international universities) involve themselves as consultants.

The aim of the SUNRISE process was not only to involve the usual suspects who regularly share their points of view, but also the perspectives of hard-to-reach groups (e.g. older people, children, young people, people with a migration background or people with disabilities). Therefore, various methods were used to address specific groups. These were, for example, walks through the neighbourhood with people with disabilities or targeted interviews in retirement homes, schools, and community centres. The methods had a mainly informative, but in some cases also a conversational nature which increased the inclusivity of the engagement methods. In addition, excursions were also used to take a look beyond the borders of the neighbourhood to get ideas or learn from best practice examples. In SUNRISE, excursions as a method were used for selected actors who participate with long-term commitments (in SUNRISE, the members of the "Core Group") to visit other cities that are facing similar challenges but have already developed or implemented solutions.

In addition to face-to-face methods, digital tools also create options for integrating different groups of actors and provide opportunities for information, dialogue, learning and creating innovative outcomes. In SUNRISE, mainly neighbourhood-specific project websites were used as an online tool for actor information and involvement. The websites were used as virtual information centres, where all information material is made available. Some SUNRISE-neighbourhoods, a web-based mapping forum was implemented through the website. The objective of this forum was the collection of geo-referenced problems, needs and ideas, which are subsequently rated or commented by other users. Websites and online tools in SUNRISE were largely aimed at sharing information with the wider public. Through an exchange among each other (e.g. in SUNRISE the mapping tool), moments of dialogues and co-creation can also be generated, especially if the online tool allows open discussion and has the option for joint steps in the direction of common ideas or vision development. Digital tools create options for integrating the wider public into co-creation processes, but many online tools like the mapping tools in SUNRISE have the disadvantage that it remains often unknown who participated.

4.4 Developed mobility solutions and side effects of the co-creation process

Co-creation is characterized by the fact that heterogeneous actors from different sectors are mobilized in a collaborative process to create something together (Haufe & Franta 2019: 55). Co-creation can have two distinct goals: One purpose of the co-creation can be "making" together a situation where people work together towards an output such as a product, service, or process innovation. A second purpose of co-creation can be "learning" together through situations where actors collaborate towards building knowledge, learning from one another, and creating networks between actors (Puerari et al. 2018: 4). Frequently, both goals are sought, though often the "making together" or the output is in the focus of co-creation in every day practice.

In the co-creative processes of the six neighbourhoods in SUNRISE, a total of 33 solutions for the identified mobility problems of the respective neighbourhoods were developed. Between three and nine mobility solutions were developed for each neighbourhood. The mobility solutions result from the individual neighbourhood-specific, co-creative processes and reflect the respective problems of the neighbourhoods, but can be divided into six categories:

- Public space (10 measures): As part of the co-creative processes, a number of improvements for the quality of stay in public spaces were developed. These include the construction of street furniture (in particular benches), the greening of squares and streets, additional opportunities for children to play, and activities (e.g. festivals, events, initiatives with specific focuses in cooperation with local associations) in public spaces to increase the feeling of security.

- Bicycle traffic (8 measures): Improvements for bicycle traffic were a result of the co-creative processes in five of six SUNRISE neighbourhoods. The measures developed include the installation of bike racks at central locations in the neighbourhoods and in housing complexes, the establishment of rental stations for cargo bikes, the redesign of bicycle underpasses and intersections, as well as information campaigns for the use of bikes in the neighbourhood and the intermodal use of the bike.
- Pedestrian traffic (7 measures): Mobility solutions for pedestrian traffic were developed in all SUNRISE neighbourhoods. In many neighbourhoods, the focus was on improvements of school routes, including information and education campaigns for safe and sustainable school routes as well as a walking bus ("school bus on foot") for kindergarten children and pupils. In addition, pedestrian routes in the neighbourhood will be redesigned and pathfinding improved.
- Motorized private transport (6 measures): In three SUNRISE neighbourhoods, measures were developed that aim to reduce motorized private transport. The measures developed include the establishment of Tempo 30 zones, targeted parking management and micro-hubs for delivery services and car-sharing stations. Measures for sustainable and safe school routes have also been developed, including measures to reduce delivery and pick-up traffic by means of motorized individual transport and kiss & ride zones in front of schools and kindergartens.
- Local public transport (2 measures): In only one SUNRISE neighbourhood, measures for local public transport were developed. The focus here is on public transport stops, including measures to improve the quality of stay at stops as well as improved information through timetables, neighbourhood maps, and real-time information.

In addition to the mobility measures developed, SUNRISE showed that the co-creation process produces side-effects due to the opportunity to "learn" together, to build up knowledge and to create networks between people. New collaborations and learning processes developed between departments of the city administration that had never worked with each other before in some SUNRISE cities. The co-creative development of mobility solutions with and for the neighbourhood also created new collaborations and learning processes between local actors. For example, in a SUNRISE neighbourhood, residents organised in an initiative that wants to implement a temporary SUNRISE measure on a permanent basis. These side-effects are an indicator that co-creation is not only an approach for creating product or service innovations, but also a way to create social innovations, responsibility, identification, and acceptance of mobility solutions in context.

5 CONCLUSION

In the context of urban planning today, co-creation is an increasingly common concept to integrate various actors in planning processes to create something together. In general, co-creation is characterized by the fact that heterogeneous actors from different sectors are mobilized in a collaborative process to create something together. Co-creative urban planning can be defined as the set of interacting processes in which heterogeneous actors mutually interact and work together to develop answers (e.g. knowledge, instruments, technology, artefacts, policy, know-how, plans etc.) to urban challenges.

Nowadays, co-creation has become a buzzword in urban planning and is often also seen as a new concept in planning. This paper shows that co-creation is not a new concept but based on the communicative and collaborative planning theory developed in the last four decades. Co-creation is a form of collaborative planning practice in which knowledge, instruments, technology, artefacts, policy, know-how, plans etc. are created through an ongoing process among heterogeneous actors. The distinguishing feature of collaborative planning from technocratic planning is that it delegates the responsibility for planning directly to involved actors. It encourages people to engage in a situational dialogue of equal empowerment and shared information, to learn through mutual exchange, to create innovative outcomes, and to build institutional capacity.

With the Horizon 2020 project SUNRISE as an example, this paper gives an overview of the involved actors, the applied methods, the formats of collaboration, and the outcomes of a co-creative process for finding sustainable mobility solutions at the neighbourhood level. The six co-creative processes in SUNRISE show that in practice co-creation offers the opportunity to involve a wide variety of different actor groups from different sectors in the planning process. In addition to the Quintuple Helix (government, science, business, non-profit organizations and citizens), the co-creation processes in SUNRISE show that the media sector in co-creation processes is also an important actor to promote the flow of information to the wider public.

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In order to address various actors and target groups, it is useful to apply a mix of methods. The SUNRISE neighbourhoods have used a variety of different face-to-face and online methods to reach both a large public and specific target groups. Despite the broad range of actors in the SUNRISE processes, government, academia, business, NGOs, citizens, and media rarely collaborate directly in physical space. Rather, the local initiators of the co-creation processes collect the ideas and solutions proposed by the individual groups of actors and pass them on to other groups of actors.

The co-creation approach in SUNRISE offers an opportunity to develop local mobility solutions or neighbourhood mobility concepts. A total of 33 solutions for the identified mobility problems of the respective neighbourhoods were developed in the course of the co-creative processes in the six SUNRISE neighbourhoods. Between three and nine mobility solutions were developed for each neighbourhood. The mobility solutions result from the individual neighbourhood-specific, co-creative processes and reflect the respective problems of the neighbourhoods. The developed mobility solutions include improvements for the quality of public spaces (e.g. greening of squares, construction of street furniture), for bicycle traffic (e.g. installation of bike racks), mobility solutions for pedestrian traffic (e.g. safe and sustainable school routes), and for reducing motorized private transport (e.g. tempo 30 zones) as well as individual measures for local public transport (e.g. quality stay at stops).

The mobility solutions developed in SUNRISE are small-scale measures tailored to local conditions to attract and improve sustainable mobility in the neighbourhood. Mobility solutions are less about the objective (technological) novelty than about the question of whether an idea or solution is new or innovative for the neighbourhood. For this reason, the solutions developed in co-creative processes need to be viewed less from a global or supra-local, but rather from the perspective of the local socio-spatial constellation. Only through the local context can the degree of innovation of the solutions developed with co-creation be understood and classified in a meaningful way.

In addition to the developed mobility measures, SUNRISE shows that co-creation processes also built institutional capacity and created new collaborations and learning processes between local actors. In some SUNRISE cities, new collaborations and learning processes developed between departments of the city administration that had never worked with each other before. In one SUNRISE neighbourhood, residents organised an initiative to implement a temporary SUNRISE measure on a permanent basis. These side effects are an indicator that co-creation is not only an approach to creating product or service innovations, but also a way to create social innovations, responsibility, identification and acceptance for the mobility solutions and its context.

Regarding the potential of the co-creation approach in sustainable urban planning, we conclude that co-creation offers opportunities to create broad awareness and sense of responsibility for sustainable urban development in a local context. Whether co-creation is able to lead to long-term changes in local culture, collaborations, learning processes and institutional capacities, however, requires further research. In terms of mobility, the impact of mobility solutions on sustainability at the neighbourhood level (e.g. shifting traffic to other neighbourhoods) needs to be closely examined.

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Connected E-Mobility, IoT and its Emerging Requirements for Planning and Infrastructures

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1 ABSTRACT

The worldwide expansion of electric vehicle usage comes with the challenge of adapting the respective traffic and charging station infrastructure in cities, resulting in profound changes not only to traffic itself but also to the way energy is being distributed. An ongoing all-embracing real-time IoT-network will provide a vast amount of new possible data for planners, for example in order to get useful insights into the relationship between traffic flow patterns and loading patterns of e-vehicles. For this, the use of e-mobility data is essential. This paper will present potential ways of gathering data for infrastructure planning and user-oriented recommendations, such as movement patterns and charging status of vehicles, since this information is already available but not being shared by car companies. The given perspective will take into consideration individual vehicles and vehicle fleets as well as the traffic network as a whole. Efficient access to current and predicted load for charging stations in the electric vehicle transition would be a beneficial factor for the promotion of electricity-powered vehicles. In this paper, we lay out different approaches. Besides manufacturer related data-acquissition, this includes as well to provide this information via user-generated content (UGC), and to derive charging recommendations from a user-oriented, intelligent recommendation system. Furthermore, the challenges regarding the effects towards the electricity network and the necessity of physical charging infrastructure will be discussed. In a future situation of more heterogenous and dispersed energy supply, being able to predict the energy consumption of e-vehicles individually and instantaneously based on collected data will be a necessity for energy supplying companies. This will intentionally lead to more grid stability, by distributing electricity inside the network based on predicted loads, as well as work as an incentive for drivers to make the transition to e-mobility, because finding e-charging stations will eventually not be an issue. This paper will take the respective questions and potential control mechanisms for traffic patterns into consideration.

Keywords: Smart Grid, e-Mobility, User-generated-content, Traffic planning, Smart mobility

2 INTRODUCTION

A major factor holding back the expansion of renewable energy are the shortcomings of today's power grids that are unable to effectively handle decentralized and periodically fluctuating power production. One of the most far-reaching political topics in Germany is fostering the development of a smart energy grid, an integral part of the transition to green, renewable energy, the so-called "Energiewende". Offering great ecological, economic, and social opportunities- the growing share of renewable energies in energy production also poses enormous challenges for energy supply in general. But these problems do not only concern the production, but also the consumption side of the electricity infrastructure, especially considering the advent of e-mobility. A secure and sustainable energy grid of the future must take e-mobility into consideration and meet its fundamental prerequisites. The ongoing proliferation of charging stations for electronic vehicles puts an ever-growing strain on the electricity grid, not only because of the additional load but also because of the fluctuation in load during peak times. An adapted build-up of the electric vehicle (EV) charging infrastructure, including the need for embracing loading patterns in all parts of the mobility network, is needed to further facilitate sustainable e-mobility.

The approach to solving the problem laid out in this paper involves gathering relevant data, such as movement patterns of vehicles and information provided by charging stations like location, time and load to predict and thus manage electricity distribution in the grid. By intelligently distributing electricity to places with high demand at peak hours, the risk of energy oversaturation as well as shortage are minimized, and the groundwork is laid for further expansion of the charging infrastructure, thus creating incentives and lowering the cost of opportunity to charge electric vehicles. First, this paper will establish a theoretical framework incorporating viewpoints from different perspectives, such as urban planning, energy infrastructure and

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smart mobility, in order to emphasize the need for a systemic perspective on the issue. After that, a methodological approach to gathering relevant data will be introduced. This data can also be used in other contexts, for example by adding an intelligent pricing system at EV charging stations based on expected load, that could be used as an implicit way of traffic control akin to conventional city toll systems. Therefore, the last step is to consider potential further use cases for the collected data.

3 THEORETICAL FRAMEWORK

Other than conventionally fueled vehicles, which can rely on established infrastructures such as petrol stations, the expansion of e-mobility is highly dependent on infrastructures that are not sufficiently available yet. The buildup of those infrastructures needs to take into consideration the comparatively small energy storage of e-vehicles and long charging times as well as constraints of today's power grid and employ a systemic perspective. The low energy efficiency of e-vehicles necessitates the availability of charging stations practically everywhere, which means that a sufficient supply of electricity has to be available even in rural areas. Therefore, the proliferation of e-mobility must be one of the driving forces behind the overhaul and expansion of the existing power grid, and vice versa.

From a systemic perspective, this opens other areas, where the relationship between e-mobility and infrastructure must be considered. In urban planning for example, the expansion of e-charging stations needs to be extensive, but at the same time additional traffic congestion caused by short loading cycles and long loading times must be prevented. Transmission system operators and electricity distribution operators, on the other hand, need to build a secure and sustainable power grid equipped to incorporate highly fluctuating energy production and consumption. Developers and system engineers must craft an ICT environment around those systems in order to enable them in the first place, by gathering, transmitting and processing data that power intelligent machine learning processes, able to predict changes in energy consumption or traffic routing instantaneously and operating the elements autonomously. Additionally, and often overlooked, politics have to shape adequate laws and regulations as well as offer incentives in order to facilitate this overall transition process. The development of e-mobility and energy infrastructures will be strongly connected in the future and enable new methods for data gathering.

4 ASSESSMENT OF METHODOLOGICAL APPROACHES

The methodological approaches differ between their nature of data gathering regarding the location information and in addition the respective charging patterns.

4.1 Manufacturer-related data acquisition

Today's cars are utilizing sensor technology to gather a wide variety of user and vehicle data. McKinsey estimates that modern cars collect up to 25 gigabytes of data per hour, much of which is then transferred to the manufacturer by Wi-Fi or mobile data connection to be analysed for performance control and maintenance. The most notable data collected by a car is illustrated in a study conducted by German automobile club ADAC (2020). According to them, a new Mercedes B-Class for instance collects data such as GPS position, mileage, consumption, tank filling, tire pressure and various liquid levels like coolant, brake fluid and screen wash, which is sent to the Mercedes backend every two minutes. Sensors also record the style of driving by measuring how often the seatbelt is tightened up by breaking too hard or how often the engine running speed and engine temperature are too high. Additionally, the car collects data allowing the manufacturer to create a detailed user profile by tracking the last one hundred charging cycles with GPS coordinates, date, time and mileage. While this approach by Mercedes is basically a standard procedure for modern cars, other manufacturers like Renault employ much more curious practices. Not only can they read the data provided by the different sensors, they can also send commands to the car via mobile connection, for example to prohibit drivers from charging their car, if they failed to pay a bill for example, activate remote diagnosis, which is deactivated by default, or remotely extend the kind of data being transmitted. Practices like these open up a lot of questions regarding data privacy, one of which is: What happens with all the collected data? A good example of how to profit from this data is GM. They offer a service called GM Marketplace that brings personalised advertisements into your car, thus for example guiding you to a specific gas station or local restaurant by offering discounts. But vehicle data isn't just valuable because of suchlike business models. Car manufacturers want to improve their product and increase lifetime value, insurance

companies want to provide more accurate, individual estimates for usage-based insurance, urban planners want to know more about people's movements and developers want to build new products and services utilizing this data. Therefore, McKinsey predicts as much as $750 billion of value in vehicle data by 2030 (Peters 2019).

This paper aims to present potential ways of gathering some of the same data, also independent from the car manufacturers, in order to better inform infrastructural planners as well as potentially drivers. The underlying technical approach to this will be presented in the following paragraphs. Furthermore, corresponding use cases for the approach shown are presented. E-fleet-Management is such a use case, because E-fleets are an essential component of future e-mobility, and they will generate large, local energy fluctuations in the power grid if they are not charged in a coordinated manner. This problem is prevented with the following, data-driven methodology.Sensor and telematics-based data gathering. One approach could be to collect data by a telemetry module, which reads the energy status of the car. One use case is to minimize the energy costs of a fleet with the help of a recommendation assistant for intelligent charging management. The first component of the solution is a recommendation wizard for the load operation strategy. This recommendation wizard creates a charge plan for all vehicles in the fleet under a fixed timetable, depending on network charge estimates, for example, or flexible electricity tariffs and solar yield forecasts using optimization methods and artificial intelligence methods. This plan contains which vehicle is charged when and with which power source and thus attempts to minimize the maintenance costs of the eFleet and indirectly brings stability to the energy grid. This can be further improved by adjusting the schedules. This adjustment depends strongly on the energy consumption of the vehicles during a journey. Based on this, the second component for this use case is the forecast of the energy consumption of a vehicle for one journey. This can be predicted using artificial intelligence methods on the basis of destination, starting time and the route to be taken - for the destination as well as for each part of the route. Among other things, neural networks, especially recurrent networks, can be used for this forecast.

The next component is the adaptation of the timetables to further improve the results from the first component. For instance, ferry schedules include which vehicle is assigned for which trip at which time. For this purpose, the forecasts from the second component and other data such as vehicle specifications, in particular the loading capacity and performance of the vehicle and the requirements of the trip (number of people/goods transport) are used. This can be solved with methods of combinatorial optimization such as Evolutionary Algorithms.

Another use case of this data is the optimal positioning of charging infrastructure. This depends above all on the level of demand for charging at a particular position. Such data is very difficult to obtain at the moment. But with this approach it can be also calculated by user generated content, because the demand of charging depends mainly on the traffic flow of electric vehicles and the charging status of these vehicles. Whereas some of these mentioned solutions were used in the fleet-management context for a dedicated set of vehicles, the principles could be transferred also the mobility network as a whole.

4.2 Data gathering by UGC

A potential way to collect location and charging data is with user-generated-content (UGC). In this way, a platform based on UGC could be the foundation for an improvement in the efficiency of future charging infrastructures, targeting electric vehicle owners, with the intent of making the charging process effective for both the users and the mobility network in general. The focus on UGC from other approaches, is the scheme to collect user-generated content, that has been created with a collaborative effort of individuals, contrary to using data from third parties, because it is not certain if this data will be provided by car companies. We consider a platform where users exchange information with each other, including several important parameters such as how long they plan to charge, flexibilities that state whether they can, for example, make a 30-minute charging break for a user who needs an urgent charge. This data is transmitted to all users of this network, and they can plan their route in advance or real-time accordingly. This platform would be ideal for an EV owner, as they would be able to have an expectation time for how long they would need to charge their vehicle at a station, with respect to the demand at charging stations nearby, by using an intelligent system that learns user preferences and peak load times on local or regional charging stations. The motivation is to save their time and make the EV charging experience more efficient and comfortable. Besides this approach, there are also potential other ways of gathering, like for instance with a camera based

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solution or if that's not possible, by a camera, which takes pictures of the charge display. This data can be collected until the drive ends and uploaded to the cloud. An artificial intelligence service such as a convolutional neural network can classify these pictures into an energy status.

Once UGC is available from other users, the model capable of predicting peak loads on a charging station and estimating the typical waiting time for a user at a specific station, will be used to build a user-oriented recommendation system. The system is capable to handle each user individually and create their own route recommendation based on estimated charging times and preferences. The vision for this application is, however, broader than just information exchanging in a narrow network connecting the EV owners.

We plan to use this user-generated content to train an Artificial Intelligence model to make predictions of the electricity and traffic load on the charging station during various times of the day or week or year as well as getting insights to the mobility traffic patterns at the charging stations. This would aid in monitoring and limiting traffic congestions in cities. Crowdsourcing in real time can provide great input data to current applications for computing optimized routes to current and forthcoming users. One of the reasons for such an approach is to be independent of collecting data from the third-party EV companies or EV charging stations, which can become quite a difficult task due to information sensitivity, competition, and data ownership. This data retrieval method is known as user generated content mining which is formatted into a knowledge representation entity, used for downstream tasks. One of the main advantages of user generated content mining for data in a recommender system is the initial setup time period. The duration is relatively short, some data is ready instantly, and the system can start using its algorithms to make recommendations for the users. Another feature is the ability to adapt to changes quickly. This can be an advantage in comparison to other methods, when the environment (in our case the amount of charging stations, chargers, and electrical vehicles) changes rapidly. Since the Artificial Intelligence model needs data to learn a function to make a load forecast, using newly collected data would increase the accuracy of the model and prevent data from going out of date. When using data collected over time, the AI responsible for decision making would only learn the trends of EV usage at certain charging stations for the given time period. However, as soon as the number of electrical vehicles would change, new data would be needed for the training of the AI, whereas with the user generated content approach, no changes would be needed. One disadvantage of this mining method is that data can contain false information, as it is no requirement of proving the validity. Another challenge that we would face is to motivate the users to submit data. However, if the product is rewarding, as it would make it easier for users to get used to the EV charging and avoid conflicts at charging stations, there would be a positive dynamic of people using the platform and submitting their data. Crucial aspects in this approach is the user acceptance and willingness to contribute UGC for the named purpose, since this data would allow very detailed personal movement patterns to be analyzed, so there should be necessary mechanisms to protect the privacy of users.

Data mining with sensors and by user generated content do have their own strengths and weaknesses. Sensors for example can be quite intrusive by not being transparent on what kind of data is collected precisely. This raises issues of data privacy and leads to negative public reception. They are also intrusive in the way that they are either part of the road network or your car, as a driver you don't have a lot of control over them. On the positive side, they're quite cheap and easily employed and they can reliably collect vast amounts of very different kinds of data. While this sounds good, it also comes with the challenge of transferring and analyzing huge amounts of data effectively. User-generated content on the other hand will most likely not raise any questions regarding data privacy as the user has full control over what kind of data he wants to send to whom. The data generated here is also processed already by the user who puts it into some kind of website or application, thus the chance of collecting irrelevant data is much lower and it is presumably easier to process the data. But the kinds of data that can be gathered is limited to something that can easily be perceived by the users and it likely suffers from subjectivity, either in the way it is perceived or whether it is recognized as relevant in the first place.

5 POTENTIAL APPLICATIONSFOR URBAN AND TRAFFIC PLANNING

Theoretically, urban and traffic planners can apply the data in two different ways, on the one hand there is the location data enabling the informed improvement of traffic routing and on the other hand the information on charging patterns are helpful for upgrading and expanding the energy infrastructure. Generally, digitization will have a drastic and lasting impact not only on mobility, individual transport as well as public

transport, but also on infrastructure planning overall, especially the relationship between traffic control and energy distribution. Thus, the future development of urban areas and districts will require a new and innovative approach to energy supply, particularly involving solutions for renewable energy, storage possibilities and adequate e-mobility infrastructure.

The following chapter will introduce a potential additional use case for the data generated by the proposed methods, aiming to further demonstrate the intricate relationship between e-mobility and energy infrastructure, at the same time taking political control mechanisms into consideration.

5.1 Potential further data use traffic planning

The data collected by the presented approach can be used for infrastructural planning purposes in primarily two ways, firstly for monitoring purposes in general and secondly for traffic management, for example by providing incentives and restrictions.

5.1.1 Real time traffic Monitoring

A smart e-mobility charging infrastructure, as outlined in this article, would be an integral part of a holistic mobility concept for future smart cities and the potential synergies between such a system and other key elements of smart urban mobility promise to offer an interesting outlook into the future. As a conclusion to this article, the following chapter investigates the potential interaction between a smart charging infrastructure and a real time traffic management system. Smart traffic management is often perceived as synonymous with smart mobility in an urban context even though it is only one component of it. An integrated real time traffic management system could possibly circumvent issues such as traffic congestion, insufficient parking space capacities, high emissions and low quality of life for residents, e.g. because of noise pollution. While the goals and presumed benefits of such a system are clear, the implementation is still severely lacking. This is because it is heavily reliant on several preconditions, some of which are technological ones, that have not yet been realized. In order to illustrate this, it is helpful to envision the implementation of a smart traffic system as a multi-stage process (Citron 2019):

- Developing (Vehicle Detection & Data Collection): Camera, sensor, GPS data Focus on traffic planning
- Managed (Traffic Analytics & Evaluation): Traffic routing is possible Travel time analysis Optimization of traffic lights
- Mature (Advanced Traffic Management): Real time control of systems Integrated in vehicles AI & cloud-based platforms Data exchange with other places

In order to realize a fully manageable real time traffic control system, several enabler technologies need to be widely available and controlled via a shared platform, e.g. IoT, Cloud Computing, Machine Learning / AI. A smart way of energy distribution, that can supply energy needs when und where they occur, will be an integral part of such a system. One example for an integrated system like that could be a connected grid of charging stations for e-vehicles that is supplied depending on traffic flow. Thinking even further, a smart charging infrastructure that is integrated into a smart traffic control system could be used as a way of controlling traffic flow itself, by providing a system of incentive-based pricing. One of the reasons why data is often referred to as the ‘oil’ of the digital age, is because of its ‘raw’ nature and its ability to be refined into a plethora of useful states. This means the same data can be used for different means, depending on how it’s processed. The data produced by the means presented in this paper for example can also provide the basis for smart traffic management.

5.1.2 Incentive based pricing for e-mobility as a way of traffic management

Theoretical incentives could be distinguished into “positive” and “negative” approaches. Be it positive ones, such as tax exemptions, money grants or other benefits like free parking, being able to drive on bus lanes or being exempt from paying city tolls, or negative ones, like city tolls, auto free zones or combustion engine bans, incentives already are a main driver behind the proliferation of e-mobility (Wang et al. 2015). Other approaches for toll systems based on location data (Nagothu 2016) as well as potential applications in highway networks (Lee, Tseng, and Wang 2008; Tan et al. 2017) are discussed in relevant literature (Sanal et al. 2019). While suchlike measures are mostly explicit and therefore obvious, possibly leading to negative repercussions, additional implicit measures promise a way of more subtle control. A possible way of

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'nudging' residents to use specific routes could be to employ smart pricing at e-charging stations. For example, an app in your car or on your phone, like electrific (electrific 2020), that aims to optimize your routing through everyday traffic based on anticipated congestion and other factors, may be able to guide you to charging stations that have lower prices, therefore disincentivizing you from using 'more expensive' routes. The prices at such stations would of course be variable and based on the current traffic flow or on city policies, e.g. to make districts car free, etc. A system like that could even work better than city tolls, that are generally not very appreciated by most residents. An implicit system, that guides you based on prices on charging stations, could eventually replace city tolls altogether.

City tolls have been established in many cities around the world (e.g. Civitas 2013), while implementation practices differ widely. Whether there is a ring of toll stations around cities or there are electronic means of tolling residents (Sanal et al. 2019), while effective, these measures tend to be unpopular with local inhabitants. The challenge with a system like that is that it needs a highly integrated, interoperable ICT and energy infrastructure. While IoT-sensors or cameras need to measure traffic flow and/or other environmental data, this information needs to be bundled, analysed and interpreted by AI in a cloud computing environment, and the derived optimizations need to be communicated, e.g. by changing traffic light circuits, adjusting energy prizes at charging stations or directly messaging drivers (Popoola et al. 2018; Abari et al. 2015; Soylemezgiller, Kuscu, and Kilinc 2013). This in turn requires drivers to be able to receive such information, either by phone or directly in the car and acting on it. All in all, a system like that is only imaginable in a holistic integrated smart city environment.

Research in this field is scarce. Most projects are limited in scope to specific use cases, for example lokSmart (LokSMART 2020), which is focussed on local flexibilities for e-mobility, 3connect (Smartlab 2020), mainly concerned with commercial e-mobility in smart grids or electrific (electrific 2020), a consumer side platform for smart routing. Only very few research projects, such as iMove (Hubject GmbH 2019), are trying to bring data from different sources together and craft an integrated ICT infrastructure. But even those are mostly limited to a technological perspective and don't account for political viewpoints. Incentive based routing options could also be used ultimately for virtual city tolls. They can be designed theoretically with "soft barriers". Tolling by making charging costs related to geographical location (expensive charging prices in the city center) as well as with a stricter concept, like a geofencing for vehicles. This means that toll barriers could theoretically be installed everywhere in the urban area, flexible in location and also time. This enables new possibilities for real-time-traffic management for planners, such as influencing the rush-hour traffic as well as reactions to natural disasters like flooding for instance. In addition, this potentially enables new business models. Though, this far reaching possibilities have to be critically considered reagarding legal, privacy and ethical aspects. There are first concepts regarding privacy-preserving toll systems (Jardí-Cedó, Castellà-Roca, and Viejo 2016), but the embracing view regarding the mentioned aspects have to be taken into consideration.

5.2 Requirements for energy infrastructures

It will be important to demonstrate how intelligent grids with a majority of renewable energy ensure a secure and efficient energy supply and which concepts and technologies can be used for this purpose to achieve efficient and safe energy networks, especially in the traffic context. The core functionality of Smart Grids itself is connectivity. With this, it is possible to connect plants, systems and devices via the Internet, regardless of location. If the systems and components involved can communicate quickly and securely, they can, for example, be combined into virtual power plants and controlled as required for instance. These aspects will be especially crucial regarding the development towards a more e-vehicle based transport model. The resulting effects of a higher rate of e-vehicles for the grid will be enormous. Besides, for instance the potential location finding process and approval of combined heat and power plants, district-based energy storage, geothermal powerplants the impacts of the mobility sector will seriously induce some effects. General question concerning the general model of transport (more public transport, more individualized, more car-sharing) have their own demands for the design of the urban space and the corresponding connection to the electricity network. In this way, the design of a mobility concept is inseparably connected to the design of a Smart Grid in the light of a Smart City (Exner et al. 2019). Especially with question of using approaches such as vehicle to grid, the planning and use of grids has to be linked to real time – as well as strategic - traffic management.

6 CONCLUSION

From a systemic point of view, fundamentally new requirements for vehicle-related charging will develop, as well as an increasing demand on the power grid. It will be crucial, how the amount of investments in the low, medium and high voltage grid by 2050, in case of a strong electrification of transport (more than 50% of all vehicles), will be held at a level comparable to the historical investment level by the use intelligent management of charging all vehicles. This new digitized world of electrified transport provides multiple new options for planning purposes based on location data and charging status. Society will face a post-fossil fuels – future, but in this world, data will be the new oil. The transport and mobility network and stable electricity network won't work together efficiently, if there aren't any real time information available regarding location and charging of vehicles within the traffic network. We presented different methods to collect a coherent dataset, with all respective advantages and disadvantages. From one perspective, this database enables totally new possibilities for monitoring the traffic network as a whole, but also for an embracing traffic management, even towards the use of virtual city tolls, which are flexible in time and location. Though, this raises issues of security and data privacy, especially when new technologies have to be applied (blockchain for instance) in order to address these problems. Also, ethical questions will arise in this context, if restrictions could be applied, regarding who can drive where and if these issues will also be incentive-based. All of these aspects have to be considered from a multidimensional and interdisciplinary perspective which will strengthen the need for cooperation of urban planners, traffic planners, data scientists and respective other partners.

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🏆 *reviewed paper*

Das Konzept der Regiopole als Entwicklungsstrategie kleinerer Großstädte im (inter-)nationalen Standortwettbewerb

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1 EINFÜHRUNG

Seit circa zehn Jahren wird das Konzept der Regiopole in der deutschen Raumordnung diskutiert. Das Konzept zeigt als Entwicklungsmöglichkeit für (kleinere) Großstädte und Regionen, die sich im ständig verändernden Wettbewerb um Bevölkerung und Unternehmen positionieren möchten, eine Alternative zu etablierten stadtregionalen Instrumenten (z.B. Metropolregionen) auf. Angelehnt an das metropolitane Konzept sieht sich eine Regiopole als kooperative Organisationsform zur Vernetzung unterschiedlicher Akteure einer Stadtregion und deren Verflechtungsbereich. Historische, kommunale Verwaltungsgrenzen können dabei durch moderne Governance-Strukturen überwunden werden und an tatsächliche, funktionale Stadt- und Regionsstrukturen angepasst werden. Durch Einbindung von Akteuren der Raumentwicklung (z.B. Regionalverbände, Kommunen, wirtschaftliche Akteure, Bürger- und Zivilgesellschaft) soll die Gesamtregion durch eine gestärkte regionale Identität nach innen sowie ein gestärktes regionales Image nach außen profitieren.

Seit 2006 haben sich sieben Städte und Regionen in Deutschland als Regiopolen positioniert und im deutschen Regiopole-Netzwerk zusammengeschlossen. Diese informellen Stadt-Umland-Kooperationen stützen sich auf Strategien wie das Leitbild „Wettbewerbsfähigkeit stärken“ der Ministerkonferenz für Raumordnung aus dem Jahr 2016, sind jedoch (noch) nicht als Raumkategorie in der deutschen Bundesraumordnung verankert.

In diesem Beitrag wird am Beispiel von drei ausgewählten bestehenden Regiopolen diskutiert, welcher konzeptionelle Ansatz hinter einer Regiopole steht und welcher Mehrwert für die jeweiligen Stadtregionen erwartet werden kann. Dabei wird anhand der in diesen Regiopolen in den Mittelpunkt gerückten Zielen und Aktivitäten auch verdeutlicht, welche Kooperationen – trotz auch weiterhin bestehendem innerregionalen Wettbewerb in anderen Bereichen – eingegangen werden, um im nationalen Kontext Wettbewerbsvorteile zu generieren.

Abschließend werden am Beispiel der potentiellen Regiopolregion Koblenz-Mittelrhein-Westerwald Eckpunkte der Ausgestaltung einer Regiopolregion diskutiert. Das Oberzentrum liegt im nördlichen Rheinland-Pfalz und umfasst mit seiner Verflechtungsregion Mittelrhein-Westerwald einen Einzugsbereich von über einer Million Einwohnern. Seit einigen Jahren findet sich, initiiert durch einen regionalen Verein, die Regiopolenidee in der Region wieder. Aktuell sind Akteure wie die Stadt Koblenz, die Planungsgemeinschaft Mittelrhein-Westerwald, die IHK oder ein regionales Unternehmensbündnis im Prozess eingebunden. Die Diskussion um die konzeptionelle Ausgestaltung einer Regiopolregion in Koblenz und der Region Mittelrhein-Westerwald wird anhand folgender Fragestellungen geführt: Welche potentiellen Ziele und Aktivitäten könnte das Konzept in der Region aufgreifen? Welche lokalen und regionalen Akteure sind in den Etablierungsprozess und die Organisationsstruktur einzubinden? Wie könnte eine räumliche oder funktionale Abgrenzung der Regiopolregion ausgestaltet werden? Welchen Mehrwert würden Koblenz und die Region durch eine Stadt-Umland-Kooperation erfahren?

Anhand dieser Fragestellungen zeigt der Beitrag einerseits auf, ob und in welcher Form Koblenz und die Region Mittelrhein-Westerwald durch die Initiierung einer Regiopolregion langfristig profitieren können. Andererseits wird ausgehend von diesem Fallbeispiel der Frage nachgegangen, inwieweit Verflechtungen in einer Stadtregion durch neue oder zusätzliche Governancestrukturen (wie z.B. einer Regiopole) besser abgebildet und dadurch auch Stadtregionen insgesamt erfolgreicher entwickelt werden können.

Keywords: Regiopole, Regiopolregion, Stadt-Umland-Kooperation, Stadtregion, Governance

2 REGIOPOLEN IN DEUTSCHLAND

Die Stadtplaner Jürgen Aring und Iris Reuther (beide Universität Kassel) haben im Jahr 2008 ein Vorgehen zur Identifikation potentieller Regiopolen in Deutschland entwickelt. Hierzu wurden die drei grundlegenden Kriterien „Großstadtschwelle“, „vorhandenes Potential an Wissen und Innovation“ sowie „Lage außerhalb von Metropolregionen“ herangezogen. Anhand dieser Kriterien wurden 33 deutsche Großstädte als potentielle Regiopolen identifiziert und daraufhin anhand einer aufgestellten Gravitationsthese klassifiziert. Diese besagt, dass das Potential einer Stadt als Regiopole umso höher ist, je größer die räumliche Entfernung zu einer Metropole (Distanz) und je größer ihr demografisches und ökonomisches Gewicht (Masse) ist.[1]

Von den 33 durch Aring und Reuther identifizierten Regiopolen haben sich aktuell sieben als solche positioniert bzw. etabliert. Auf den nationalen „Vorreiter” Rostock folgten Bielefeld, Erfurt, Paderborn, Siegen, Trier und Würzburg. Diese haben sich bereits im Jahr 2009 das Ziel gesetzt, analog zur Metropolenstruktur, ein deutsches Netzwerk aller Regiopolen als Interessensvertretung zu schaffen. Ähnlich dem Initiativkreis Europäische Metropolregionen in Deutschland (IKM) versprechen sich auch die Mitglieder des RegioPole Netzwerks eine Verbesserung der Wettbewerbs- und Handlungsfähigkeit, um Motoren der nationalen Entwicklung darzustellen. Durch eine Zusammenarbeit der Mitglieder, anderer regionaler Akteure und politischer Vertreter, soll zum einen eine Stärkung der regionalen Identität erfolgen, zum anderen der Ausbau und die Verstetigung der Zusammenarbeit zwischen den Regiopolen.[2]

2.1 Ziele, Funktionen und Mehrwert des Regiopolenkonzepts

Durch die Positionierung als Regiopole zielen Stadt und Region auf eine positive Entwicklung und eine Generierung von Wettbewerbsvorteilen im nationalen Kontext. Ziel des Konzepts der Regiopole ist zunächst, eine neue Raumkategorie der zentralörtlichen Gliederung für kleine Großstädte unter der Ebene der Metropolregionen einzuführen. Gleichzeitig soll diese neue Raumkategorie auch in den raumordnerischen Leitbildern der MKRO Berücksichtigung finden. Durch die Weiterentwicklung der „Leitbilder und Handlungsstrategien für die Raumentwicklung in Deutschland” im Jahr 2016 konnte in Bezug auf die Erreichung dieser Ziele bereits ein erster Schritt gemacht werden. Durch das Konzept der Regiopolen soll weiterhin die Beachtung dieser im Bund-Länder- sowie den kommunalen Finanzausgleichen angestrebt werden. Die Anerkennung als Regiopole sollte eine besondere Berücksichtigung in diesen Systemen finden, um finanzielle Mittel für die regionale Entwicklung zwischen Metropolregionen und ländlichem Raum zur Verfügung zu stellen.[3] Ziele einer einzelnen Regiopole sind

die Bündelung regionaler Kräfte als Impulsgebeber und strategischer Partner des Umlands für eine Stadt-Umland-Parterschaft[4],

die Stärkung von endogenen Innovations- und Wettbewerbspotentialen,

Standortentwicklung und Standortmarketing für die Stadtregion sowie

Netzwerkbildung und Kooperation zwischen lokalen Akteuren.[5]

Zur Erreichung dieser und weiterer Ziele ist es unabdingbar, dass eine Regiopole ein breites Spektrum an Funktionen wahrzunehmen hat. Regiopolen fungieren v.a. vor dem Hintergrund des demografischen Wandels als „räumliche Konzentrationspunkte”[6] abseits der Metropolregionen, um „Räume zu stabilisieren und Funktionen zu bündeln”.[7] Die Leipzig Charta spricht in diesem Zusammenhang von einer Übernahme der “Verantwortung für den territorialen Zusammenhalt [durch] Kristallisationspunkt[e] der stadtregionalen Entwicklung.”[8] Funktionen einzelner Regiopoen sind

die Übernahme der Rolle als regionaler Entwicklungsmotor[9],

[1] vgl. Aring, Jürgen/ Reuther, Iris (2008): Die Regiopole. In: Aring, Jürgen/ Reuther, Iris (Hrsg.): Regiopolen, S. 23
[2] vgl. Sinz, Manfred (2008): Die Republik der Stadtregionen. In: Aring, Jürgen/ Reuther, Iris (Hrsg.): Regiopolen, S.40f.
[3] vgl. Regiopolregion Rostock, unter: http://www.regiopole.de/ueber-regiopole/ziele/
[4] vgl. Knieling, Jörg (2008): Eine Behauptungsstrategie. In: Aring, Jürgen/ Reuther, Iris (Hrsg.): Regiopolen, S. 77
[5] Steinmüller, Lena Marie (2013): Die Regiopole. In: IfR (Hrsg.): Raumplanung, Heft 168/3-2013, S. 48
[6] Knieling, Jörg (2008): Eine Behauptungsstrategie. In: Aring, Jürgen/ Reuther, Iris (Hrsg.): Regiopolen, S. 77
[7] ebd.
[8] Mlejnek, Ingo (2008): MINIMA MAXIMA. In: Aring, Jürgen/ Reuther, Iris (Hrsg.): Regiopolen, S. 91
[9] vgl. Aring, Jürgen/ Reuther, Iris (2008): Die Regiopole. In: Aring, Jürgen/ Reuther, Iris (Hrsg.): Regiopolen, S. 8

die Erfüllung oberzentraler Funktionen über die Grundlagen des Zentrale-Orte-Systems hinaus (v.a. Versorgungsfunktionen),

die Übernahme von Gatewayfunktionen im nationalen Raum in multiplikativer Ergänzung der Metropolregionen[10] sowie

die Übernahme metropolitaner Teilfunktionen aus den Bereichen Politik, Wirtschaft, Wissenschaft, Verkehr und Kultur (= „regiopolitane Funktionen").

Mehrwerte erfahren regionale Akteure einer Regiopole bzw. Regiopolregion hauptsächlich durch die zielführende Nutzung lokaler Potentiale und Synergieeffekte, die durch Vernetzung und Clusterbildung entstehen. Ob für Städte und Gemeinden, Landkreise, Planunsgverbände, lokale Unternehmen oder Bürger – alle Gruppen erfahren durch Integration und verbesserte Zusammenarbeit spezifische Vorteile:

die gemeinschaftliche Wahrnehmung kommunaler Aufgaben durch Initiierung von „Ein-Themen- und Mehrzweckverbänden" [11] (z.B. gemeinsame Wirtschaftsförderung mit dem Ziel regional optimierter Unternehmensansiedlungen),

Prozessvereinfachungen durch Abbau doppelter (Verwaltungs-) Strukturen,

Erhöhung des fachlichen Austauschs und Generierung von Vorteilen durch direkter Kontakt zwischen Unternehmen, Kammern und politischen Entscheidungsträgern,

eine hohe Quantität und Qualität infrastruktureller Einrichtungen der Daseinsvorsorge

eine positive Einwohnerentwicklung sowie

eine gestärkte regionale Identifikation als weicher Standortfaktor.

2.2 Akteure und Organisationsformen der deutschen Regiopolen

Aufbau und Organisation sowie die involvierten Akteure und Partner der bestehenden Regiopolen in Deutschland sind sehr different. Da es keine Vorgaben oder Richtlinien zur Etablierung einer Regiopole gibt, sind die Organisationsformen unterschiedlich und an regionale Gegebenheiten angepasst. Stadtregionale Arbeits- und Organisationsformen von Regiopolen bündeln eine Vielzahl an Ressourcen und stellen Synergien zwischen den einzelnen Akteuren her, um insbesondere der Entwicklungsfunktion der Region gerecht zu werden. Daher wird das Modell der Regional Governance auf die Organisationsform einer Regiopole übertragen. Hierbei wird die regionale Selbstorganisation mit einer hervorgehobenen Rolle der regionalen und privaten Akteure in den Mittelpunkt gerückt.[12] Eine Regional Governance lässt sich von einer „gewöhnlichen" Steuerung auf regionaler Ebene, die sich auf politisch-administrative Akteure begrenzt, differenzieren. Regional Governance kann als „weiche" Form der Selbststeuerung bezeichnet werden und ist ein auf Netzwerken basierender territorialer Ansatz, der politisch-administrative, wirtschaftliche und sonstige nichtöffentliche Aktuere einbindet.

Die Regiopolregion Rostock verfügt über eine eigene Geschäftsstelle, die zwischen den verschiedenen Akteuren und Organen vermittelt. Die Geschäftsstelle ist im Planungsverband Region Rostock angesiedelt, der als Projektträger fungiert und die Grundfinanzierung der Geschäftsstelle sichert. Die Leitlinien zu Zielen und Projekten der Regiopolregion legt ein Lenkungsausschuss, bestehend aus je einem Vertreter der Partner der Regiopolregion (u.a. Städte und Gemeinen, Landkreis, IHK, Ministerien, Marketinginitiative), fest. Im Lenkungsausschuss, der bei Bedarf um fachkundige Experten ergänzt werden kann, werden konkrete Vorhaben, zu beteiligende Partner, Träger und Netzwerke sowie der Einsatz, die Zusammenstellung, Auflösung oder Veränderung der Arbeitskreise beschlossen.[13]

Die Regiopolregion Paderborn ist im Gegensatz dazu als eingetragener Verein organisiert, welcher sich aus ordentlichen (Städte und Gemeinden) und fördernden Mitgliedern (Institutionen, Kammern, Einrichtungen und Verbände aus den Bereichen Wirtschaftsförderung, Bildung, Sport, Kultur, Tourismus etc.) zusammensetzt. Die Mitgliederversammlung des RegiopolREGION PADERBORN e.V. hat direkten Einfluss auf die zentrale Geschäftsstelle der Regiopolregion, die an das Stadtplanungsamt der Stadt

[10] vgl. Regiopolregion Rostock, unter: http://www.regiopole.de/ueber-regiopole/ziele/
[11] Steinmüller, Lena-Marie (2013): Die Regiopole In: IfR (Hrsg.): Raumplanung, Heft 168/3-2013, S. 48
[12] vgl. Knieling, Jörg (2008): Eine Behauptungsstrategie. In: Aring, Jürgen/ Reuther, Iris (Hrsg.): Regiopolen, S. 78
[13] vgl. Regiopolregion Rostock: Organisation, unter: https://www.regiopolregion-rostock.de/ueber-uns/organisation/

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Paderborn angedockt ist. Analog zur Regiopolregion Rostock erfolgt von dort die Vermittlung zwischen Mitgliedern, Partnern und anderen Akteuren sowie die Steuerung der Arbeitskreise, die sich themenbezogen mit Strategien und der Umsetzung von Projekten beschäftigen.[14]

Wiederum über eine andere Art der Organisationsstruktur verfügt die Regiopolregion Bielefeld. Eine Arbeitsgruppe Regiopolregion, der kommunale Vertreter aller zehn Partnerkommunen angehören, kann als Hauptausschuss angesehen werden. Inhaltliche Konzepte sowie die Koordinierung der themenspezifischen Fachgruppen werden von hier gesteuert. Parallel dazu sorgt eine Geschäftsstelle, die im Büro des Oberbürgermeisters Bielefelds angesiedelt ist, für die Sicherstellung der Kommunikationsflüsse. Strategische Ziele und Eckpunkte für das operative Handeln der Regiopolregion werden im Steuerungskreis beschlossen. Dieser ist das zentrale Gremium und setzt sich aus den Bürgermeistern der Partnerkommunen sowie dem Bielefelder Oberbürgermeister zusammen.[15]

2.3 Aktivitäten deutscher Regiopolen

Ähnlich different wie die Organisationsformen stellen sich die inhaltlichen Aktivitäten der deutschen Regiopolen dar. Abhängig von regionalen Gegebenheiten und Einflussfaktoren wie Einwohnergröße, Lage, kommunale Finanzkraft usw. unterscheiden sich Ziele, Themenfelder und Projekte der Regiopolen. Anhand der Regiopolen Rostock, Bielefeld und Paderborn wird beispielhaft die inhaltliche Ausgestaltung des Konzepts verdeutlicht.

Die Stadt Rostock mit der zugehörigen Verflechtungsregion bildete als Abschluss eines langwierigen Findungs- und Kommunikationsprozesses der verschiedenen involvierten Akteure schließlich die erste Regiopolregion Deutschlands. In Anschluss an die Gründung der Geschäftsstelle, stellte diese 2013 einen Aktionsplan auf, in dem sieben Kernziele für die Entwicklung der Region festgelegt wurden, auf die alle Handlungsfelder und Aktivitäten ausgerichtet sind. Hierbei gibt es sowohl Ziele, die auf die Innenentwicklung abzielen („Potentiale voll ausschöpfen"), die auf die Innen- und Außenwahrnehmung ausgerichtet sind („Standortstärkung nach innen und außen"; „Regionale Identifikation und Imagegewinn") und die auf die Wettbewerbsfähigkeit nach außen abzielen („Positionierung als starker Wachstumskern zwischen den Metropolregionen"; „Etablierung einer Dachmarke"; „Kategorie der zentralörtlichen Gliederung"; „Beachtung im Finanzausgleich des Bundes und der Länder").[16] Zur Erreichung dieser Ziele wurden sechs thematische Handlunsgsfelder bestimmt, die nach Bedarf angepasst und weiterentwickelt werden können. Die Handlungsfelder, die den inhaltlichen Rahmen für die Projektentwicklung geben, sind: „Verkehr und Mobilität", „Wirtschaftliche Entwicklung", „Daseinsvorsorge", „Bildung und Wissenschaft", „Umwelt-Energie Konzepte" und „Tourismus und Kultur".[17] Insgesamt ist die Regiopolregion damit prozesshaft und inhaltlich sehr breit aufgestellt und versucht die Region in vielen Bereichen weiterzuentwickeln.

Die Regiopolregion Paderborn hat in ihrem Zukunftskonzept „Entfaltung + Ausstrahlung, Anziehungskraft + Energie" fünf Themencluster definiert, in deren Bereichen sie Herausforderungen und Handlungsbedarfe der Region sieht. Innerhalb der unterschiedlichen Themenfelder wurden zentrale Zukunftsfragen und Ziele formuliert, die durch Umsetzung von Projekten erreicht bzw. realisiert werden sollen. Das Themencluster „Siedlungsentwicklung und Wohnungsmarkt" untersucht den regionalen Wohnungsmarkt und die Wohnorientierung der Menschen, die sich nicht an administrativen Grenzen, sondern an funktionalen Verflechtungen, Mobilitätsangeboten und Arbeitsplätzen orientieren. Im Bereich „Mobilität und Verkehr" werden das sich wandelnde Mobilitätsverhalten sowie veränderte Ansprüche an Mobilität untersucht. Ausgewälte Ziele sind die Nutzung digitaler Möglichkeiten zur Vernetzung sowie die Förderung von E- und Sharing-Mobility. Die Bindung von Schulabgängern und Hochschulabsolventen an die Region oder die Sicherung regionaler Raumbedarfe sind beispielhafte Zielsetzungen der Bestrebungen im Themencluster „Wirtschaft, Arbeitsmarkt und Bildung". Ein weiteres Themencluster umfasst die Herausforderungen des Bereichs „Daseinsvorsorge, Gesundheit, Sport und Kultur", wobei insbesondere die Parallelität von Wachstum und Schrumpfung in engen räumlichen Zusammenhängen einen zu lösenden Konflikt darstellt. Ziel ist die Gewährleistung von Daseinsvorsorgeangeboten wie medizinische Versorgung, zum Beispiel

[14] vgl. RegiopolREGION PADERBORN e.V. (2018): Vereinssatzung
[15] vgl. Stadt Bielefeld: Arbeitsstruktur der Regiopolregion, unter: https://www.bielefeld.de/de/dob/rr/as/
[16] vgl. Regiopolregion Rostock (2013): Der Aktionsplan der Regiopolregion Rostock 2013-2015, S. 4
[17] vgl. ebd, S. 7

durch Modellprojeke zur Nutzung lokaler Kompetenzen im Bereich E-Health. Das fünfte Themencluster der Regiopolregion Paderborn „Zusammenarbeit und Verwaltungskooperation" verfolgt den Grundsatz, Identitäten und Kompetenzen der Kommunen zu wahren und gleichzeitig offen und wirkungsvoll zu kooperieren. Auf Basis von Netzwerken, Plattformen und Wissenstransfer sollen administrative Hürden gemildert werden, um eine gemeinschaftliche regionale Entwicklung vorantreiben zu können.[18]

Die Regiopolregion Bielefeld, bestehend aus elf Partnerkommunen, zielt unter dem Slogan „Intensivierung gemeindeübergreifender Kooperation" auf eine regionale Entwicklung durch gemeinsame Aufgabenwahrnehmung. Hierzu verfügt die Regiopolregion über fünf themenspezifische Fachgruppen: „Mobilität", die sich insbesondere mit dem Aufbau eines Radwegesystems beschäftigt, „Kultur" mit Ziel ein regionsweites Kulturportal zu schaffen, „Hochwasserschutz", die einen regionsweiten Leitfaden zu diesem Thema entwickelt, „Geoinfirmation", die Kartenmaterial zur Analyse und zu Marketingzwecken erstellt und „Ökoprofit", die sich mit Ansätzen des betrieblichen Umeltmanagements beschäftigt. Neben den dauerhaft bestehenden Fachgruppen hält die Regiopole Informationsaustausche zu unterschiedlichen Themen vor. Beispielsweise erfolgen fachliche Erfahrungsaustausche zwischen den Partnerkommunen in den Bereichen „Schulentwicklung" und „Kostenoptimierung von Bauhöfen".[19]

	Rostock	**Paderborn**	**Bielefeld**
Regiopole seit	2008	2016	2016
räumliche Abgrenzung	Hansestadt Rostock, LK Rostock, zwei Städte aus LK Vorpommern-Rügen	insg. 32 Städte und Gemeinden aus LK Paderborn und LK Höxter	Bielefeld und zehn weitere direkt angrenzende Städte und Gemeinden
Ziele des Konzepts			
Bündelung regionaler Kräfte als Impulsgeber	x	x	x
Stärkung von Innovations- und Wettbewerbspotentialen	x	x	x
Standortentwicklung und Standortmarketing	x	x	x
Netzwerkbildung und Kooperation	x	x	x
Funktionen			
regionaler Entwicklungsmotor	x	x	x
Erfüllung mind. oberzentraler Funktionen	x	x	x
Übernahme nationaler Gatewayfunktionen[1]	-	-	x
Übernahme metropolitaner Teilfunktionen	x	x	x
Beteiligte Akteure			
Städte und Gemeinden	x	x	x
Landkreis(e)	x	x	-
Kammern / Verbände	x	x	-
Marketinginstitution	x	-	-
Tourismusinstitution	-	x	-
Ministerium	x	x	-
Bildung, Wissenschaft	-	x	-
Wirtschaft / Unternehmen	-	x	-
Wirtschaftsförderung	-	x	-
Kultur	-	x	-
regionale Initiativen	-	x	-
Organisationsform			
	Geschäftsstelle im Planungsverband Region Rostock	eingetragener Verein / Geschäftsstelle im Stadtplanungsgamt	AG Regiopolregion / Geschäftsstelle bei OB
Aktivitäten			
	Verkehr / Mobilität	Mobilität / Verkehr	Mobilität
	Wirtschaftliche Entwicklung	Wirtschaft, Arbeitsmarkt und Bildung	Ökoprofit
	Bildung / Wissenschaft		
	Daseinsvorsorge	Daseinsvorsorge, Gesundheit, Sport und Kultur	
	Tourismus und Kultur		Kultur
	Umwelt-Energie Konzepte		Hochwasserschutz
		Siedlungsentwicklung / Wohnungsmarkt	
		Zusammenarbeit / Verwaltungskooperation	Geoinformation

Tab. 1: Überblick zu Zielen, Funktionen, Akteuren, Organisationsformen und Aktivitäten der Regiopolregionen. [1] Kriterium: Regelmäßiger ICE-Systemhalt

[18] vgl. Regiopolregion Paderborn (2017): Zukunftskonzept, S. 27 ff.
[19] vgl. Stadt Bielefeld, unter: https://www.bielefeld.de/de/dob/rr/as/

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2.4 Vergleich der Akteurs- und Organisationsformen sowie Aktivitäten der untersuchten Regiopole

Alle drei Regiopolen haben die Ziele des Gesamtkonzepts (vgl. Kap. 2.1) in ihre Agenden übernommen und richten ihre inhaltlichen Strategien daran aus. Zur Erreichung der Ziele übernehmen sie die Funktionen als regionaler Entwicklungsmotor und erfüllen mindestens oberzentrale Funktionen. Alle drei Regiopolen übernehmen metropolitane Teilfunktionen und sind dadurch Standorte regiopolitaner Funktionen. In Bezug auf die Übernahme nationaler Gatewayfunktionen kann lediglich Bielefeld die Funktion durch einen regelmäßigen ICE-Systemhalt erfüllen.

Die beteiligten Akteure und Organisationsformen der Regiopolen unterscheiden sich in wesentlichen Punkten. Die Regiopolregion Rostock wird von einer Geschäftsstelle im Planungsverband Region Rostock koordniert und bindet kommunale Vertreter wie auch Marketinginstitutionen und Kammern bzw. Verbände mit ein. Die Regiopolregion Paderborn entstand durch einen Bottom-up-Ansatz aus der Region heraus, was sich in einer sehr akteursorientierten Ausgestaltung niedergeschlagen hat. Durch die Organisation als eingetragener Verein können zahlreiche Akteure aus kommunalen, wirtschaftlichen und zivilgesellschaftlichen Bereichen beteiligt werden. Im Gegensatz dazu orientiert sich der regiopolitane Ansatz der Regiopolregion Bielefeld sehr nah an vorhandenen politischen Strukturen. Die Organisationsform sieht (bisher) keine direkte Einbindung von Akteuren außerhalb der Politik bzw. Verwaltung vor.

Im Hinblick auf inhaltliche Aktivitäten verfügen die drei Regiopolen über breite Themenspektren. Besonders hervorzuheben sind dabei die Themen Mobilität, Wirtschaftliche Entwicklung, Bildung, Daseinsvorsorge und Kultur, die in allen drei Regiopolregionen Beachtung finden.

3 DIE REGIOPOLREGION „KOBLENZ-MITTELRHEIN-WESTERWALD"

Neben der Darstellung des Konzepts der Regiopolen, ist es Ziel dieses Beitrags mögliche Eckpunkte der Ausgestaltung einer Regiopole zu diskutieren. Hierfür wird beispielhaft die potentielle Regiopolregion Koblenz-Mittelrhein-Westerwald herangezogen. Der Untersuchungsraum der als Grundlage durchgeführten sozioökonomischen Strukturanalyse umfasst die kreisfreie Stadt Koblenz sowie das Gebiet der umliegenden Planungsregion Mittelrhein-Westerwald. Anhand dieses Fallbeispiels werden thematisch-inhaltliche, strukturell-organisatorische sowie räumlich-funktionale Aspekte der Ausgestaltung diskutiert.

Die Idee, eine regionale Identität herzustellen bzw. zu stärken und somit die Entwicklung der Region voranzutreiben existiert bereits seit der Auflösung des ehemaligen Regierungsbezirks Koblez im Jahr 2000. Seitdem versuchen regionale Akteure, wie die Initiative Region Koblenz-Mittelrhein e.V., Impulse zur Initiierung einer Regiopolregion zu setzen. Konkretisiert wurde die Regiopolenidee in der Zukunftskonferenz „Regiopolregion Koblenz-Mittelrhein" im März 2017 sowie schließlich durch die Vergabe einer wissenschaftlichen Vorstudie zur Etablierung einer Regiopolregion im Auftrag der Planungsgemeinschaft Mittelrhein-Westerwald.

3.1 Koblenz und die Region Mittelrhein-Westerwald

Die Stadt Koblenz mit 112.586 Einwohnern liegt im Norden des Bundeslandes Rheinland-Pfalz, in der Planungsregion Mittelrhein-Westerwald an der Mündung der Mosel in den Rhein. Die Region gliedert sich in eine kreisfreie Stadt und acht Landkreise, sechs verbandsfreie Gemeinden, vier große kreisangehörige Städte und 52 Verbandsgemeinden sowie 898 Ortsgemeinden.[20] In einem Umkreis von ca. 100 Kilometern findet sich keine Metropolregion, wodurch das Oberzentrum Koblenz einen großen Einzugsbereich vorweisen kann. Aufgrund der großen Distanz besteht keine unmittelbare Beziehung zwischen Stadt und Region zu Metropolregionen. Koblenz, als Universitätsstandort, erfüllt demnach alle drei grundlegenen Identifikationskriterien einer Regiopole nach Aring und Reuther.

Als Ergebnis einer sozioökonomischen Strukturanalyse der regionalen Voraussetzungen und ergänzenden Expertengesprächen[21] lassen sich einerseits Aussagen zu Standorten regiopolitaner Funktionen (Politik, Wirtschaft, Wissenschaft, Verkehr und Kultur, vgl. Abb.1) innerhalb der Region machen und andererseits eine räumlich funktionale Abgrenzung ableiten.

Der Funktionsbereich „Politik", der sich vor allem durch Sitze nationaler Regierungen und Nicht-Regierungsorganisationen abbildet, ist in abgestufter Form in der potentiellen Regiopolregion vorzufinden.

[20] vgl. Planungsgrmeinschaft Mittelrhein-Westerwald (2018): Regionaler Raumordnungsbericht 2018, S. 3
[21] Expertengespräche vgl. Weber, Tobias (2019)

Die Stadt Koblenz bildete bis 1999 den Sitz des gleichnamigen Regierungsbezirks. Die darauffolgende Struktur- und Genehmigungsdirektion Nord hat bis heute ihren Sitz in der Stadt. Weiterhin ist Koblenz Standort von Verbänden wie der IHK und HWK und stellt einen der größten Bundeswehrstandorte Deutschlands mit Einrichtungen wie dem Bundeswehrzentralkrankenhaus dar. Ausgelagerte Teile der rheinland-pfälzischen Landesregierung sind in Koblenz und Bad Ems angesiedelt, die demnach Standorte von regiopolitanen politischen Funktionen sind.

Weiterhin wird die Funktion des regionalen Entwicklungsmotors durch den Funktionsbereich „Wirtschaft" abgebildet. Standorte finden sich v.a. in Koblenz und in direkt angrenzenden Städten wie Neuwied oder Mülheim-Kärlich. Sie bilden das Arbeitsplatzzentrum der Region. In und um Koblenz finden sich zum einen Standorte großer Unternehmen, zum anderen auch Sitze kleinerer „Hidden Champions", wie EWM AG in Mündersbach oder Griesson – de Beukelaer GmbH & Co. KG in Polch. Ein weiterer bedeutsamer Wirtschaftsstandort findet sich mit dem europaweit einmaligen Keramik-Cluster in Höhr-Grenzhausen.

Der regiopolitane Funktionsbereich „Wissen und Innovation" ist in der Region Mittelrhein-Westerwald stark ausgeprägt und stellt eine Stärke dar. Zahlreiche Universitäten und Hochschulen mit unterschiedlicher Schwerpunktsetzung und eine hohe Anzahl an Studierenden in der Stadt Koblenz verdeutlichen das Bild der bildungs- und wissenschaftlich geprägten Region. Bedeutend für die (Aus-) Bildung innerhalb des Bundeslandes Rheinland-Pfalz sind auch die Hochschule der Polizei (HdP) am Flughafen Frankfurt-Hahn und die Hochschule für öffentliche Verwaltung (HöV) in Mayen. Über bundesweite Bedeutung verfügt die staatliche Hochschule der Deutschen Bundesbank in Hachenburg. Zudem finden sich in Höhr-Grenzhausen, Remagen und Wissen innovative Forschungseinrichtungen. All diese Faktoren zeugen von einem hohen Innovationspotential sowie der Rolle der Stadt Koblenz und der engeren Verflechtungsregion als Motor regionalen Wachstums.

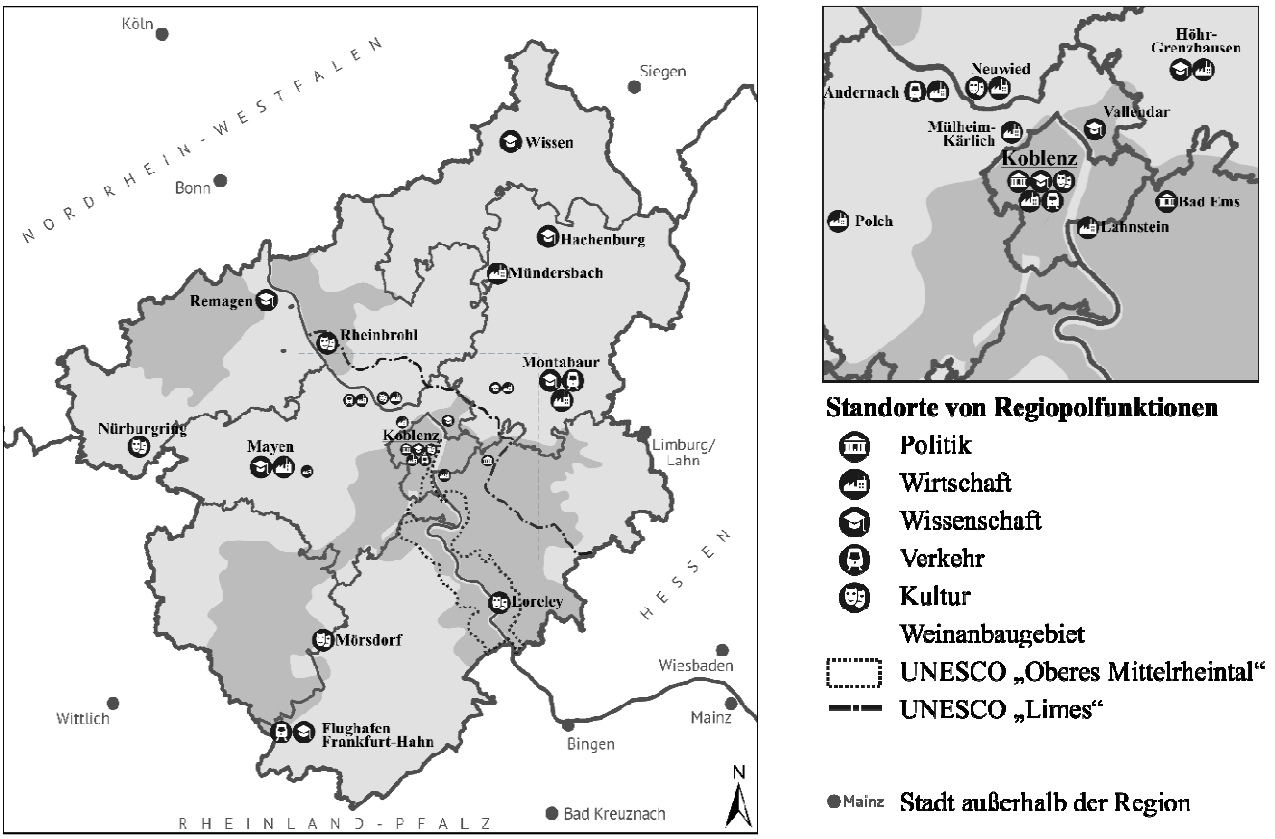

Abb. 1: Standorte regiopolitaner Funktionen in der Region Mittelrhein-Westerwald
(Quelle: Weber 2019, S. 62)

Die Gatewayfunktionen werden durch den Funktionsbereich „Verkehr" abgebildet und durch die überregionalen Bundesautobahn- und Bahnfernverkehrsverbindungen in das Rhein-Main-Gebiet und die Metropolregion Rhein-Ruhr erfüllt. Zusätzlich trägt die Stadt Montabaur mit der Anbindung an die ICE-Schnellfahrstrecke Frankfurt-Köln zur Wahrnehmung dieser Funktion bei. Als Standort der internationalen Verknüpfung gilt der Flughafen Frankfurt-Hahn im Süden der Region.

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Der regiopolitane Funktionsbereich „Kultur" als weicher Standortfaktor und Identifikationsmerkmal ist mit zwei UNESCO-Welterbestätten und einer großen kulturellen Ausstattung (z.B. Theater in Koblenz und Neuwied, Freiluftbühne auf der Loreley) gut ausgeprägt Die naturräumliche Vielfalt sowie die Weinanbaugebiete an Rhein, Mosel und Ahr tragen zu einer hohen Lebensqualität in und Identifikationsmöglichkeiten mit der Region bei. Die Profilierung im Bereich Sport, durch identitätsstiftende Vereine oder große Sportereignisse, findet sich in der Region vor allem am Nürburgring im Westen der Region, einer der bedeutendsten Rennstrecken weltweit.

Wie in Abbildung 1 erkenntlich, bündeln sich zwar insgesamt die Standorte aller Funktionsbereiche im Oberzentrum Koblenz und dem umgebenden Verdichtungsraum des Neuwieder Beckens (von Andernach bis Lahnstein), verteilen sich aber funktionsbezogen nahezu in der gesamten Region.

3.2 Ziele der potentiellen Regiopolregion

Oberstes Ziel der potentiellen Regiopolregion stellt eine verbesserte Positionierung im Standortwettbewerb der Städte und Regionen dar. Auf Grundlage der strukturellen Analyse, Aussagen von regionalen, in den Prozess involvierten, Experten sowie Aussagen des Landesentwicklungsprogramms IV Rheinland-Pfalz und des Regionalen Raumordnungsplans Mittelrhein-Westerwald, lassen sich folgende Entwicklungsziele für die zukünftige Regiopolregion ableiten:

Etablierung eines „Dachs über der Region" zur Milderung von Problemlagen und Nutzung von Potentialen und Chancen durch interkommunale Kooperation[22];

Nutzung der Brückenfunktion ziwschen den Metropolregionen Frankfurt/Rhein-Main und Rhein/Ruhr[23];

Nutzung zukunftsfähiger Entwicklungspotentiale der Region auf demografischer, wirtschaftlicher und infrastruktureller Ebene[24];

Steigerung der regionalen Identifikation und Imagegewinn durch Herstellung einer regionalen Identität bzw. eines regionalen Images[25];

Kanalisierung des vorhandenen Siedlungsdrucks im Neuwieder Becken[26];

Verbesserung der regionalen und überregionalen öffentlichen Mobilitätsinfrastrukturen[27];

Etablierung eines Exzellentszentrums durch Clusterbildung mit unternehmensnahen Dienstleistungen im gewerblich-industriellen und wissenschaftlichen Bereich[28].

Diese Entwicklungsziele stellen eine Sammlung bisher nebeneinanderstehender Leitideen zur Entwicklung der zukünftigen Regiopolregion Koblenz-Mittelrhein-Westerwald dar. Es kann aber festgehalten werden, dass die regionalen Akteure mit diesem „Kanon" an Entwicklungszielen die Ziele und Funktionen des Konzepts der Regiopolen voll abdecken und damit eine gute Basis für die Gründung einer Regiopole gegeben ist. Gleichwohl sind die Entwicklungsziele im weiteren Prozess zu konkretisieren.

3.3 Aktivitäten der potentiellen Regiopolregion

Die untersuchten Regiopolen in Deutschland weisen breit aufgestellte Themenspektren auf und entwickeln Projekte in nahezu allen strukturellen Bereichen. Anhand einer Clusterung von Themen zu potentiellen Handlungsfeldern sollen mögliche inhaltliche Ausrichtungen der Regiopolregion Koblenz-Mittelrhein-Westerwald aufgezeigt werden. Die Auswahl bezieht sich vor allem auf, in Experteninterviews mit involvierten Akteuren genannte Themen und stützt sich zudem auf die sozioökonomische Strukturanalyse.

Die Erarbeitung und Einigung auf eine regionale Strategie im Sinne eines Handlungsrahmens (vgl. Aktionsplan in der Regionlregion Rostock bzw. Zukunftskonzept der Regiopolregion Paderborn) mit einer Analyse, einer Leitvorstellung, Zielen, Handlungsfeldern und Maßnahmen, die von allen Akteuren getragen wird, kann als wesentlicher Erfolgsfaktor für eine effiziente Arbeit einer Regiopolregion betrachtet werden.

[22] vgl. Vorsitzender Initiative Region Koblenz-Mittelrhein e.V.
[23] vgl. Planungsgemeinschaft Mittelrhein-Westerwald (2017): Regionaler Raumordnungsplan: G3, S. 1
[24] vgl. Vorsitzender Initiative Region Koblenz-Mittelrhein e.V.
[25] vgl. Referent Planung der IHK zu Koblenz
[26] vgl. Leitender Planer der PG Mittelrhein-Westerwald
[27] vgl. Vorsitzender Initiative Region Koblenz-Mittelrhein e.V.
[28] vgl. Ministerium des Innern und für Sport Rheinland-Pfalz (2008): Landesentwicklungsprogramm IV, S. 68

Denn wird diese in einem gemeinsamen Prozess erarbeitet, spiegelt sie einerseits die Motivationen und Erwartungen der Akteure und dient anderseits der Identifikation mit dem anvisierten Mehrwert, der aus der Regiopole entstehen soll.

Zentrales Themencluster, das zur Erreichung der formulierten Entwicklungsziele Beachtung finden sollte, ist „(Aus-) Bildung, Wissenschaft, Forschung, Innovation und Wirtschaft". Auf Grundlage der guten strukturellen Bildungs- und Innovationslandschaft kann durch die Nutzung der vorhandenen Potentiale die Dachmarke „Innovations- und Wissenschaftsregion" zu einem Standbein der Regiopolregion werden und die Standortentwicklung fördern. Dafür gilt es, den wissenschaftlichen mit dem gewerblich-industriellen Bereich stärker zu vernetzen, um durch Synergieeffekte positive Entwicklungen auf dem Arbeitsmarkt zu generieren.

Besonderes Augenmerk sollte auch auf die Themen Innen- und Außenwahrnehmung, Marketing, regionale Identität, regionales Image, Kultur, Natur, Weinbau und Tourismus gelegt werden. Zur Erreichung der formulierten Entwicklungsziele ist die Entwicklung einer regionalen Identitäts- und Imagestrategie als „Dach"[29] über der Regiopolregion sinnvoll. Gleichzeitig kann durch die Umsetzung von Projekten innerhalb dieses Bereichs zum einen die Akzeptanz der lokalen Bevölkerung, zum anderen die Wahrnehmung von außen erhöht werden.

Nach Vorbild der bestehenden Regiopolregionen und Aussagen von Experten und des LEP IV, sind Themen wie Mobilität, Verkehr und Erreichbarkeiten essentieller Bestandteil einer regionalen Standort-Entwicklungsstrategie.[30] Der Ausbau von Mobilitätsinfrastrukturen sollte jedoch stets unter Beachtung der Umweltverträglichkeit und Nachhaltigkeit stehen. Daher ist eine Verknüpfung dieser beiden Themenfelder zu einem Handlungsfeld (z.B. „Grüne Infrastruktur") empfehlenswert. Schwerpunkte sollten dabei Projekte im Bereich der E- und Sharing-Mobility bilden.

Zur Steuerung der Siedlungsentwicklung, die an ungleiche demografische Entwicklungen der Region anzupassen ist[31], finden die Themen Wohnen, Leben, Daseinsvorsorge und Versorgung Berücksichtigung in der regionalen Entwicklungsstrategie. Hierbei gilt es gleichermaßen die Herausforderungen des demografischen Wandels, wie auch die des wachsenden Siedlungsdrucks in Kernbereichen zu beachten. Die Priorität des Handlungsfelds, das diese Themen clustert, stellt die Entwicklung des regiopolitanen Zentrums als zusammenwachsende Stadtregion dar[32].

Die Clusterung dieser Themen zu Handlungsfelden stellen einen ersten inhaltlichen Rahmen für die potentielle Regiopolregion Koblenz-Mittelrhein-Westerwald dar. Dabei ist die Liste keineswegs abschließend und bedarf einer ständigen Evaluierung und Anpassung an externe Trends und veränderte Rahmenbedingungen. Letztendlich sind Themen, die in einem Strategiekonzept verankert werden, wie oben beschrieben, durch partizipative Prozesse der involvierten Akteure festzulegen.

3.4 Akteure und Organisationsform der potentiellen Regiopolregtion

Maßgebliches Element der Etablierung einer Regiopolregion ist ein entsprechender Akteurskreis, der die zielführende Entwicklung der Region als übergreifendes Ziel ansieht. Hierbei sind insbesondere die bisher in den Prozess involvierten Akteure gefragt, die die Idee einer Regiopolregion als Bottom-up-Ansatz aus der Region heraus entwickeln. Im Sinne einer Regional Governance gilt es einen Akteurskreis aus kommunalen Vertretern, Akteuren der Wirtschaft sowie Vertretern der Bürgerschaft und Zivilgesellschaft zu schaffen.

Der Impuls zur Initiierung einer Regiopolregion mit Koblenz als Zentrum ging von der Initiative Region Koblenz-Mittelrhein e.V. aus. Die Initiative verfügt durch ihr breites Spektrum an Mitgliedern aus wirtschaftlichen und zivilgesellschaftlichen Bereichen bereits über ein vorhandenes Netzwerk, das zur Akquirierung von Akteuren genutzt wird. Weiterhin hat die Planungsgemeinschaft Mittelrhein-Westerwald mit der Vergabe einer wissenschaftlichen Vorstudie zur Etablierung einer Regiopolregion innerhalb ihres Einzugsbereichs das Thema im vergangenen Jahr aufgegriffen. Die Planungsgemeinschaft stellt dadurch ebenfalls einen bedeutenden Akteur im Entwicklungsprozess dar, da sie über regionales Know-How verfügt,

[29] vgl. Vorsitzender der Initiative Region Koblenz-Mittelrhein e.V.
[30] vgl. Vorsitzender der Initiative Region Koblenz-Mittelrhein e.V.
[31] vgl. Weber, Tobias (2019): Das Konzept der Regiopole und Möglichkeiten der Umsetzung am Beispiel der „Regiopolregion Koblenz-Mittelrhein-Westerwald", S. 36 ff.
[32] vgl. Leitender Planer der Planungsgemeinschaft Mittelrhein-Westerwald

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in der Kooperation mit den Kommunen der Region geübt ist und als Träger der Regionalplanung dezidiert auch einen Entwicklungsauftrag für die Region hat

Diesen beiden Hauptakteuren obliegt es nun, in dem Ziel eine Regiopole zu gründen sowie weitere Partner der Regiopolregion zu gewinnen, um ein leistungsfähiges Kooperationsnetzwerk aufzubauen. Allen voran gilt es kommunale Vertreter aller Gebietskörperschaften einzubinden: Gemeinden, Verbandsgemeinden, Städte und Landkreise, sowie Vertreter von Kammern und Verbänden und führender regionaler Unternehmen einzubinden. In der Region findet sich aktuell ein Zusammenschluss aus neun Unternehmen, die durch Kooperation versuchen, die Attraktivität der Region für Investoren, Fachkräfte und Politik sichtbar zu machen: die R56+ Regionalmarketing GmbH & Co. KGaA mit Sitz in Koblenz. Diese kann ein bedeutender Teil der Vertretergruppe der wirtschaftlichen Akteure bilden. Weitere potentielle Institutionen zur Einbindung könnten sein: Universitäten und Hochschulen der Region, Wirtschafts- und Wissenschaftszusammenschlüsse, Forschungseinrichtungen, Verkehrsverbünde und Mobilitätsbetriebe, Tourismus-Institutionen oder Gewerkschaften. Zudem sollten Vertreter der Umwelt, Landwirtschaft sowie verschiedener Generationen und Geschlechter in den Akteurskreis integriert werden. Ohne ein solch breit aufgestelltes Netzwerk an involvierten Akteuren und Kooperationspartnern wäre eine wirkungsvolle Arbeit der Regiopolregion eingeschränkt.

Als Basis der strukturellen Organisation bietet sich die Gründung eines Vereins an, der alle zu einer Zusammenarbeit motivierten Akteure durch Mitgliedschaft an die Regioopolregion bindet. Hierbei dient die Regiopolregion Paderborn mit dem „RegiopolREGION PADERBORN e.V." als Vorbild. Positive Aspekte der Gründung eines Vereins sind zum einen eine erste Grundfinanzierung durch die Beitragszahlungen der Mitglieder. Zum anderen ist die Regiopolregion durch regelmäßig stattfindende Mitgliederversammlungen stets präsent und auf der Agenda der Akteure. Den bedeutendsten Vorteil eines Vereins bietet jedoch die Möglichkeit, die aktuell involvierten Akteure, wie die Mitglieder der Initiative Koblenz-Mittelrhein e.V., in leitenden Positionen abzubilden.

Organisation, Kommunikation und Marketing sowie Projektleitung sind durch eine zu schaffende Geschäftsstelle abzudecken und zu steuern. Dabei bietet sich aus mehreren Gründen ein Andocken an die bestehende Geschäftsstelle der Planungsgemeinschaft Mittelrhein-Westerwald an. Zum einen hat diese einen regionalen Entwicklungsauftrag, zum anderen verfügt sie über das benötigte Wissen über die Region, das für eine nachhaltige Strategie von Nöten ist. Weiterhin findet sich die Planungsgemeinschaft bereits in einem bestehenden interkommunalen Konsens mit den Städten und Gemeinden der Region, worauf eine weiterführende Kooperation im Sinne der Regiopolregion aufbaut. Neben organisatorischen und kommunikativen Aufgaben umfasst die Funktion der Geschäftsstelle die Koordiniierung bzw. Leitung der Projekte der Regiopolregion. Zur Initiierung von Projekten sollten entsprechend den inhaltlichen Handlungsfeldern (siehe 3.3) Arbeitskreise gebildet werden, die bei Bedarf auf die Unterstützung externer Experten zugreifen können.

Die tatsächlichen Organisationsstrukturen sind abhängig von der Zusammensetzung und dem Engagement der regionalen Akteue vor Ort. Das strukturelle Grundgerüst als Regional Governance sollte jedoch in einer Anlehnung an vorhandene administrative Verwaltungsstrukturen vorgezogen werden.

Die räumliche Abgrenzung der Regiopolregion wird sich letztendlich durch das Kommittment der Gebietskörperschaften und weiteren Akteuren ergeben. Die Analyse der regiopolitanen Funktionen hat gezeigt, dass diese in der gesamten Planungsregion verortet sind, mit einem Schwerpunkt auf Koblenz. Entsprechend auch dem regionalen Verflechtungsbereich, sollte sich eine Erstansprache zur Partnerschaft in der Regiopole auf die Gebietskörperschaften, Wirtschafts- und Sozialpartner der Planungsregion Mittelrhein-Westerwald beziehen. Diese werden vor dem Hintergrund einer potentiellen Vereinsmitgliedschaft sicher realitätsnah entscheiden, ob sich die Verflechtungen und die Orientierung der Bevölkerung in der Planungsregion abbilden und dementsprechend eine Mitgliedschaft und Zugehörigkeit zur Regiopole von Vorteil ist.

4 MEHRWERT UND AUSBLICK

Bislang forcierten Leitbilder, Handlungsstrategien oder Konzepte der Raumordnung vor allem zwei Ebenen: Wirtschaftliche Wachstumsräume um Metropolen und den ländlichen Raum. Eine Verankerung der Regiopole als Raumkategorie im System der deutschen Bundesraumordnung würde die

Entwicklungschancen dieser Großstädte erhöhen und eine Verflechtung zwischen Wachstums- und Schrumpfungsräumen generieren. Die sieben Regiopolen in Deutschland haben in den letzten zehn Jahren vereinzelt auf sich aufmerksam gemacht. Durch die Etablierung des RegioPole-Netzwerks existiert ein bundesweites Gremium, welches die Bekanntheit des Konzepts weiter steigern wird. Durch innovative thematische und inhaltliche Konzeptionen und auf das Konzept angepasste Organisationsformen, werden Regiopolen in den kommenden Jahren eine Wahrnehmungssteigerung erfahren.

Die etablierten Regiopolregionen, als akteursorientiere stadtregionale Ansätze, unterscheiden sich gerade hinsichtlich ihrer Organisationsformen in vielen Punkten. Eines eint jedoch alle Organisationsstrukturen: der Drang nach einer regionalen Entscheidungsebene. Entwicklung, Bestehen und Wachstum einer Stadtregion richten sich nicht (mehr) nach historischen administrativen Grenzen, sondern sind von funktionalen, organischen Faktoren abhängig. Eine Loslösung von diesen administrativen Grenzen durch eine neue, stadtregionale Entscheidungsebene, die Verflechtungen einer Stadtregion durch Governancestrukturen abbildet, scheint die Lösung der Organisation einer Stadt-Umland-Kooperation zu sein.

Governancestrukturen, die zusätzlich zu bestehenden Verwaltungsstrukturen geschaffen werden, um Stadt-Umland-Herausforderungen zu lösen, bedürfen der Akzeptanz durch die Bevölkerung und sollten in der Gesellschaft Verankerung finden. Hierfür können folgende Elemente hilfreich sein: Etablierung von Kommunikationsprozessen als konstituierendes Element des regionalen Entwicklungsprozesses, die Bestimmung gemeinsamer regionaler Entwicklungsleitbilder und eine Bandbreite regionaler Zielsetzungen. Gleichzeitig sollte ein Paradigmenwechsel von einer alleinstehenden hoheitlichen Planung hin zu einem dynamischen Initiieren, Formen und Begleiten – stets in kooperativen Partizipationsprozessen – regionaler Entwicklung erfolgen.

Können Koblenz und die Region Mittelrhein-Westerwald durch die Initiierung einer Regiopolregion langfristig profitieren? Die Großstadt Koblenz und ihr Verflechtungsbereich bieten alle strukturellen Voraussetzungen und verfügen über einen ausreichend motivierten Akteurskreis, um eine Regiopolregion zu initiieren. Durch die Umsetzung einer regionalen Strategie können Stadt, Region sowie die involvierten Akteursgruppen eine positive Entwicklung und einen spürbaren Mehrwert erfahren. Funktionale Vernetzung und Clusterbildung ermöglichen Wettbewerbsvorteile für einwohnerorientiere, wirtschaftliche oder wissenschaftliche Standortwettbewerbe. Eine weiterentwickelte regionale Identität kann die Regiopolregion sowohl nach innen als auch nach außen sichtbar mit einem innovations- und zukunftsorientierten Profil abbilden. Eine Regiopolregion Koblenz-Mittelrhein-Westerwald könnte, mit dem beschriebenen Akteursverbund, so als starker Wissen- und Wirtschaftsraum mit der Stadt Koblenz als Zugpferd positive Entwicklungen in demografischer, wirtschaftlicher, infrastruktureller und kuklturelle Hinsicht generieren.

Insgesamt stellt das Konzept der Regiopole als neue Raumkategorie eine gute Alternative für kleinere Großstädte zur Positionierung zwischen Metropolregionen dar. Die nationalen „Vorreiter-Regiopolen“ Rostock oder Paderborn zeigen, dass der Ansatz vor allem auf (stadt-) regionaler Ebene eine große Entwicklungschance bietet. Stadt-Umland-Herausforderungen gilt es auf einer funktionalen Ebene zu entwickeln – administrative Verwaltungsgrenzen sind oft nicht zuielführend.

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🏆 *reviewed paper*

Deciphering and Modelling Spatiotemporal Patterns and Processes across Scales – Migratory Flows and their Implications under a Healthy City Scenario in the Ruhr Area, Germany

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1 ABSTRACT

As it has been stated over and over again, today's large-scale urban structures are becoming increasingly hard to be grasped and understood through the lens of conventional spatial and temporal scales. Due to their dynamic interactions and complex interdependencies, cities are expanding way beyond traditional - such as municipal, regional or even national – barriers and boundaries. Nevertheless, comprehensive methods and innovative tools for effectively deciphering and designing complex urban systems are still relatively few. Here, we introduce a five-step integrated methodology to understand, reveal and model dynamic spatiotemporal patterns and processes across scales. The main focus of this paper will thereby lie on factor and cluster analysis of prevailing socioeconomic contexts and on their embedding into multiscale urban modelling. We contend that a meaningful connection between empirics and modelling is a quintessential and often missing link of endeavours simulating long-term development of urban environments. Therefore, we demonstrate how - with a machine-learning mechanism called self-organising maps - empirical findings may effectively infiltrate into modelling attempts of complex urban systems. Subsequently, we will use the example of the residential and employment migration subsystem of the multiscale urban model (Lengyel and Friedrich, 2019), to study the effects of demographic change, local and regional migration flows, as well as their interdependencies with the ongoing economic structural change between 2011 and 2050 in the Ruhr region. Furthermore, we show how we can use micro-scale outcomes to identify the small-scale anchoring of latter regional processes. In our example, we determine neighbourhoods with substantial changes in their local economic and land value profiles: which might be indicators for future hot and cold spots of gentrification processes. The main aim is to inform and instigate meaningful cooperation and synchronised action between urban stakeholders and decision-makers on different scales. The latter task is perhaps even more pressing and challenging for large-scale polycentric regions such as the Ruhr Area in Germany, which will serve as the case study for this paper.

Keywords: multiscale, exploratory spatial data analysis, self-organizing maps, modelling complex urban systems, residential and employment migration

2 FIVE-STEP METHODOLOGY FOR DECIPHERING AND MODELLING SPATIO-TEMPORAL PROCCESSES ACROSS SCALES

First of all, we provide a general overview of the five-step comprehensive methodology for deciphering and modelling spatiotemporal patterns and processes across scales. Each step is being illustrated with some relevant examples from the Ruhr Area in Germany. Additionally, they seek to give practical advice for increasing the real-world applicability and efficacy of corresponding efforts. In this paper, step one, three and five are only discussed shortly (for more information please see Lengyel and Friedrich, 2020), whilst the crucial step of effectively bringing empirics and modelling together (step two) will be reviewed in detail in Section 3, followed by an extensive description of the residential migration sub-model in Section 4 (which is a crucial part of step four).

2.1 Step 1: Analysing trends and deciphering their spatial projections

To start with, we must try to identify the most influential historic as well as current trends of the area in question and thereby comprehend their important shaping factors and mechanisms. Henceforth, the operational scale of this step is a macro spatial boundary e.g. city, regional or even national layers, combined with an investigation time period of the minimum past 25 years (depending on data availability). Such macro-scale trends may include demographic (age or ethnic structure), economic (sectoral shifts) or societal (household, gender) processes. In order for this step to be applicable for both planning and policy, as well as for modelling purposes, one may carry out the following three main consecutive tasks: firstly, with the help of historical data analysis carefully quantifying spatiotemporal development tendencies, and secondly, studying their connections and interdependencies. Closely connected to this is the third and very important

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task (since we are dealing with urban environments), with the main goal to deduce the spatial impact of identified trends. As an example, we studied how the ongoing economic structural change in the Ruhr Area has left its massive traces on land use development of the last couple of decades and how the amplitude of impact is roughly distributed throughout the region (see Fig. 1). Over the course of this first step, we suggest an alternating method of literature review and spatiotemporal data analysis.

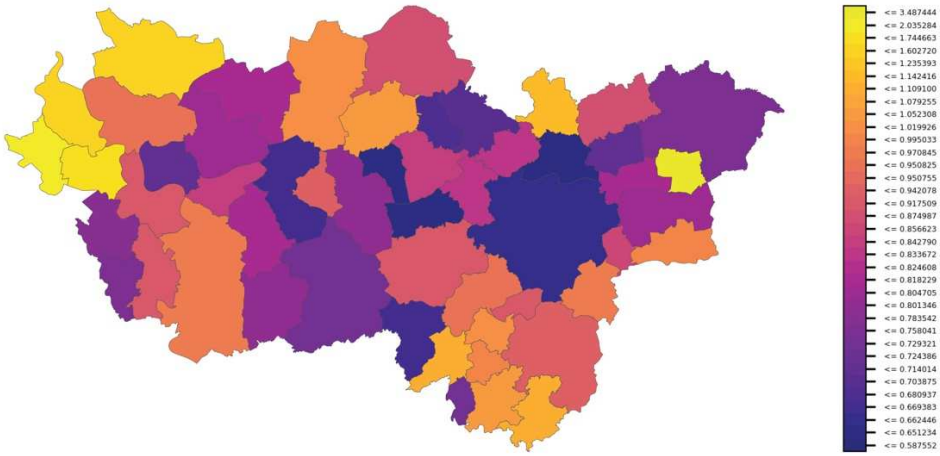

Fig 1: Commercial and industrial land use change between 1994 and 2015 (factor of change compared to 1994 values). Own graphic. For data source: see Section 4.3

2.2 Step 2: Unravelling spatiotemporal patterns and building clusters

Now that we are aware of the major influencing trends of our area, we shift focus from macro towards subjacent scales, and observe their local impact and anchoring. Firstly, with the help of exploratory spatial data analysis we study the spatial, demographic, socio-economic and economic patterns and try to capture their corresponding characteristic scales. Throughout our investigations into the Ruhr Area we observed that the spatial distribution of large number of socioeconomic indicators are still displaying a pattern which follows very closely the layered structure of the historical development zones of the region. Thus, today's city boundaries are almost invisible (see Fig. 3). Both industrialisation and deindustrialisation processes took place in several consecutive phases from the south northwards (Wehling, 2014), leaving behind some very important characteristic scales for age, economic, ethnic and socioeconomic structures. Secondly, we demonstrate how - with a machine-learning mechanism called self-organising maps – latter empirical findings can by synthesised for more clarity and for their effective infiltration into modelling attempts of complex urban systems (the latter method will be reviewed at length in Section 3). This second step may be considered as the first effort towards delineating new spatial and temporal dimensions for action, which may prove to be more efficient for some measures than operating on the scale of traditional urban boundaries.

2.3 Step 3: Delineating Future Development Tendencies

The goal of step three is envisioning possible long-term urban development scenarios for the study area and testing solutions for prevailing issues or impulses for potentials. When it comes to examining future urban development paths, one might take two important points into consideration. First, we may integrate already existing design concepts of the region in our scenarios: let these be large-scale projects such as international expos or locally relevant urban design projects at selected study areas. For this paper, we assume that the "generational project" (URL-1) implementing the re-naturalisation measures of the river Emscher and its tributaries, which have for decades served as an open sewage system, is a unique opportunity to provide sustainable intermodal mobility for the Emscher zone as well as for the whole Ruhr region. Additionally, the new transport infrastructure will most probably have a major influence on all other urban subsystems (demographics, employment, land use, etc.) and vice versa. Secondly, one might try to integrate issues of great societal relevance and interest at the time of conception – in our case this will be the transition towards more sustainable mobility patterns ("Verkehrswende" in German). The latter two efforts combined may substantially increase both the interest and acceptance by the local and regional stakeholders. In pursuance of studying these alternative development paths we use a scenario approach (Schmidt and Klemm, 2019). In more detail, this paper will review results under a "Healthy and Sustainable City" scenario. The starting point is an increased overall acceptance and awareness of the scientifically proven health risks (UN

Environment, 2019) of man-made pollution and environmental damage, such as that of fine-particulate air pollution in cities (Pope III et. al, 2009). Urbanites are now widely aware of their right to a healthy city, leading incrementally to the emergence of new sustainable models for political and administrative decision-making processes. In terms of mobility patterns, car-free and thus sustainable neighbourhoods are becoming more and more widespread in the region, where both owners and tenants progressively commit themselves to corresponding lifestyles. Sharing and on-demand transport options are becoming popular, whilst car lanes are gradually being reconstructed for autonomous buses and cycle-routes.

2.4 Step 4: Multiscale urban modelling and its calibration for a selected scenario

The multiscale urban model (MURMO) has been specifically designed for high-density polycentric urban regions (Lengyel and Friedrich, 2019). Throughout simulations, the six subsystems of population, residential migration, employment location, land price, land use and accessibility evolve simultaneously in an interactive manner. Residential and employment dynamics are captured by the well-known master equation approach from statistical physics (Haag and Weidlich, 1984), whilst land price relies on a novel method whose emphasis rests on the analogy between spatial land price fluctuations and velocity fluctuations in turbulent flows. We provide a detailed overview of the master equation method in section 5, the description of remaining MURMO methodology is however beyond the scope of this paper (please see Lengyel and Friedrich, 2019 for more information). Accessibilities values used for simulations in this paper are provided externally by the MatSIM transport model (Kaddoura et. al, 2019). Calibrated on a 100 x 100-meter spatial grid, the model is able to delineate small-scale trends of variables. At the same time it can intrinsically recognise meaningful trajectories in regional economic, land-use and population dynamics. For the example used in this paper, simulations are running from 2011 to 2050. In pursuance of translating the healthy city scenario (see Section 2.3) into MURMO we make the following assumptions:

- Immense reduction of man-made pollution and environmental damage: former large-scale industrial production and excavation sites available for new development
- Urban settings are becoming increasingly compact whilst at the same time further expansion of urban sprawl is restricted with the help of a variety of push and pull measures: areas with above average share of medium and high-density urban land use (URL-2) will become 20% more attractive by 2050. For the description of attractivities see Section 4
- Mobility in 2050 is foreseen to be intermodal, shared, walkable and active. Investment in new transport infrastructure accordingly: neighbourhoods in the vicinity of the Emscher river win attractiveness by 5% until 2050, largely due to the re-naturalidation process, improved accessibilities, etc. Accessibility values according to MatSIM measures come into existence (Kaddoura et. al, 2019)
- New urban areas may only emerge according to the official land use plan (URL-3) however they shall be strictly mixed use.

2.5 Step 5: Formulating recommendations for stakeholders on different spatial and temporal scales

We strongly believe that the combination of analysis and modelling results helps us to reveal competition as well as potentials for collaboration and shared interests within the 53 cities of the Ruhr area. A large potential of long-term and spatially highly resolved simulations lies in the effective application of outcomes to find suitable urban design and planning measures on and in between the newly defined characteristic scales. The overall aim is to inform and instigate meaningful cooperation and synchronised action between urban stakeholders and decision-makers.

3 SOCIOECONOMIC FACTOR AND CLUSTER ANALYSIS

Here, empirical results are brought together with the purpose of unravelling meaningful relationships between the different socioeconomic and demographic parameters as well as for dimensionality-reduction and modelling purposes. To this end, we use Self-Organising Maps (SOM) a machine learning mechanism, which “is able to convert complex non-linear statistical relationships between high-dimensional data items into simple geometric relationships on a low-dimensional display” (Kohonen, 1990). SOM is an artificial neuron network (ANN), made up of interconnected nodes - or artificial neurons - that are able to

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communicate with each other via signal-transmission, similar to the synapses in animal or human brain. These signals are numerical values that are being received by each neuron and then further processed according to the learning mechanism in question, in order to come to the output. Furthermore, there are weights assigned to both the nodes (or neurons) and their connections (or edges) which are being incrementally adjusted through the learning process. In case of the SOM, data projection happens in a way that similar values in the input space are mapped into the same neuron or to its close vicinity in the output space. Therefore, as Kourtet et. al put it, ”the output of a SOM can be thought of as a spatial representation of the statistical relations between the observations; in this map, the axes are not north-south or east-west but measures of statistical similarity, which is expressed in the distance between observations” (Kourtit et. al, 2012). In order to carry out the computational part of this analysis we used the Python package ”Sompy” (with some minor adjustments) developed by Vahid Moosavi, Sebastian Packmann and Iván Vallés (URL-4).

In our case, ten factors (see Fig. 2) are brought together and subsequently clustered into twenty-five distinct groups (see Fig 4). Figure 2 shows the component maps of the neural network, which may be interpreted in the following way. Firstly, brighter yellow colours correspond to higher values and darker colours to lower ones. Secondly, if we move on the surface showing the clusters on Fig. 4 from the right to the left (from less towards more transparency on the bivariate graph) we observe increasing median age and decreasing household size. If we move from the bottom towards the top, we encounter rising socio-economic advantages and a decrease in foreign population (from red towards blue). Henceforward, districts located in the upper left corner of the output space, can be characterised by the following parameters (each being in a strong statistical relationship with each other, in accordance with SOM rules): very high purchasing power and rent prices, below average share of foreign population and high percentages of above-65-year-olds. These would then belong to the clusters 24, 19 and 11 according to Fig. 4.

If we now observe the distribution of clusters on the regional map (Fig. 3), there is an evident pattern of more red and yellow districts in the central area (Emscher and Hellweg zones) and gray and blue colours dominating the outer regions. Firstly, these results correspond and underline the already described relationships on zonal scale (see Section 2.2). Secondly, on the two-dimensional maps on Fig. 2, the three types societal segregation patterns (Wehling, 2014) in the Ruhr area become clearly evident: namely those of nationality, age and economic power. Thirdly and perhaps most importantly, the clusters were found to be highly invaluable tools for the embedding of empirical findings into modelling as well as for an adequate implementation of scenarios into our simulations. We refer the reader to Section 4.2 for follow-up.

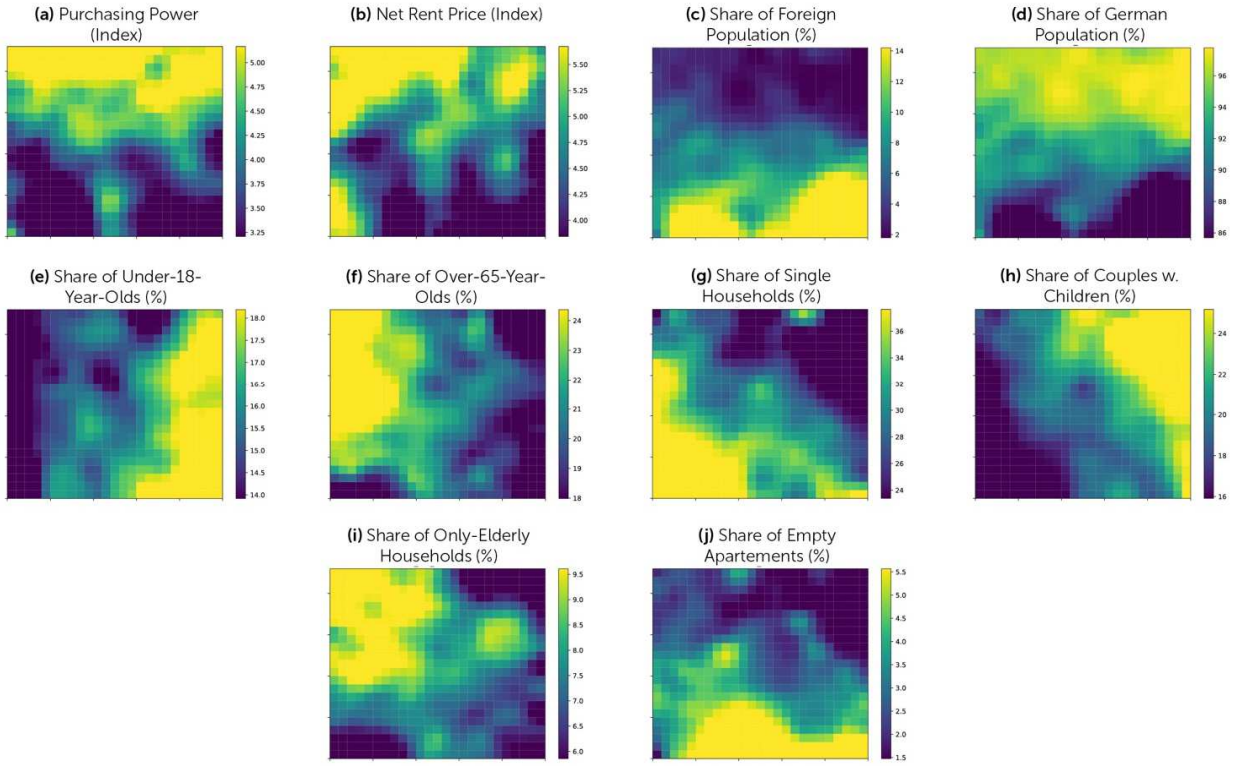

Fig 2: 2D Component maps of the SOM model-space. Data source: see Section 4.3

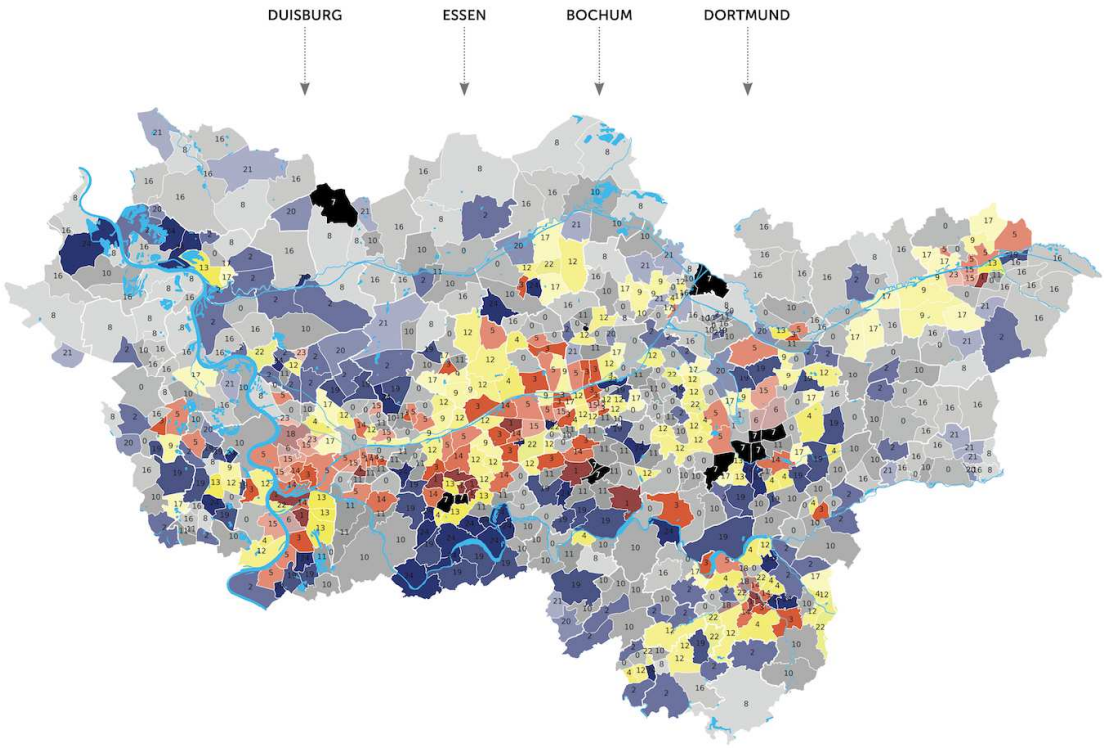

Fig. 3: Distribution of socioeconomic clusters throughout the Ruhr region in 2016. Data source: see Section 4.3

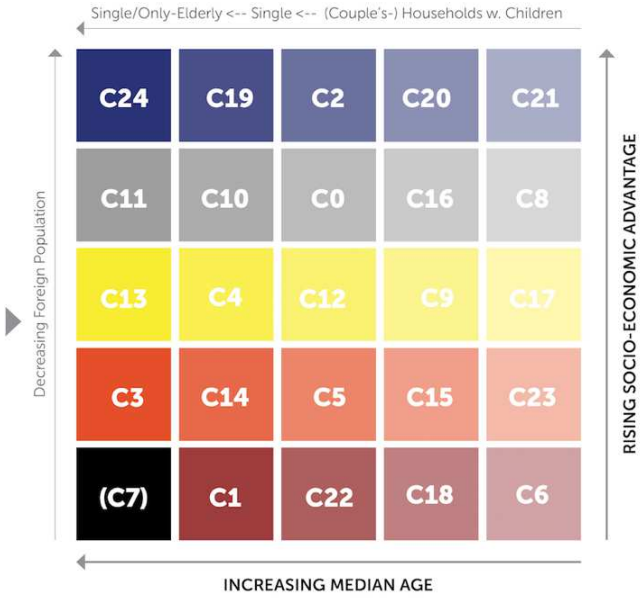

Fig. 4: SOM clusters on 2D model-space (see component maps on Fig. 2). Data source: see Section 4.3

4 MODELLING RESIDENTIAL MIGRATION WITH THE CAREFUL INTEGRATION OF SOCIOECONOMIC CLUSTERS IN THE RUHR AREA

In this section we give a brief review of the recently developed multiscale urban model (Lengyel and Friedrich, 2019). One of the main questions that we hope our model will answer is how the Emscher (and Ruhr) region and its inhabitants may react to different influences, e.g., changes of infrastructure (the re-naturalisation of the Emscher river, transport, housing, recreational areas), economic changes (labour market, increased spending power of certain neighbourhoods), and attractiveness changes (urban amenities, land price, congestion phenomena) that arise from in- or outside the urban system. In this context, we contend that due to many uncertainties in such systems, especially if we take long-term urban development into consideration, we cannot expect to capture each and every decision that is being made individually. Therefore, the residential and employment model relies on a *statistical description of urban structures* via probability density functions (PDFs) of certain key quantities, using the statistical model by Haag and

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Weidlich (1984). We also refer to the monographs (Haag, 2017 and Weidlich and Haag, 1999) for further details and applications. Here, the PDF $f_N(\mathbf{n},t)$ of a certain socio-configuration $\mathbf{n} = \{n_1,n_2,...,n_L\}$, where n_i denotes the number of members of the population in area i, is governed by the so-called *master equation*

$$\frac{\partial}{\partial t} f_N(\mathbf{n},t) = \sum_{\mathbf{k}} \left[p(\mathbf{n}|\mathbf{n}+\mathbf{k}) f_N(\mathbf{n}+\mathbf{k},t) - p(\mathbf{n}+\mathbf{k}|\mathbf{n}) f_N(\mathbf{n},t) \right] \quad (1)$$

where $p(\mathbf{n} + \mathbf{k}|\mathbf{n})$ stands for the *transition probability* from socio-configuration $\mathbf{n}$ to socio-configuration $\mathbf{n} + \mathbf{k}$. Transitions from area i to area j are favoured if the so-called *utility function* $g_i(n_i)$ in area i exceeds the utility function $g_j(n_j)$ in area j. Therefore, utility functions can be roughly considered as a measure of "**attractiveness**" of a given area in comparison to another area. The latter feature makes this modelling approach particularly suitable for urban design and planning purposes, since it makes scenario-calibration rather straightforward. The utility functions (2) are further evaluated in terms of a Taylor series of the population number n_i

$$g_i(n_i) = \delta_i + \kappa_i n_i + \rho_i n_i^2 \quad (2)$$

of each area i. Utility functions are being constructed with the help of three trend parameters, which are divided into the *preference parameter* δ_i (availability of schools, cultural offerings, climate, landscape, desire to remain in someone's birthplace), the *cooperation parameter* κ_i (offers of employment, increasing rent, accessibilities), and the *saturation parameter* ρ_i (constricted housing situation). As the intricate interplay of the three trend parameters fully determines where residents (and firms) may move to, their precise and adequate definition is of outmost importance – the task of Section 4.1 and Section 4.2.

4.1 Household types

In case of residential migration, we were interested in the drivers of a household's decision to move or to stay at their prevailing places of residence. Henceforth, we were curious about what crucial variables might affect the attractiveness of a region for the different household types or, in other words, which are the location choices that residents are most likely to make (once they decided to move). In the followings we refer to such influencing variables, according to the Weidlich-Haag model, as spatial preferences parameters. Due to data limitations, where we could not get hold of precise number of individuals per household-type per grid cell, we substitute households with age groups in our simulations. They can be hypothesised to have the following associations with household structure, living-space demand, urban amenities, land price and tendency to migrate (Haag and Weidlich, 1984, Haag, 2017, Lengyel and Friedrich, 2019):

- Under 18; Households with children. Vicinity to kindergarten, schools and playgrounds may be significant. Potentially high living-space demand per household. Low mobility (0.00005).
- Between 18-29; Association with single households or flat shares. Young adults possibly moving out from home for the first time. Probable importance of closeness to higher education, daily urban amenities and public transport. Might prefer lower rent prices. Normally low per capita living-space demand. Age group with the highest mobility (0.0002).
- Between 30-49; Young professionals that may or may not be starting a family. Associated with both single households and couples with children. Might be able to afford higher housing and land prices. Potential importance of proximity to jobs, cultural, and recreational facilities as well as to kinder-garden and schools. Might be moving towards ever higher living-space demands per household. High mobility (0.00023).
- Between 50-64; Double households living with or without child or children. Possible role of vicinity to jobs, schools or leisure facilities. Low to medium mobility (0.00008).
- Over 65; Associated with households with seniors-only as well as with single households. Potential importance of proximity to health facilities, daily urban amenities and public transport. Lowest mobility (0.00002).

4.2 Spatial preferences of socioeconomic clusters

Over the course of our simulations, each household type (see Section 4.1) is described by its own master equation (1) and has its own set of preference parameters. We compiled values for more than hundred parameters on our grid and sought to find the most influential locational factors for each of the age groups with the help of multiple regression models. Moreover, we carried out the regression analysis for the twenty-five SOM clusters separately. The latter step is extremely significant for two reasons. Firstly, we gain a very detailed knowledge of the spatial preferences for each socioeconomic cluster and therefore a better numerical description of the real-world situation. Secondly, since it is the tangled combination of preference, cooperation and saturation parameters which drives the master equation (see Section 4) and therefore our migratory flows, we may have achieved a highly effective way of interlinking the findings of empirical analysis with the internal dynamics of our model. We now demonstrate the regression analysis on two selected clusters.

	PCT_U18_S	PCT_18_29_S	PCT_30_49_S	PCT_50_64_S	PCT_O65_S
Intercept	-1.2545*** (0.1340)	-0.5135*** (0.0990)	-0.8202*** (0.2591)	-0.0486 (0.1983)	2.3016*** (0.0893)
AM_Shops_pro_100res_S					0.5781** (0.2815)
Access_Public_Transport_S					0.7571*** (0.1572)
Age_Mean_S			-0.3339** (0.1560)		
Amount_attractions_pro_100res_S			0.4500** (0.1640)		
Area_BUI_Sport_Recreation_pro_100res_S		-0.1944** (0.0794)			
Area_Playgrounds_pro_100res_S				0.9044* (0.4563)	
Area_Public_Green_pro_100res_S					0.2230*** (0.0510)
BUI_Size_mean_S	0.4940*** (0.1619)				
Employees_pro_100res_S		0.4026*** (0.0442)			
I(Newly_Built_BUI_S ** 2)				0.3238* (0.1664)	
Newly_Built_BUI_S			-0.3036** (0.1315)		
Nr_Commercial_BUI_pro_100res_S	-0.1994*** (0.0356)				
Nr_MixedUse_BUI_pro_100res_S			0.2952** (0.1308)		
Nr_Property_AP_pro_100res_S				0.4277*** (0.1468)	
Purchasing_Power_mean_S	0.2198* (0.1197)	-0.3845*** (0.0890)			
R-squared	0.70	0.83	0.63	0.57	0.66

Table 1: SOM Cluster Nr.24: Multiple regression analysis for the preference parameters of the five different household types in the residential sub-model. Standard errors in parentheses. * p<.1, ** p<.05, ***p<.01. Abbreviations; BUI: Building, PCT: Percentage, AP: Apartment, HH: Households, S: Standardized, U: Under, O: Over

Results are summarised in Table 1 (for cluster 24) and Table 2 (for cluster 5). The first column of the tables displays the explanatory variables which were identified to be significantly associated with one or more of the household types in the neighbourhoods belonging to the two selected clusters. What stands out in these tables is that there is not only a difference between the coefficients and statistical weights belonging to one parameter, but also that differing preference parameters were found to be significant both for the response variables and for the clusters themselves. As an example, for Cluster 24 (C24) the average building size, the level of commercial building stock and mean purchasing power seemed to be the best predictors of the percentage of under 18-year-olds per grid cell. What is interesting is the relatively high positive parameter estimate for purchasing power (which is somewhat uncommon in the Ruhr area for this age group), suggesting that households with children are rather affluent in C24 neighbourhoods. Let us now compare these results with those of Cluster 5 (C5). Firstly, the intercept shows that children are much more likely to live in C5 than in C24 clusters and that the share of under-18-year-olds is in a very strong positive correlation with vacancy rates. Furthermore, their corresponding parent-clusters seem to be living in the vicinity of commercial and industrial areas, which is in general a rather undesirable locational factor. Finally,

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no significant (positive) correlation was found for any of the age groups with more desirable determinants, such as that of new building-stock, ownership or rising rent prices. These three findings are pointing towards more disadvantageous life settings for people living in C5 cells. As a last example, we observe a very high occurrence of seniors in C24 clusters, as daily urban amenities, good access to public transport and proximity to green seem to be the most important locational factors for them. Finally, cooperation parameters κi of the residential sub-model (see section 4) were obtained by similar methods as described above, and were found to be associated with land price, employment rates and the different accessibility values (public transport, car, walk, bike) for a given area.

	PCT_U18_S	PCT_18_29_S	PCT_30_49_S	PCT_50_64_S	PCT_O65_S
Intercept	0.6763*** (0.0952)	-2.7986*** (0.8107)	-0.1960** (0.0935)	-0.2423* (0.1297)	3.1641** (1.1569)
Amount_attractions_pro_100res_S				3.1360* (1.7247)	
Area_Playgrounds_pro_100res_S	0.8046** (0.3598)				
Area_Woods_pro_100res_S		-56.6641*** (14.2296)			62.9386*** (20.2871)
Area_cimlu_pro_100res_S			1.8446*** (0.5405)		
BUI_Size_mean_S				-0.5141*** (0.1216)	
Newly_Built_BUI_S					-0.3223*** (0.1089)
Nr_Empty_BUI_pro_100res_S				-0.2769** (0.1001)	
PCT_Empty_AP_S	0.4557*** (0.0955)				
PCT_Flatshare_HH_S		0.5388*** (0.0779)			
PCT_OnlyElderly_HH_S			-0.4905** (0.2010)		
PCT_Single_HH_S	-0.3687* (0.2121)				
R-squared	0.65	0.69	0.40	0.57	0.44

Table 2: SOM Cluster Nr.5: Multiple regression analysis for the preference parameters of the five different household types in the residential sub-model. Standard errors in parentheses. * p<.1, ** p<.05, ***p<.01. Abbreviations; BUI: Building, PCT: Percentage, AP: Apartment, HH: Households, S: Standardized, U: Under, O: Over

4.3 Data Sources

For the purposes of this study we only used secondary observational data. All city level information stems from the official database of North Rhine-Westphalia (URL-5). For more detailed analysis, we subdivided the 53 cities into their 736 municipal districts. Values on this level were either provided by local municipal authorities or aggregated using higher-resolution data from the following sources. Socioeconomic and employment data was acquired from the German 2011 census database (URL-6), the micro-dialog data of the German post, and from the Hoppenstedt firm database (URL-7). We collected land use material from the Urban atlas of the Copernicus Land Monitoring services (URL-2), and from the database of Regionalverband Ruhr (URL-3). Points of interest were provided by the Regionalverband Ruhr. Finally, in accordance with the 100 x 100-meter grid of the German Population Census in 2011 (URL-6) we further sub-divided city districts and obtained almost half a million grid cells for the whole Ruhr area. Data sources of this level are either directly from the German Census Database (URL-6) or accumulated using the same data sources as described above.

5 RESULTS OF MIGRATORY PROCCESSES UNDER A HEALTHY-CITY SCENARIO

This section is dedicated to the discussion of modelling results using the example of the residential migration sub-model. The goal is to unravel some important effects of demographic change, local and regional migration flows as well as their interdependencies with small- and medium-scale changes in rent price profiles between 2011 and 2050. First of all, and as expected - due to assumptions made under the healthy city scenario - there is the ubiquitous tendency of falling population numbers: by 5.64% on a regional scale compared to values of 2011. What is interesting though is that zones of the outskirts (Kreis Moers, Kreis Recklinghausen and Lippe zones) have lost 4.61% more residents than their central counterparts (Emscher, Ruhr, Hellweg), implying rather strong densification tendencies and periphery-core migration flows. It is the

Northern and Southern Emscher zone combined, which is showing the least population decrease with solely minus 2.67%. Spatial projection of latter trends is the incremental occupation of vacant and newly accessible land (former industrial sites) in between already high-density urban areas to cater for the increased interest in central zone living (which is clearly observable on Fig. 6). As for the Emscher zone, changes were most likely further amplified by the accumulative effect of improved accessibilities, enhanced environmental qualities, new land availabilities and a massive investment in public infrastructure (see Section 2.4).

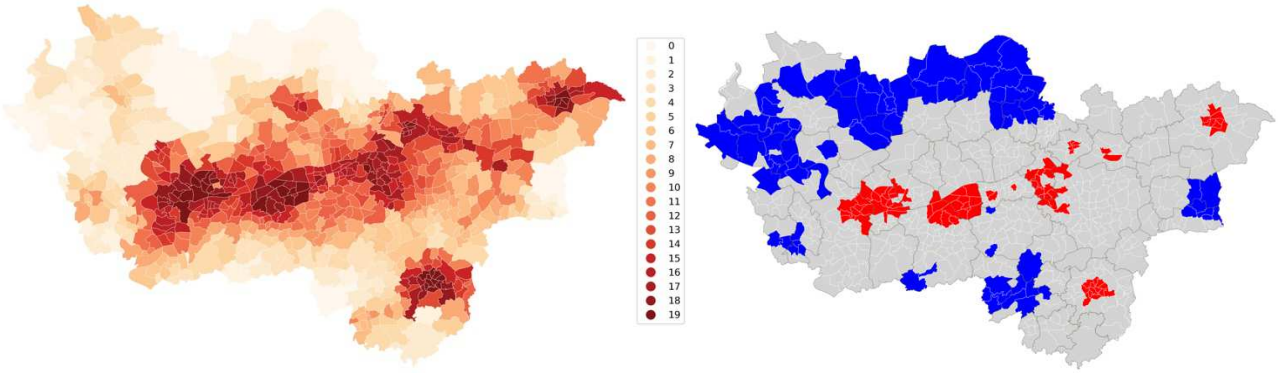

Fig. 5: Spatial lag twentiles of relative change of mean rent price on the district level between 2011 and 2050 (left). Hotspots (red) and cold spots (blue) of change in mean rent price values on district level between 2011 and 2050 (right). Own Graphic.

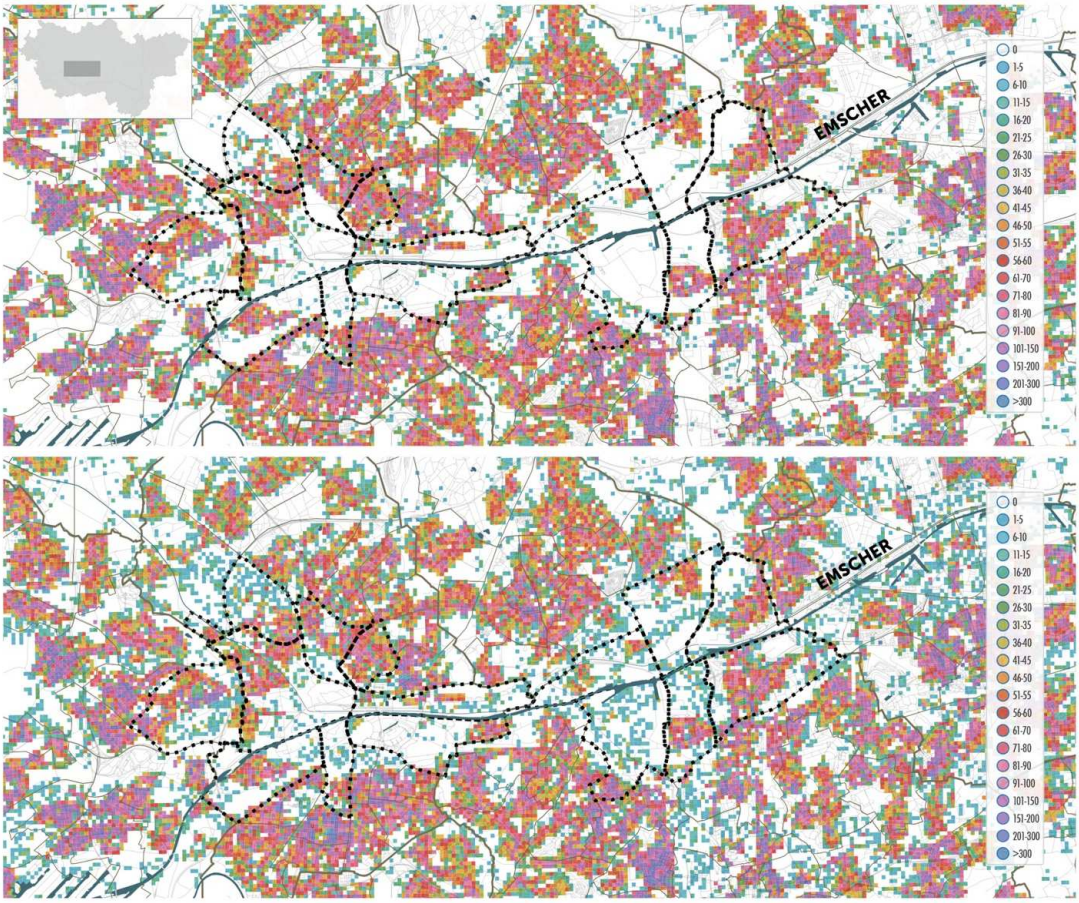

Fig. 6: Number of Residents per Grid cell in 2011 (Above), Number of Residents per Grid Cell in 2050 (Below). Own Graphic

Against the above background, it may come as no surprise that the observed spatial and demographic development trajectories around the Emscher river are associated with a substantial increase in average net rent prices: by 60.20% between 2011 and 2050 compared to an only 26.17% growth in the whole Ruhr region. Hence, it would now be extremely important to find clues for the amplitude and location of potential gentrification processes, in order to apply timely alleviation measures. Due to the high spatial resolution and the innovative computational methods of the MURMO model, we can easily identify districts which are hotspots and cold spots for rent price changes under the Healthy City scenario. Figure 5 reveals that hotspots concentrate in central Oberhausen, north of Essen, south of Bottrop, Castrop-Rauxel, the western

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neighbourhoods of Dortmund and in the urban cores of Hamm and Hagen. In contrast, cold spots accumulate in the outskirts of the Ruhr area. We must stress here, that latter changes in mean rent price are largely outcomes of residential and employment location choices as well as demographic, transport and land use change processes, as the six subsystems are in close interaction throughout the modelling process.

6 CONCLUSIONS AND OUTLOOK

The present study firstly set out to give an overview of the five-step integrated methodology for deciphering and modelling urban processes across scales and illustrated it with practical examples from the Ruhr area in Germany. Secondly, it made a case for effectively connecting analysis findings with the internal dynamic of the multiscale urban model. Thirdly, we have seen that over time the closely entangled reciprocal dynamic of the six MURMO subsystems led to a variety of substantial changes in the urban structure. These may be indicators for the following processes: attracting new landscape and urban design projects, anchoring a range of additional businesses (or superseding existing ones) or altering real estate prices along with their local socioeconomic profiles. Finally, we showed how modelling results can be applied to identify small scale anchoring of major urban development processes under a chosen scenario. The primary intention of this paper was that the generated knowledge may provide a cohesive framework for both spatial and non-spatial measures. Several questions however still remain to be more carefully investigated. For instance, there is an urgent need to improve the scenario approach specifically for computational modelling attempts of urban environments. We should seek ways to enhance their quantifiability and modelling-applicability in order to yield even more transparent simulation results.

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🏆 *reviewed paper*

Decision Support System Design as a Method to Enhance Public Participation in Urban Development: The CRISALIDE Project, Rostov-on-Don

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1 ABSTRACT

Contemporary urban development in Russia differs from that of the Soviet period by the presence of many new actors, the existence of private property and capital influencing development decisions. A new season of public investment in city planning is emerging in Russia. There is an ongoing discussion of creating new master plans. However, how can be designed and proposed these tools useful and efficient? How to characterize them in their strategic and regulatory aspects? Above all, how to make sure that the master plans are truly tailor-made on the problems of the cities and not standardized tools that do not respond to the needs of the local communities? All these open questions call responsible authorities considering different interests in planning and policymaking. The previous system of administrative planning had to be changed to correspond adequately to new conditions. Officially, the current version of the Russian Urban Planning Code requires 'public discussion' of any urban development project that should be organised by local authorities. However, the formal evolution of the planning law has found little consequences in practice. Regularly organised public discussions remain more rituals than a real planning tool; they have 'recommendatory nature' according to the law that allows public administrations to ignore public opinion in their final decisions.

The paper represents the results of the one-year experience of the CRISALIDE (EU/Russian Federation financed project through Eranet Rus Plus) project consortium in enhancing public participation in the urban development process. The R&D project, aiming at bringing together technological, social and organizational innovations, uses the area-based approach and experiments within the territory of a brownfield (old airport) in the selected city Rostov-on-Don. The chosen work area attracts notable attention of different local and regional actors due to its size, location, marketing potential and regional significance. Design of a decision support system for this area redevelopment becomes a kind of provocation that helped to involve in the design process local experts, activists and policy-makers. Through a series of the organised by the CRISALIDE consortium events, the new collaborations between the local and external actors established and the public discussions of the possible future redevelopment scenarios boosted. Public participation influences the DSS design process and is resulted in the system's goals and methods used that was its main target. At the same time, public discussions at the pre-planning stage is not a common practice in Russia, CRISALIDE proposed and tested a methodology for effectively and efficiently running a participatory planning process capable of grasping the local territorial demand coming from citizens and stakeholders. Moreover, the development of a smart platform, driven by IGis technology, aims at shaping the local decisional environment towards smart design and land use planning.

Keywords: smart cities, smart design & planning, urban planning, participation, DSS, Russia, Eranet Rus Plus.

2 INTRODUCTION

The sharp increase of innovations introduced in the field of urban planning going in parallel with the development of GIS technologies, Big Data technologies and smart city concept popularisation characterise the recent years. Many tools and modelling approaches are being developed to support decision making in

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urban planning (Leeuwen & Timmermans, 2006) based on land-use or movement simulation, virtual environment, or augmented reality. However, to be innovative, the process of urban planning should go beyond technological innovations and imply organizational and social innovations that often lag behind technology. Moving towards democracy and civic engagement in urban planning requires the involvement of many stakeholders. It makes decision-making in urban development quite a challenging task, especially in the societies that do not have accumulated experiences and legitimized practices of public participation.

The project CRISALIDE (City Replicable and Integrated Smart Actions Leading Innovation to Develop Urban Economies) is a winner of the second call of the EU/Russian Federation Programme called ERA.Net RUS Plus. Its goal is to bring innovations into the field of urban planning in the Russian city Rostov-on-Don. The project is experimenting a joint EU-Russian research and collaborative approach for the creation of an Innovative Decision-Making Tool (IDMT), designed to facilitate the renewal and regeneration of abandoned areas and brownfields.

The CRISALIDE R&D project is being developed on the background of the post-socialist transition of the Russian cities and its urban planning system. This system is still top-down, centralised, comprehensive and does not consider public participation as an essential element of decision-making. At the same time, following the global trends in the development of the information technologies, the Russian state introduces projects and programs targeting information technologies development, such as the national project 'Smart City'. The ‚Smart City' national project being a part of the National program ‚Digital Economy of the Russian Federation 2024' claims innovative principles to base on: people-centred; manufacturability of urban infrastructure; improving the quality of urban resource management; a comfortable and safe environment; emphasis on economic efficiency, including the service component of the urban environment. However, in practice, the declared principles are far from being integrated into the urban development process, and innovations in urban planning in Russia are mainly seen in the usage of the new technological tools, such as GIS or e-platforms.

Together with the immaturity of the Russian civic society and little experience in public participation in urban development that has still been implementing through top-down approach create critical conditions for introducing social and organizational innovations. CRISALIDE's approach is to build innovative solutions through a dialogue between stakeholders placed before the transformation of a given urban context, the practice that is not common in Russian urban development projects. The paper represents the results of the first year of the project implementation in which several events organized within the project framework enhanced public participation in urban development and created conditions for the new collaborations between local and external stakeholders. The construction of collaboration between the CRISALIDE partnership and the local authority was a significant project's achievement that implies the introduction of innovations through the bottom-up process.

3 URBAN DEVELOPMENT AND PUBLIC PARTICIPATION IN RUSSIA

The Russian cities are following the in-depth transformation process since the USSR dissolution, and this process is far from being complete (Zupan, 2015). The transformations that change the Russian cities include institutional (political and economic), social (peoples' behaviours and cultural norms) and urban transformations (Sykora and Bouzarovski, 2012) which also means the transition of the urban planning system and planning methods and tools used. However, the mentioned changes do not follow each other in a linear way (Zupan, 2015) and institutional and social transformations can be slow. The urban planning system and practices in Russia, relying on an entirely different compared to the socialist period legislative base created from zero (Golubchikov, 2004; Jounda, 2004) still have many attributes borrowed from the soviet past such as the tendency to centralization, bureaucratization and technocracy (Iyer, 2003). Introduction of private property, new actors interested in shaping decisions in urban development and redistribution of power between territorial levels of governance call for developing new tools enhancing public participation in decision-making. The administrative planning had to be changed to realise the advantages of democratization and decentralization (Jounda, 2004). The new Urban Planning Code enacted in 2004 formally introduced such tools as public hearings that is an obligatory event before approval of any urban development project. According to the Urban Planning Code, urban residents have the right and the opportunity to participate in the discussion of urban planning projects and to express their needs through public hearings' (Ivanova, 2017). However, the practical impact of public hearings on urban development is

minimal since their results have the recommendatory nature and municipal or regional governments have rights not to consider any proposals or critique expressed during the public hearing process even if such proposals can be in thousands (Ivanova, 2017). The local authorities have the right to approve or decline any project taking this decision on their own without public influence.

Another critical point is that, according to the Russian Urban Planning Code, public hearings consider an already complete project developed by the local or regional government together with an urban planning or architectural company hired after tenders. In this case, the discussion is usually limited by one version of the project prepared without any pre-design investigations of public opinion and the projects often do not receive support from the society (Jounda, 2004). Using such an approach provokes inertia and inactivity of citizens (Ivanova, 2017), who understand that their opinion cannot influence the final decision and is not essential in urban development projects.

The situation has been slightly changing, and some local authorities try to introduce new tools for people's engagement, actively using information technologies and promoting e-participation. These participation strategies are usually formed under the dominance of a 'vertical' approach and may not change the relationship between citizens and government but may lead even to conflicts between them (Chugunov, Kabanov & Misnikov, 2017). The non-organised by the government forms of public participation are represented by the traditional NGOs, expert NGOs and spontaneous initiatives which rise as a reaction to the threats to the population (Belokurova & Vorob'ev, 2011). There is always a lack of horizontal communication and their intersection with the developed ‚vertical' mechanisms of participation. It worth noting that civil society in Russia is still immature, and there is no tradition of ist participation in decision-making (Ivanova, 2017).

4 PARTICIPATION PRACTICES IN ROSTOV-ON-DON

The same disadvantages in the process of the local citizens' involvement in urban planning characterise the city of Rostov-on-Don, where the CRISALIDE project is being implemented. The city is the capital of the Rostov region in Southern Russia and the administrative centre of the Southern Federal District with a population of 1,130,305 people. The city's population has a high intellectual potential and entrepreneurial activity due to a relatively diversified economy and the presence of many higher education institutions. However, citizens' participation in urban development is quite modest. At the stage of decision making the local experts are usually involved personally – they advise government departments in person or through advisory groups, but usually, they have little influence on the final decisions. The most active public participation in Rostov-on-Don is evident in so-called ‚problematization' (Belokurova & Vorob'ev, 2011) in the form of protests when people manifest their disagreement with the decisions taken by the local authorities. In Rostov protests, for example, were against the construction of a landfill and a plant near the residential area Leventsovsky in 2019. The other protests were against the transport reform in 2017 when several routes and transport units the local authority planned to reduce.

Public hearings required by the Urban Planning Code have not become an important tool in decision-making in Rostov-on-Don. First, very few public hearings are organized in the city. Second, there are few initiative groups and social movements able to influence final decisions in urban development. Thus, in 2017, 29 projects of urban design in Rostov-on-Done were developed and presented for public hearings, and 20 of them were approved without any comments and suggestions. Only one project was sent for revision based on the results of comments and suggestions. (Merkulova & Kozlov, 2018). Considering the results of public hearings in Rostov-on-Don, it is possible to conclude that this tool is too far from being effective in communication between the local authorities and the public.

Like many other Russian municipalities, the city of Rostov-on-Don implemented instruments of e-participations – city portals. The official City Duma and the Administration of the city of Rostov-on-Don portal (https://rostov-gorod.ru/) is an information system containing a broad array of data about the city (history, official documents (decisions, draft decisions and regulatory legal acts), city events – both past and upcoming, the structure and powers of the city government, and public chamber. Open data located in this information system allows obtaining information for subsequent decisions on urban development divided into several categories: social sphere, roads and transport, education, culture, safety, housing and communal services, construction and architecture, trade or service industry. The portal claims that the above data has to

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ensure the transparency of the authorities and the reliability of information about them allows citizens to obtain data for solving everyday tasks and needs. The portal provides top-down communication between local authorities and Rostov's citizens.

Fig. 1: The start page of the official portal of the City Duma and the Administration of the city of Rostov-on-Don with the citation of the Head of Administration' words: 'City development should be carried out taking into account the opinion of the architectural community and the wishes of Rostovites' [Accessed 29 January 2020]

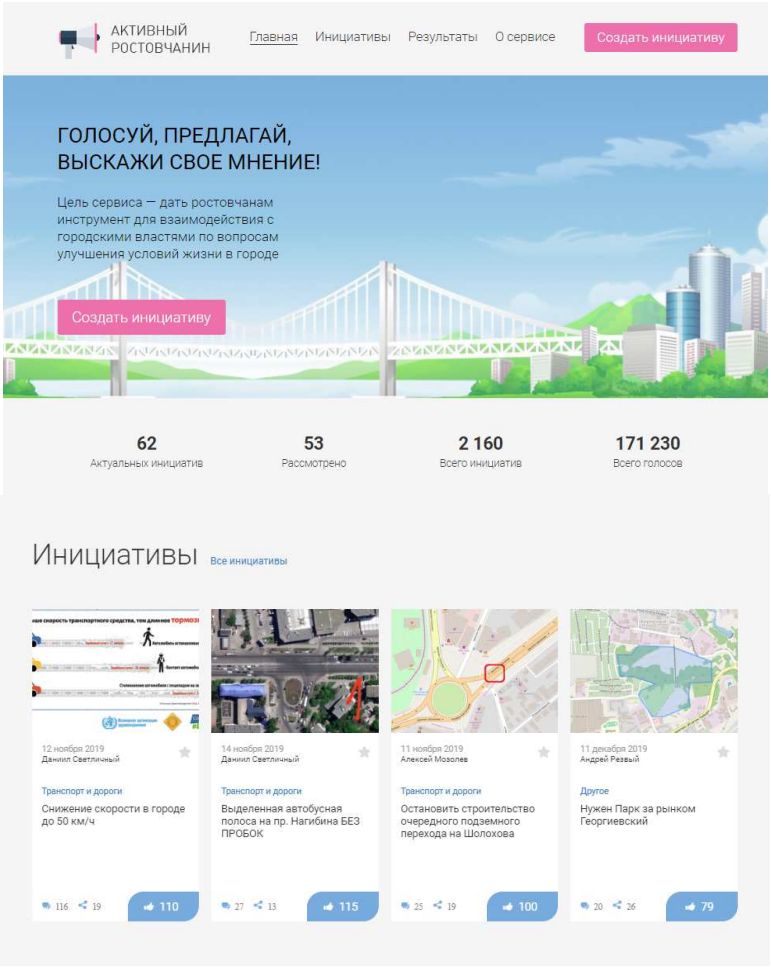

Fig. 2: Start page of the service 'Active Rostovite' or 'Aktivny Rostovchanin' (https://ar.rostov-gorod.ru/

In addition, the official web-portal includes several services among which there is a service 'Active Rostovite' or 'Aktivny Rostovchanin' in Russian language (https://ar.rostov-gorod.ru/). This service provides

a possibility for bottom-up communication. Its start page says that 'The service is designed to identify the most popular initiatives by citizens on improving living conditions in the city of Rostov-on-Don, as well as to obtain the citizens' opinion on the initiatives of the local authorities'. The citizens can propose initiatives and vote for the initiatives made by others. The municipality considers the initiative when it collects over 500 votes. However, the statistic published on the web-portal 'Active Rostovite' is not that promising: the municipality considered only 53 initiatives among 2,160 proposed by the citizens.

The analysis of the vertical and horizontal communication concerning urban development in Rostov-on-Don demonstrates lack of dialogue between local authority and citizens, lack of bottom-up activities and initiatives and little interest of municipality to involve citizens in decision-making in urban development.

5 CRISALIDE IMPLEMENTATION

The CRISALIDE project leverages on the principle of participatory planning and its methodology being guided by establishing a multi-stakeholder group to sustain the collaboration in the field of R&D and innovation through a set of participatory events. The key idea of the CRISALIDE project was in the involvement of the local stakeholders at different stages of the R&D, including the pre-design phase.

5.1 Experimentation area

The experimental site selected for the CRISALIDE project implementation is the area of the former airport 'Rostov-on-Don' located in the eastern part of the city in nine kilometres from the city centre, in the Pervomaysky administrative district. The airport stopped its operation in December 2017, when the new international airport opened - Platov International Airport. The local planning documents consider the old airport's territory as an internal spatial resource for development years before the actual realization. Thus, the city's General plan approved in 2015 proposed the construction of 1,596 thousand square meters of housing within the plot of 267 ha until 2035. After the new airport construction, the local authority started to promote the area for redevelopment and several projects have been done, one of which was presented at the Russian Investment Forum in Sochi in 2018.

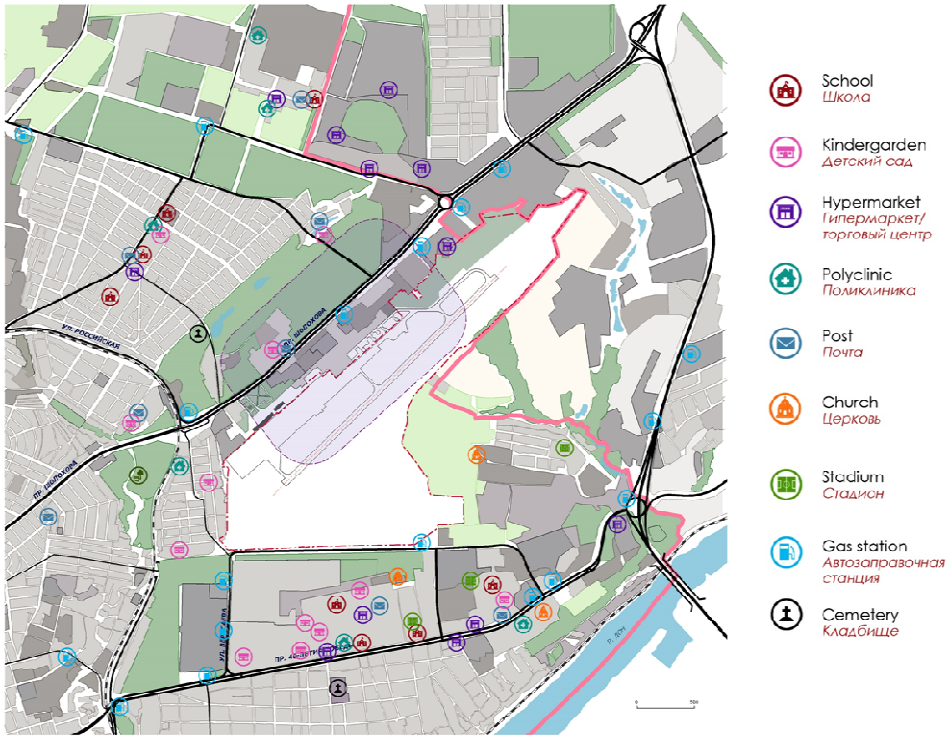

Fig. 3: The former airport 'Rostov-on-Don' area with the existing services in its surroundings.

The local authority does not have many alternatives for the former airport's area development. In essence, the most desirable scenario assumes the arrival of a prominent investor able to implement a large-scale project in the construction of housing and commercial real estate. However, the value of such a significant territorial resource for the development of the city, the potential for creating a high-quality urban

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environment and opportunities for innovative economic development, forming a positive image of the city and attracting investments provide advantageous conditions and excellent prospects for the application of innovative methods and technologies in planning and development of this territory.

5.2 CRISALIDE participation process

The CRISALIDE project aimed at enhancing bottom-up participation in the urban development process. Through the selection of an experimental area that is an essential site for different types of local stakeholders – authorities, business or public representatives – CRISALIDE creates conditions for the collaborations and public discussions of the area's future. This practice is very distant from the standard practices used in Russia in general and in the city of Rostov-on-Don in particular. The CRISALIDE methodology builds the solutions from the bottom and works with the stakeholders in identifying the problems to be faced. It defines the figure of the planner as that of a mediator and facilitator of complex processes. A methodology does not offer a priori solution, which does not have the innovation package ready to be sold and applied top-down. The process aims at bringing to the project the local values and discover opportunities for long-term collaborations' construction. The process was designed divided into several steps.

The first initial step had the purpose of announcing the project, attract local experts interested in the areas' development and introducing new tools in decision-making and expand experts' networks that would promote future collaborations. The first event resulted in constructed cooperation between the CRISALIDE partners and local stakeholders representing science, business and public sectors. The first stage of the project presentation was followed by the work of partnership members with the local and external experts to develop a hypothesis about the structure of the future decision support tool.

The second step included active involvement of the local stakeholders (experts, public activists and representatives of the local authorities) into the participatory process aimed at joint elaboration of the visions that could become the basis for the decision-making. The participatory process was organized through a one-week workshop that had a double purpose: 1) to lay the foundation for the design of a decision support system by mapping existing knowledge and collecting evidence, and 2) to develop technical and local requirements for innovative decision-making tool.

However, the results of this participatory practice implementation went beyond the objectives of IDMT design and provoked a broad public discussion on the area's future development. Most experts participated in the workshop agreed that with the development of the territory of the old airport, one could not use outdated approaches to planning and construction. The general opinion was the need to consider this area as an experimental platform for the introduction of new planning methods and practices, advanced construction technologies, organization and management of the urban environment, taking into account such modern challenges as climate change, environmental pollution, demographic problems, socio-economic stratification of society and the rapid development of new technologies. Avoiding the construction of commercial housing, the formation of high-comfort public spaces, the introduction of new forms of mobility and environmentally friendly technologies, the creation of conditions for maintaining the health of the population, the realization of its creative and intellectual potential, the activation of innovative forms of economic activity - these key positions were voiced by most experts. Several unexpected development scenarios were proposed, including 'standby mode' in which the areas' development should be postponed until the local society will be able to use and enhance its advantages effectively.

The next step of a participatory process was built on the defined set of values discussed and agreed with a multi-stakeholder group. The values' discussion resulted in a set of key performance indicators (KPIs). The current stage of the IDMT development includes collaborative work between the CRISALIDE partners and the Rostov-on-Don municipality which has as the main objective integration of a formalised set of values, scenarios, knowledge, methods and tools evolved during the participatory workshops into the existing decision-making process. At this point, the main CRISALIDE goal is to create an intersection between the government (vertical) and public (horizontal) perspectives.

Simultaneously, a series of public events such as conferences and workshops organized to promote CRISALIDE ideology and involve new participants.

The final stage of the project development will include testing the IDMT use by different users in a variety of scenarios which will impact both decision-making process in municipality and level of public involvement in

this process that will be another step to the democratization of the decision-making in urban development in Russia. Since the project has been implemented in the city included as a pilot city into the Russian national project 'Smart City', there is an opportunity of the CRISALIDE methodology dissemination and upscaling.

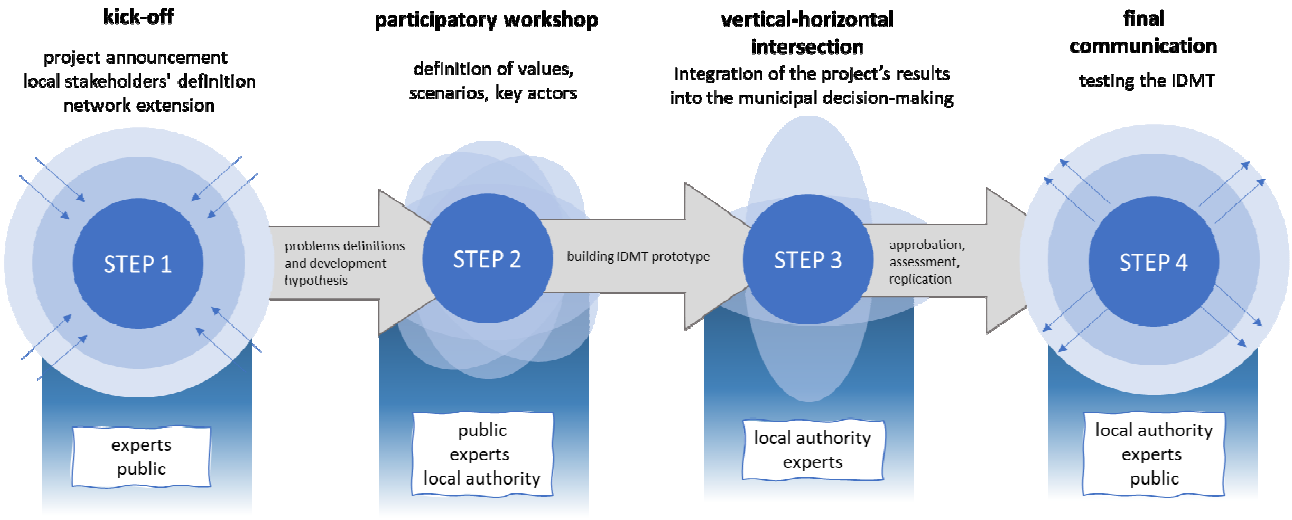

Fig. 4: CRISALIDE participation process.

6 CONCLUSION

The CRISALIDE project aimed at establishing a decision support system in urban development creates an opportunity to enhance dialogue between public and local authorities and integrate bottom-up initiatives into the local decision-making system. The practice of public involvement at the pre-design stage is uncommon in Russian cities. It, therefore, is an innovation that allows consolidating public opinion, taking into account the various interests of the present and future periods, including most effective local development resources in the use and launch processes at the local level that activates socio-economic development. The CRISALIDE participation process demonstrated that local community in Rostov-on-Don is ready for a constructive dialogue and that public discussions should accompany the development of the territory at all stages of project design and implementation. The appearance and support of the bottom-up initiatives in urban development might positively contribute to the development of the new approaches in urban development decision-making. Introduction of public participation at the different stages of urban projects development (especially at the pre-planning stage) might significantly increase the public impact on urban development.

7 ACKNOWLEDGEMENTS

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🏆 *reviewed paper*

DevOps Competences for Smart City Administrators

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1 ABSTRACT

A fledgling and still scattered knowledge stream on multi-disciplinary Smart city phenomena is developing. For the development of smart cities intellectual minds and a synthesis of quite diverse competences are required to shape cities to becoming smart with the overall objective to ever more improve the quality of life of its citizens in the most efficient and sustainable way. Both, the master minds and operators behind this development need to embark on an intensive change process, unlearn ingrained behavioral patterns and internalize an innovative competence set. This research is aiming to address the shortage of both, digital and transferrable skills that are needed for the various smart cities' sectors differentiated by more strategic roles of Smart City Planner and Chief Digital Officer as well as the more operational IT Officer. This study addresses the gap of competences by providing preliminary quantitative and qualitative research findings of the still ongoing DevOps project.

Keywords: Chief Digital Officer, Smart City Planner, Technical Competences, Transversal Competences, Smart Cities

2 INTRODUCTION

The ever increasing popularity and speed of the Smart City movement is reflected by the results of a Bosch initiated study revealing that the Smart City (SC) market grows at a yearly rate of 19% amounting to an investment volume of 800 bio US$ (Boehne, 2018). A further recent study by Berger (2019) with SC decision makers and experts in 50 mid-sized cities asked, for example, about the key success factors of SC projects. A well- defined strategy and guidance achieved with 58% the highest frequency level. Contradictory to the primacy of strategy and guidance, only 20% of the asked city representatives had a strategy pointing to a still existing research gap.

The aim of this research is to differentiate perspectives and competencies between SC planners, chief digital officer and IT officers. In order to successfully cope with this intensive change and digital transformation process and prepare for an effective and efficient future Smart City development, the administrators must thoroughly understand the complexity of smart city areas, new digital technologies facilitating the SC development and map newly required technical and transversal capabilities with newly emerging job profiles. Aiming to support strategic and operational SC administrators, the DevOps project, supported by ERASMUS + Sector Skills Alliances, (Project No.: 601015-EPP-1-2018-1-EL-EPPKA2-SSA Erasmus+ Program) KA2: Cooperation for innovation and the exchange of good practices-Sector Skills Alliances) addresses the gap between today's and future's skills demands of municipal workforce by emphasizing on the exploitation of emerging employment paradigms such as DevOps (http://devops.teilar.gr/). The final aim of the project is the development of VET MOOCs curricula to impart newly required technical and transversal competences and skills provided on a Moodle platform. The project, furthermore, aims to create an international community of best practice. It strives to cover the following identified research gaps:

a. lack of explanation of the nexus between Smart City Applications, DevOps (Agile Software Development) differentiated by a Citizen driven or Technology driven perspective.

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b. Lack of a, so far, not existing integrated Competence/Skill Portfolio (IoT & DevOps Related Skills & Transferable Skills) from a Citizen Perspective differentiated by Planners and Chief Digital and IT Officers.

c. Lack of academic models for individualized or standardized Smart City Planning differentiated by European countries.

The research is designed to achieve the following objectives:

(1) To investigate how the SC philosophy (citizen/identity driven, or technology driven or both) influences the competences of SC team members.

(2) To investigate how the SC philosophy (citizen/identity driven, or technology driven or both) influences SC service priorities and DevOps related decisions.

(3) To research to what extent different SC administrative profiles (Smart City Planner, Chief Digital Officer and IT Officer) require different IT/IoT specific and general/transversal competences.

(4) To identify to what extent different SC Service priorities, require different competences (specifically as to DevOps) and training.

(5) To explore the situations when Smart Cities prefer either to work independently or to co-operate with external partners.

(6) To develop a conceptual model explaining the nature of relationships between the three foci of the project.

3 DEFINITION OF A SMART CITY

The interest in SCs was sparked exponentially only in 2010. Harrison et al. (2010) specifically described a SC as an instrumented, interconnected and intelligent city (van den Bosch, 2017; Unhelkar, 2008; Celino and Kotoulas, 2013). The operations follow the main mission of SCs which is to improve the quality of live for its citizens pursuing the purpose of sustainability (Ahvenniemi et al., 2017). The 17 Sustainable Development Goals of the UN Agenda 2030 serve as a normative sustainability framework (United Nations, n.y.). Expanding on the technological focus of the aforementioned definition, the preconditions for a SC to flourish refer to the existence of a knowledge society (Barth et al., 2017), an open innovation System (Paskaleva, 2011), a user friendly connected infrastructure (Albino et al., 2015), the use and smart integration of resource endowments/equipment and activities (http://www.smart-cities.eu/model.html, in: Griffinger und Haindlmaier, 2010) and, last but not least, self- decisive, independent and conscious citizens (Griffinger and Haindlmaier, 2010; http://www.smart-cities.eu/model.html, in: Griffinger und Haindlmaier, 2010). Hence, Smart Cities must ensure congruency between needs and knowledge of citizens and community at large, investments, social and ecological sustainability, digitalization, urban responsibility and technology (Angelidou, 2015; Bas Borsma, 2017).

4 CITIZEN AND/OR TECHNOLOGY DRIVEN SMART CITIES

Following Angelidou (2015), two main sub- categories for smart cities may be found in the literature: the technology-oriented class and the people-oriented one. Within the technology-oriented direction, the term “smart cities” was examined primarily in relation to potential improvements on city services in relation to ICT developments, infrastructure and the greater ecosystem. Within this approach, smart SC technologies are providing the foundation for initiatives of strategic importance to be developed (Angelidou, 2014). The people-oriented approach places priority on the role of human resources, at individual or community level (Albino, Berardi and Dangelico 2015). Here, mostly social, economic and environmental sustainability issues are addressed implying the heightened importance of socio-technicality and of the richness of diversity of perspectives among involved stakeholders (i.e. citizens, businesses, NGOs or governmental agencies).In line with Angelidou (2015), Zait (2017) sees a predominance of soft smart SC dimensions such as human and social capital over the hard SC dimensions as they affect all other SC dimensions.

Taking the people orientated version into account, sociological factors such as urban attachment, belongingness or social and environmental relationships have a high impact on urban services (Belanche et al., 2016; Angelidou, 2014). According to Zait (2017), SC are currently assessing and developing their idiosyncratic identity. The emphasis on citizen engagement or civic culture in this context is supported by Gartner (2018): “Smart city initiatives are no longer about optimized traffic patterns, parking management,

efficient lighting and improvements to public works. The way forward today is a community-driven, bottom-up approach where citizens are an integral part of designing and developing smart cities, and not a top-down policy with city leaders focusing on technology platforms alone," said Bettina Tratz-Ryan research vice president at Gartner" (Gartner, 2018). However, literature suggests that the importance of citizens in the development of smart cities is often overlooked (Hollands, 2008; Hollands, 2015; Vanolo, 2014).

The importance of urban attachment, belongingness or the quality of social and environmental relationships point to consider sociological theory when developing S.C. Relating exemplarily to identity, Arnett's, German's, and Hunt's (2003) pioneering work calls for providing additional social benefits to customers or - in the case of smart cities- citizens, beyond a merely economic exchange relationship, as a logical consequence of the integration of the sociological identity theory. Identity focuses on the human factor in a conceptual and methodological context, and can be regarded as both, a desirable finality (i.e. social identity or livelihoods of smart cities) and a mechanism to achieve it, as the central internal and external communication platform (Balmer, 2008; Kaufmann, Czinkota and Zakrzewski, 2015).

Relating technological developments to smart city service domains, Tratz- Ryan and Finnerty (2018), in an interesting longitudinal study, portray an life cycle of technological progress. According to these authors this life cycle consists of five phases: innovation trigger, peak of inflated expectations, trough of disillusionment, slope of enlightenment and plateau of productivity. In their 2018 study, the authors hold that none of the SC technologies, so far, has reached the plateau of productivity stage. Only Smart Lighting has reached the slope of enlightenment stage predicted to reach the plateau in less than 2 years. The most innovative technological off springs, on the other hand, are Artificial General Intelligence and Autonomous driving level (both still requiring more than 10 years to end up in the plateau stage), smart building, data for good, data market place and 5 G, all occupying the Innovation Trigger stage (Tratz- Ryan ad Finnerty, 2018).

Summarizing, whilst a focus on technologies may increase efficiency in designing IS systems, it may ignore or neglect more complex social, organizational and technical factors (Eichhorn and Tukel, 2015). A fair balance of the two directions is endeavored by the DevOps project.

5 DEVOPS

Specially, the analytics, application and participation (citizen centric) perspectives imply the enhanced importance of software development. SC which need to become more flexible to react to rapid environmental changes, competitive and citizen centric, require innovative, albeit under researched, agile software development approaches, such as DevOps. The literature review revealed a still existing gap of explanatory research in this knowledge stream. For example, Feijter et al. (2018) point to the lack of a clear overview of practices aiding the DevOps adoption. A definition of DevOps knowledge is provided by the DevOps Institute (2019, p.15): "Working towards a common goal that enables the fast flow of planned work into production while achieving world-class stability, reliability, availability, and security".

To shorten the time to market for the software product, DevOps is assembled from the words „Development" and „Operations ". In software development, this method is used as an acronym combining the software development (Dev) and software implementation/production (Ops) phase (Lwakatare, Kuvaja and Oivo (2015) requiring integrated work flows of IT operative and DevOps focused IT teams within one business unit to facilitate and speed-up the continuous deployment of new software features (Sebastian et al. 2017). From a business perspective, DevOps is better predisposed to address customer needs in short cycle times (Lwakatare, Kuvaja and Oivo, 2015) than other software development approaches. A framework describing elements and outcomes of DevOps as well as problems addressed by DevOps by Lwakatare, Kuvaja and Oivo (2015) provides a basic insight into the functioning of the DevOps approach.

Furthermore, Senapathi, Buchan and Osman (2018, p. 5) provide a framework suggesting that DevOps leads to improved user experience. A high level of agility in product and services and a rapid deployment of fixes through frequent continuous deployment of new features result in being more responsive to customer needs. In addition, by avoiding infrastructure delays and late problems by the eliminations of the dev and ops team silos, a higher level of team productivity is created supported by more team control over deployment and more automation. In tandem, improved user experience and higher team productivity result in higher levels of competitive advantage.

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6 DEVOPS COMPETENCES FOR SC ADMINISTRATORS

This research synthesizes a wide range of literature and frameworks for a DevOps competence typology. As to be expected in this innovative research stream much literature is from grey sources and many models are of conceptual or exploratory nature. One framework guiding this research was that of Wiedemann and Wiesche (2018) with seven seven skill categories (full-stack development, analysis, functional, decision-making, social, testing, and advisory skills) and additional 36 skill- sub-categories. One key finding of this research strongly points to the integration of technical and general/transversal management skills/competences. A further skill categorization is provided by Fitsilis, Tsoutsa, & Gerogiannis (2018) differentiating by technical, behavioral and contextual sills. Another framework which seemed suitable to be validated resulted from the conceptual work of Hecklau et al. (2016). They clustered the competences into a holistic competence model consisting of 4 categories and 26 sub-categories. The researchers suggest an applicability of the model in terms of an 'industry 4.0 readiness check' by displaying multivariate data into a two-dimensional radar chart. The key characteristics of the Industry 4.0 phenomenon in terms of increased interconnectivity, real time data exchange, machine learning based on artificial intelligence implying self-controlling production systems suggested the relevance of the model to be validated. Expanding on the model of Hecklau and al. (2016), especially in terms of contextual skills Fitsilis, Tsoutsa, & Gerogiannis (2018, p.132) suggest that training of technical, transversal and contextual skills should be differentiated by the respective industry sector, software development and operations lifecycles, proficiency, up to date digital technological developments and job profiles.

The importance of innovation stimulation and start-up acceleration was underlined by Bas Boorsma (2017). In addition, civilizational competences to operationalize the soft SC dimensions which are forwarded by Zait (2017) are suggested to be added to the competence pool. Civilization competences comprise entrepreneurial culture, discoursive culture, civic culture and daily culture. Furthermore, Minnesota (2016) points to still existing training gaps relating to specific aspects in the technological competence category: skills related to product design in relation to product discovery; skills on user experience design and on software architecture; covering IoT topics. Moreover, Betz (2016) relates to gaps of digital competences currently not covered by curricula: product management related ones; software lifecycle related ones; infrastructure and operation related ones; resource management related ones and cultural ones. DevOps practitioners (DevOps Institute, 2019) highlight key categories of skills to be agreed upon by three levels of employees: C-level executives leading the business or IT strategy; management and IT team and project leaders; and individual skill contributors. They differentiate between must have, nice to have and optional skills, a method also applied for this research. A descriptive research of the Institute shows that process skills and knowledge as well automation skills are must-have (>50%) skills whilst soft skills are a must have for C-Level employees and team and project leaders. It is interesting that team interaction patterns for software delivery at scale are regarded a very important success/fail factor by the DevOps practitioners. Besides focusing on internal stakeholders, Feijter et al. (2018) suggest including external stakeholders, such as customers and software/components providers, when adopting DevOps. The researchers suggest a DevOps competence model based on three primary perspectives: Culture and Collaboration are paramount important and regarded as the 'roof of the house"; Product, Process and Quality mainly relating to a DTAP street (development, testing, acceptance and production environments); Foundation focusing on configuration management, architecture and infrastructure. A research by Bang et al. (2013) support the findings of Feijter et al. (2018) holding that knowledge and abilities on agile software development methodologies (in particular, Scrum) support the following four perspectives of DevOps: Collaboration Culture; Automation; Knowledge (architecture, cloud computing, threat modelling); Sharing of knowledge (product and sprint backlogs). A study in the Italian setting was conducted by Minchelucci, Marco and Tanda (2016). Based on a low response rate, the researchers chose an exploratory qualitative study and an exploratory factor analysis to analyze the quantitative data. Five factors appeared: technical skills including management of innovation and territorial planning; knowledge of private and public laws about procurement, innovation management, public private partnerships, and open data; soft skills relating to general management, relationship and mediation as well as leadership and personality; financial tools and economic principles and general management basic skills such as familiarity with ICT, knowledge of foreign languages and professional experiences.

Derived from the literature, exemplarily from the perspective of the Smart City Planner, a total number of 102 competences in 8 categories (specific technical, general technical/transversal, methodological, social/transversal, personal/transversal, legal, city planning, civilizational) were included in the initial survey. A conceptual framework to be empirically tested (Figure 1) was developed from the literature.

7 METHODOLOGY

From an ontological and epistemological stance, the research is based on the philosophy of Critical Realism triangulating an initial quantitative research with qualitative findings using four European countries (Germany, Italy, Greece, Cyprus) as study settings. Due to the still emerging and scattered body of knowledge in this research stream, a narrative literature review was regarded preferable. The research was designed in three stages: initially, surveys with fully structured questions were developed and via the Unipark system distributed to SC administrators in the four countries. The data were analyzed via SPSS. Informed by the survey data, interviews and focus groups were conducted in the four countries sampling SC administrators and related other strategic members of the SC ecosystem. The qualitative data will be analysed via content analysis supported by NVivo software. The analysis of the quantitative data, at this very stage, is still in progress. Notwithstanding very intensive personal efforts of the researchers in pretesting and personally contacting SC decision makers and experts either on conferences or via Smart City associations, a low response rate to the online questionnaire (i.e. 63 for the SC Planner: Cyprus 5, Germany 9, Greece 20, Italy 28, Romania 1) could only be achieved. Regarding the whole sample across all countries frequency analysis, correlation, regression analysis and factor analysis was applied. Additional, due to the existing knowledge gap, a more exploratory and qualitative stage followed. Initially, based on three very general questions 9 interviews with senior decision makers of successful smart cities (i.e. awards) were conducted.

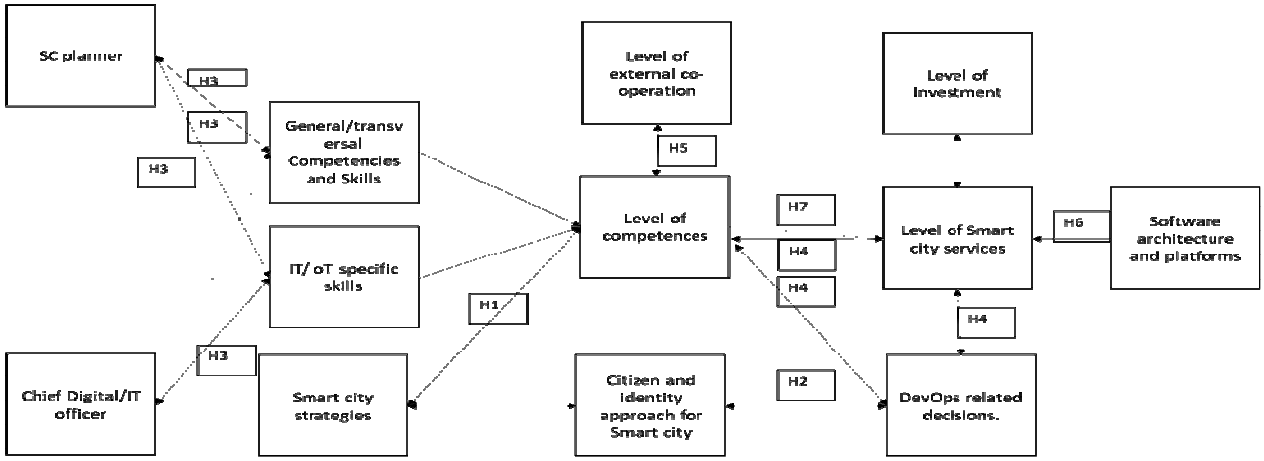

Figure 1 Initial conceptual framework

8 EXEMPLARY RESULTS OF THE FREQUENCY ANALYSIS

Key results of frequency analysis across all countries are

- Regarding the overall SC strategic approach, the majority tends to be more technology orientated (33%) compared to citizen orientated (28,6%) whilst only 9.5% focus on a people (HR) orientated approach. The majority (47,6%) prefers a combined technology, citizen, process and people driven approach.
- More specifically as to the citizen driven approach, 93,7% prefer a co-decision process.
- Regarding the most preferred citizen related goals, respectively 47,6% refer to the creation of a regional innovation resource pool followed by urban attachment of citizens (42.9%).
- Regarding the most important issues to help citizens, the majority (71%) mentioned to provide access to services followed by protecting citizens' physical and cyber security (56,5%).
- The majority (63,5%) does not already use collaboration or networking tools to enhance the SC ecosystem relations.

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- The main challenges encountered in the SC development process relate to coordinating the SC ecosystem (55,6%), followed by developing strategies (52,4%) and skill gaps (50,8%).
- 85,7% of the respondents, so far, have not adopted any method and set of indicators to monitor the SC performances from an ICT perspective.
- In the future, the SC anticipate adding value mainly to the SC service domain of transport and mobility (58,3%), followed by economy and society (48,7%), natural resources and energy (47,5) and smart building and smart homes (47,3%). The biggest leap between current and future focus is, again, in the field of transport and mobility (38,9) followed by smart building and smart homes (38,7%) and smart governance (36,2%).
- Looking at the future focus on SC service domains in more detail, the respondents mentioned telecommunication networks, pollution control, health care (74,6% respectively), public security and cultural heritage (respectively 73%), waste management (69,8%) and human capital management (68,3%).
- Asked for the perceived lowest competence levels as to the SC service domains, the respondents referred to smart grids (71,4%), power grids (65,1), smart logistics/infrastructure (63,4%), smart mobility information (62,3%), energy management systems (61,9).
- To fully address SC citizens' requirements, the majority (55,6%) calls for SC guidance material followed by regulations/legislation (50,8%) and codes of practice (46%).
- Regarding exchanging best practice, only 47,6% know SC that have a smart city strategy.
- Regarding investing into citizens' perspectives, a high majority of 74,6% state that they do not have the research know how, whilst 73% already have SC units dealing with social problems.
- 63% do not implement specific measures (i.e. training) to raise awareness of personnel on the need of smart citizens to be technologically and digitally savvy.
- Most respondents still apply classical programming (50.8%) followed by web- programming (33.3%), agile development life cycle (19%) and DevOps (17.5%) when deciding to purchase or adapt software. As to external co-operation with DevOps team representatives, the main contact persons are developers (38.1%), followed by product owners (25.4%) and testers (11.1%). The most often applied KPI to measure the efficiency of a DevOps team are quality performance (55.6%), followed by innovation and hard skills (38.1% respectively, soft skills (34.9%), delivery time (25.4%), scope (23.8%) and budget (17.5%).
- Only 25.4% are expecting to co-operate with an external DevOps team in the future, whilst 44.9% are not expecting it, and 28.1% are indeterminate. In the same vein, only 22.2% are expecting to integrating DevOps competence into their team, whilst 38.1% are not expecting it, and 33.3% are still indeterminate.
- Consultants (44.4%) and online/distance learning are the most preferred training course providers.
- Asked on the respective requested competences for the profiles of Smart City Planner and Chief Digital/Information officer and co-operation and training demand in this context, the following table highlights exemplarily the respective 3 ones most often mentioned:

Competences	Smart City Planner	Chief Digital/IT officer	Co-operation with external partners	Training demand
Specific Technical Competences	-Teamwork (57,1%) -Urban Innovation (50,8%) - User Experience Design (44,4%)	- Big Data Management (57.1%) - Software Architecture (50.8%) - Coding (50.8%)	- Mobile Development (55.6%) - IT &Cyber Security (50.8%) -Artificial Intelligence (50.7%)	-IoT specific knowledge (49.2%) -DevOps (44.4%) -Machine Learning & Deep Learning (42.9%)

Table 1 DevOps Specific Technical Competences

Transversal or generic Competences	Smart City Planner	Chief Digital Officer	Required from External IT experts, consulting service provider, University
General technical/ Transversal	-Technical skills to switch from operational to strategic tasks (54%) - Broad & Deep Process - Understanding (complexity) (49.2%) - Geospatial competences (38.1%)	- Geospatial competences (54%) - IT security (49.2%) - IT media/IoT specific skills (42.9%)	- ICT Hybrid Media literacy (41.3%) - IoT Supportive skills (41.3%) - Combining IoT supportive skills with existing skills (39.7%)
Methodological	-Creativity (44.4%) -Design Thinking (44.4&) -Efficiency Orientation (41.3%)	-Efficiency Orientation (41.3%) - Analytical Skills (34.9%) - Problem solving (34.9%)	-Research Skills & Continuous Learning (41.3%) - Entrepreneurial Thinking (34.9%) - Creativity (33.3%)
Social	-Ability to merge different skills (47.6%) - Resilience (46%) -Co-operative (46%)	-Networking (44.4%) -Ability to work in a Team (44.4%) -Create Relationships (44.4%)	-Language Skills (42.9%) -Intercultural Skills (31.7%) -Resilience (30.2%) -Networking (27%) -Ability to work in a team (27%)
Personal	-Sustainable Mindset (47.6%) -Strategic Vision (44.4%) -Open-Minded (42.9%)	- Flexibility (39.7%) - Compliance (39.7) -Leadership (every employee is a leader (38.1%)	- Motivation to learn (31.7%) - Sustainable Mindset (28.6%) - Ambiguity Tolerance (25.4%)
Legal	-Public Procurement (36,5%) -Contractual Public Private Partnerships (33.3%) - Legal notions regarding Big Data Management (31.7%) -Data Security (30.2%)	- Data Security (36.5%) - Legal notions regarding Big Data Management (34.9%) - Public Procurement (31.7%) - Contractual Public Private Partnerships (28.6%)	- Data Security (33,3%) - Contractual Public Private Partnerships (31.7%) - Public Procurement (27%) - Legal notions regarding Big Data Management (23.8%)
Smart City Planning	-Territorial Planning (49.2%) -Urban Innovation (41.3%) - Management of Urban Facilities (31.7%)	-Territorial Planning (28.6%) -Management of Urban Facilities (27%) -Urban Innovation 25.4%)	- Management of Urban Facilities (38.1%) - Urban Innovation (33.3%) - Territorial Planning (28.6%)
Civilizational Competences	Engaging Citizens (38.1%	Engaging Citizens (27%)	Engaging Citizens (27%)

Table 2 DevOps Transversal Competences

9 QUALITATIVE RESEARCH

Three countries have been targeted for these initial interviews. The respondents were from Greece (R1,R2, R7, R8), from Italy (R3,R4) and Germany (R5, R6, R9).The in-depth interviews consisted on main three main questions: 1.which key success factors are making your city a ‘smart city of the future’.2. what are the most important management skills and IT skills identified in your ‘City of the Future’?.3.how would you describe the unique identity of your city?. After the analysis has been conducted, for question 1, three main

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categories have been identified: the smart city infrastructure, the strategy and its citizens. For question 2, the category of skills and education were identified; for the last question 3. the category city identity revealed the main aspects.

9.1 Smart City Infrastructure

For this category (R1,R2, R3 and R4) agreed on the importance of having in place the right infrastructure to support and promote the implementation of a smart city. (R1) explained that in their SC committee 'all city bodies, chambers, universities and institutes of technology are involved to guarantee the commitment of action. Special emphasis has been placed on the development of collaborative platforms. (R2) refers, for example, to educational and technological institution platforms. (R3, R4) related more to internal and external stakeholder platforms for joint planning activities. (R3) explain how the Roman capital administration 'uses the stakeholders for the construction of ecosystems for the creation of smart systems by investing in projects such as Pago PA, City Data Platform, CRM, SPID (Digital Identity Public System) and CIE Electronic Identity Card) which represents enabling technologies for services in a Smart city perspective'. Another example also coming from Italy refers to Florence: (R4) stating that 'it was immediately understood that there could not exist a smart city without the involvement of the participating companies, which are the driving force behind most public services in the city. Thanks to the presence of an association that includes them all in Tuscany (Cispel Toscana), it was possible to lead all public utilities in the city's innovation processes.

These processes have been described and implemented with Triennial Action Plans in which many systemic actions have been realized, possible only with a strong city cohesion of all the innovation stakeholders. Similarly, (R6) explained that 'the decision-making process will change and be based much more on valid and relevant information. Connectivity and Networks between Administration, Stakeholder and Citizens of the Smart City have to be established and will be emerging.

Finally, it was highlighted the resource's potential by having synergies between the different stakeholders. An example of this synergy is utilized in the case of Florence as explained by (R4): synergy between the Municipality, Chamber of Commerce and the Region. Florence utilities the reclamation and alignment of data with the master data of the Municipality (e.g.: reclamation of more than 200,000 addresses in Alia, periodic alignment of the data of the water and sewage infrastructure of Publiacqua and the gas infrastructure of Toscana Energia with the municipal SIT). Apart from this synergy consortium (R4) explains the work they are currently involved in supported by the government 'the governance path leads us to the launch of the Smart City Control Room. The data are the gold dust of the new millennium, it is used by the largest multinationals to increase their business. They are now known to all, but not so obvious it is to find in the Public Administration who, concretely, invests and develops on data'.

9.2 SC Strategy

For (R6) a comprehensive framework needs to be taken into account 'to be understood, planned and managed through balanced and innovative management and IT skills: this framework consists of the political, social, technological, urban planning and economic dimensions of a Smart City. Opportunities and risks of the two central smart-city competence fields of digitization and urbanization must be managed in a balanced manner.

(R1) coming from the municipality of Heraklion in Crete (Greece) indicated their pioneer spirit, already 10 years ago, they were the first municipality in Greece developing a comprehensive strategy to digitize the municipality.(R4) focuses on the important of the SC vision and explains that 'Florence has always approached digital innovation with a strategic vision of the city system, exploiting synergies and promoting cooperation and participation among all the stakeholders of Florence. In the Manifesto for Firenze Digitale in 2014, the main values of innovation in the city were affirmed with an act of Council: sharing the main digital assets (data, infrastructures for digital identity and electronic payments, public WiFi, sensors) and cooperation in jointly promoting the various innovation initiatives of the various institutions and public utilities on a city scale. In the Smart City Plan

(http://www.spesconsulting.com/sites/default/files/Firenze%20Smart%20City%20Plan.pdf)

we have included the vision on the city to 2015, 2030 and 2050, with indicators and guidelines for the development of the Florence Smart City on different areas (Integrated Planning, Public Administration

Improvement, Energy Efficiency, Mobility, ICT means and tools for innovation, Prosperity for the sustainability of the Plan, Communication)'.

9.3 SC Citizens

For (R9) it starts with a strong top down involvement from the town's lord major with his broad team to integrate the citizens. They need to convince them to participate in this great change and to win their commitment. (R4) explains that the main focus on engagement with citizens is always looking for new "fun" forms of involvement of the population at all levels, so that the relationship with the public administration becomes more and more a pleasant. Moreover, he explains that 'only in Florence it has been possible to start the firenzesemplice.it System that allows to put the citizen back at the center and to get out of the logic of "it is not my responsibility", giving way to anyone in live chat to ask for information about any utilities service, Chamber or the Region of Tuscany. For (R7) the adoption of technology by citizens would be the key success factor.

9.4 SC Skills

For (R5, R6, R8) IT systems and digital skills are emerging and therefore, management becomes more complex and traditional management skills are changing too. (R3) support this statement and add the need from the public administration to develop these digital skills together with relational soft skills and knowledge of communication and finance leading to a more multidisciplinary learning. (R4) explained the Florence digital transformation, 'since 2018 Florence is the second smart city in Italy and the first for Digital Transformation according to ForumPA's iCityRank (https://www.forumpa.it/citta-territori/icity-rank-2019-milano-firenze-e-bologna-sono-le-citta-piu-smart-ditalia/). A synthesis of more than 100 indicators (based on more than 250 variables) that, aggregated in the final ICity Rank index, allow to draw up the final ranking of the 107 capital cities. Florence is the city most capable of fully exploiting the potential offered by digital technology, followed by Bologna and Milan. The Tuscan capital obtains the highest score in four indicators (municipal apps, digital openness, public wi-fi and digital transparency) and excellent performance in four others (broadband access, IoT and network technologies, availability of online services, social PA), demonstrating an overall approach that involves not only the municipal administration but all the stakeholders operating in the urban context. (R8) highlights the strength of the Larissa municipality in the field of IT service and project management competences. For (R7) the important skill rely on 'openness' . To be able to turn SILO systems which didn't communicate between them e.g. municipalities, public administration, ministries etc. into an open Big Data management. In addition, for him a smart city is a 'city that thinks' therefore skills to understand and work with artificial intelligence are very relevant. (R9) sheds light on 'patience' as the process involve the integration of masses and therefore time is required. In addition, he regards good communication skills, also communicating at a political level as very important. Finally, knowledge about how the town works an its needs is relevant.

9.5 SC Education

In relation to education and training (R4) explained how the citizens where involved. 'The citizens participated in every process, both in the co-design phase the firenzesemplice.it system was shared in a senior center with the "digital grandparents" of Florence) and in the learning and training phase on the new digital services possible in Florence. They created by the integration of data and processes at the city level. In 2018 (R1) explains that Heraklion was selected by the EU as one of the 27 most powerful digital cities in Europe. This gave them the opportunity to get seminars on how to build a smart city. The training was financially supported by the EU.

9.6 SC City identity

This category focuses on the identification of city aspect which characterized a town. For example (R1 and R5) indicate elements like a SC culture development, having great business development opportunities, technology and IT in other words having a strong and innovative region companies contribute to the implementation. (R3 and R5) highlighted elements more related to the uniqueness of the town e.g. the historical tradition of the town, being a touristic or cultural center or having extensive sport opportunities contributes to the town identity. (R6) provides the concrete example of Berlin being regarded as 'the world-famous capital of modern Germany stands for world-class architecture, culture, night-life and a challenging

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history in the middle of Europe and the world'. (R9) underlines the Mannheim entrepreneurial spirit by having one of the biggest innovation centers in Germany together with a vibrant music (pop academy), culture and international environment. Finally (R8) offers a more holistic perspective stressing that 'the combination of policies and technology in finding solutions that serve the coexistence of the human and natural capital of our city. It is the harmoniously coexistence between the two factors.

10 CONCLUSION

The multitude of technical and transversal/general competences required for this unprecedented SC system transformation found by this study reflects the immense challenge for SC administrators requiring high levels of open-mindedness, motivation to learn, ability to change, creativity, efficiency and speed, as well as interdisciplinarity and cross- functionality on all levels. To accomplish this competence build-up is the mission of the DevOps for SC project by typologizing SC competences according to different newly emerging administrator profiles and by imparting them via MOOCs courses. The holistic character of the competence pool has been confirmed by the research to be crucial to cover the still existing strategy and skill gaps. Competence gaps and significant training demand both, in technical and transversal competences have been signaled, and, specifically, the attitude towards DevOps seems to be rather indeterminate and reluctant with the SC still focusing on more traditional software development approaches. Also, the continuous existence of a strategy gap has repeatedly become apparent. Whilst a combined technology, citizen, people and process orientated approach is preferred by most of the respondents, an even stronger citizen orientated philosophy when embarking on the SC strategy development is recommended. The still ongoing multivariate analysis stage of this research will certainly contribute to better explaining the interrelationships of concepts involved. The findings, so far, imply a lacking body of knowledge. Therefore, specifically, from the perspective of the SC administrators, the knowledge field still seems to require in-depth qualitative research. A promising route to follow for SC administrators is to join communities of international best practice to complement cognitive learning with affective and experiential learning approaches.

11 DISCLAIMER

The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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🏆 *reviewed paper*

Digitales Entwerfen von Stadt – vom Geodesign zur Echtzeitplanung

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1 ABSTRACT

Geodesign wird in den räumlichen Disziplinen oft als der wichtigste analytische Schritt und manchmal auch als der erste wichtige Entwurfsschritt beschrieben, ohne den ein Raumkonzept nicht mehr planbar ist. Obwohl diese Analyseschritte aufseiten der Stadtplaner wichtig sind, da sie alle für die Beurteilung relevanten Fragestellungen berücksichtigen und in räumliche Modelle übersetzen, interpretieren sie den eigentlichen Entwurfsprozess sehr technokratisch. Diese Entwurfslücke versuchen wir mit unserem neuen ganzheitlichen Entwurfsansatz zu schließen. Dazu verwenden wir einen digitalen Workflow, der Geodesign als Bestandsaufnahme und räumliche Analysemethode methodisch unterstützt, aber eher als Basis/Umfrage für den eigentlichen Entwurf dient.

Der Artikel versucht, die folgenden Fragen zu beantworten: Wie können wir einen Workflow in der Lehre vermitteln, der es Architekten und Stadtplanern ermöglicht, in Zukunft sowohl mit frei verfügbaren Datensätzen als auch mit einem bewussten Einsatz von Software effizient zu arbeiten? Welche Vorteile bieten uns geodätische Ansätze in dieser Hinsicht? Und wie können wir mit einfachen Werkzeugen aus den Analyseergebnissen unsere Entwürfe in Echtzeit planen und überprüfen?

Nach einem kurzen Forschungsstand zu Geodesign-Ansätzen in der Stadtplanung und einigen Anwendungsbeispielen dieser Ansätze vergleichen wir diese Ansätze mit bestehenden Wettbewerbsbeiträgen (competitionline, 2019) und stellen unseren neu entwickelten Workflow mit OpenSource GIS und Realtime Editing and Virtual Reality Rendering Tools zur aktiven, partizipativen Verbesserung von Entwurfsprozessen vor. Neben den bekannten Modellierungswerkzeugen wie Rhino, Sketchup, Revit und ArchiCAD stellen wir Enscape3D und Twin Motion als gut handhabbare Echtzeit-Rendering-Tools für den Städtebau vor.

Keywords: Virtuelle Realität, Geodesign, Digitalisierung, Städtebauliches Entwerfen, Echtzeitplanung

2 EINLEITUNG

Räumliche Analysen und algorithmische Denkweisen sind bei städtebaulichen Entwurfsprozessen und -fragestellungen von großer Bedeutung. Denn je größer die betreffende Maßstabsebene, desto komplexer erweist sich meist auch die mit der Entwurfsaufgabe verbundene Aufgabenstellung, sodass sich vor allem die Auswahl und die Anwendung geeigneter räumlicher Analysemethoden als essenziell für einen erfolgreichen Lösungsvorschlag – also für einen gelungenen Entwurf – erweist (Steinitz, 2012).

Tatsächlich lässt sich methodisch in der relativ breit gefächerten und auf unterschiedlichen Maßstäben intervenierenden Disziplin der Architektur- und Stadtplanung jedoch feststellen, dass einige Methoden und Entwurfsprinzipien zwar auf einer gewissen Maßstabsebene funktionieren mögen, sich aber unter Umständen nicht auf einen anderen Maßstab übertragen lassen. Die Wahl einer adäquaten methodischen Herangehensweise und die Auseinandersetzung mit der Reichweite eines Projekts entscheidet also zwar maßgeblich über den Erfolg eines Entwurfs, ist in der Praxis allerdings bei Weitem kein leichtes Unterfangen.

Eine starke Diskrepanz herrscht auch zwischen den in der Lehre vermittelten, logisch aufeinander aufbauenden Entwurfsschritten und den subjektiv von gestalterischen Aspekten motivierten Argumentationsketten vor. Gerade die berufliche Praxis stützt sich immer noch auf diese „Methodik“, die einen Entwurf jedoch anfechtbar macht. Doch je größer die Maßstabsebene eines Projekts ist, desto schwieriger gestaltet es sich auch, der räumlichen Komplexität der Fragestellung im Entwurf gerecht zu werden.

Der hier vorgestellte Workflow ist ein Beispiel dafür, wie mithilfe von digitalen Werkzeugen eine effiziente Herangehensweise an komplexe Entwurfsaufgaben möglich ist und dabei schnittstellen- und plattformübergreifend die Idee des Arbeitens mit einem „Digitalen Stadtzwilling“ über die Maßstabsebenen begleitet.

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3 STAND DER FORSCHUNG

Im nachfolgenden Kapitel werden die für die Entwurfsmethodik relevanten Quellen und Technologien näher erläutert.

3.1 Geodesign

Im Kontext des Designs mit GIS und der Verknüpfung von „Design Professions“ und „Geographic Science“ ist Carl Steinitz „A Framework for Geodesign“ (2012) der meist diskutierte Ansatz. Dabei ist sich Steinitz der zwei Probleme des “Warum müssen „Design Professions“ und die „Geographic Sciences“ zusammenarbeiten”? und deren Unterschiede – schon vonseiten der Ausbildung, der Denk- und Herangehensweisen oder der Maßstäbe – bewusst. Eine enge Zusammenarbeit von beiden Seiten ist zwar erwünscht, die Trennung nach Designer und Wissenschaftler soll allerdings auch nicht verschwimmen.

Interessant ist jedoch, dass im Geodesign-Prozess alle für eine raumplanerische Bestandsanalyse wichtigen Fragen formuliert und als “Modell” beschrieben werden und auch hier dem Muster „Aus Daten wird Information und aus Information Wissen über den Ort“ folgen. Im Einzelnen sind dies die folgenden Modelle, Verfahrensschritte im Geodesign nach Steinitz:

- „Representation Model“: Wie soll der Raum inhaltlich, räumlich und zeitlich beschrieben werden – datenbasiert
- „Process Model“: Wie funktioniert momentan der Untersuchungsraum?
- „Evaluation Model“: Wie gut oder schlecht funktioniert der Untersuchungsraum?
- „Change Model“: Wie könnte der Raum verändert werden?
- „Impact Model“: Welche Unterschiede könnten die Veränderungen bewirken?
- „Decision Models“Soll der Untersuchungsraum so verändert werden?

Steiner und Shearer (2016) geben hierzu einen umfassenden Überblick, wo „Geodesign“ eingesetzt wird, angefangen von allgemeinen Planungsprojekten und Szenarien (Lee, 2016), über die Rolle des Computers im Design (Tulloch, 2016), bis hin zu der Fragestellung, ob Geodesign eine Möglichkeit bietet, soziales Lernen und kollektives Handeln zu ermöglichen (Wissen Hayek et al., 2016).

Jedoch wird gerade von Städtebauern, den Praktikern, die GIS als Entwurfshilfe nutzen, immer wieder kritisiert, dass die Methodik bei aller notwendigen Abstraktion oft als technokratisch empfunden wird. Es entsteht der Eindruck, dass Komplexität und gute Planung „wie ein automatisierbarer Ablauf gestaltet seien, bei dem ein Ergebnis auf Knopfdruck erzielt werden könne (Berchtold, 2016: 45). Aber genau hier steckt das Dilemma vieler Entwerfenden: Wie komme ich nach einer dezidierten Bestandsaufnahme auf meine neue Form?

3.2 Digital Twins

Der Begriff des „Digitalen Zwillings“ steht synonym für eine Schlüsseltechnologie der Digitalisierung vor allem im Bereich der industriellen Prototypenerstellung im Kontext von Industrie 4.0. Eine Definition angelegt an Kuhn (2017) beschreibt dabei den Zwilling als ein virtuelles Modell, das im Idealfall seine Daten in Echtzeit integriert und gemeinsam, herstellerübergreifend und plattformunabhängig bereitstellt. Dadurch ist die Kombination von Simulationsmodellen möglich und „Was-wäre-wenn-Analysen“ können virtuell durchgeführt werden, um neue Prozesse und Produkte zu testen. Der Vorteil liegt in der Tatsache, dass reale Prozesse davon unbeeinträchtigt bleiben und die reale Produktion erst dann startet, wenn eine optimale Lösung gefunden ist. Dabei ist der digitale Zwilling keineswegs eine exakte Kopie der realen und neu entstehenden Wirklichkeit, da wie bei allen Modellierungsprozessen das klassische Dilemma der Abstraktion vorliegt (Dembski et al., 2019). Michael Batty (2018) kritisiert hierzu im Kontext der Stadtplanung richtig, dass digitale Zwillinge nur eine begrenzte Menge an Variablen und Prozessen abstrahieren können und somit die wirklich stadtrelevanten Funktionen wie soziale und wirtschaftliche Vorgänge nicht korrekt abbilden (Batty, 2018). Trotz dieser Einschränkungen und Kritik ist die Idee, mithilfe des digitalen Zwillings stadtplanerische Prozesse besser abzubilden und zu kommunizieren, eine der Herausforderungen im Kontext Digitalisierung und Stadtplanung des 21.Jahrhunderts.

3.3 Städtebauliches Entwerfen

Sämtliche Literatur und Lehrbücher zum Themenfeld des “Städtebaulichen Entwerfens” im Rahmen dieses Beitrages aufzuzählen würde den Umfang sprengen. Vielfach liegt der Fokus jedoch auf dem Entwurfsprozess an sich, wie z.B. welche qualitativen Merkmale wie Sehgesetze, Gestaltungssätze und Proportionen bzw. Ordnungsprinzipien wichtig sind (Schenk, 2018), oder mit welcher Grammatik und Bausteinen die Stadt entworfen werden kann (Reicher, 2017) so wird das “Geheimnis des Entwerfens”, der Schritt von einer fundierten und wissenschaftlichen Bestandsaufnahme (wie im Geodesign) zum eigentlichen Entwurf nur selten beschrieben. Dies liegt wohl auch an der eingangs erläuterte Komplexität städtebaulicher Entwurfsprojekte. Es erscheint evident, dass eine rein subjektive und überwiegend von gestalterischen Aspekten geleitete Argumentationskette spätestens ab einer gewissen Größe des Planungsgebiets an ihre Grenzen stößt. Für Planer wird es demnach zukünftig unabdingbar sein, eine strukturierte und konsistente Herangehensweise an städtebauliche Aufgabenstellungen zu entwickeln.

Viele Entwurfsprozesse in der Disziplin des Städtebaus sind tatsächlich vergleichbar mit einer wissenschaftlichen Arbeit, geleitet von einer relevanten und exakt formulierten Fragestellung, einem reichhaltigen Methodenrepertoire, sowie der Umsetzung als Testentwurf, die wiederum, evaluiert, adaptiert und kritisch hinterfragt werden. Die entwickelten Prototypen sind somit nicht nur als ein gestalterischer Vorschlag anzusehen, sondern dass sie auch durch einen Zugang zu ihrer zugrunde liegenden Argumentationskette, eine Überprüfbarkeit auf wissenschaftlich fundierten Fakten gewähren. Oder wie es Walter Schönwandt und Kollegen so treffend formulierten: “Problems first” (Schönwandt et al., 2013)! Genau diese Problemdefinition – was fehlt dem Raum und wie wird dieser mit räumlichen Abfragen und Analysen räumlich abgegrenzt – hilft dabei, einen ersten Entwurf zu skizzieren, was in Kapitel 4 kurz angerissen werden wird.

3.4 Virtual Reality im Städtebaulichen Entwerfen

3.4.1 Modelling

Die Arbeit mit dreidimensionalen Modellen ist bei komplexen städtebaulichen Aufgabenstellungen seit jeher unverzichtbar, sondern dienen vor allem auch dem Vorstellungsvermögen im eigenen Entwurfs- und Arbeitsprozess. Eine Vielzahl an Programmen bieten Planern hier die Möglichkeit, anstelle der zeitaufwendigen Erstellung eines physischen Modells, den eigenen Entwurf in einem digitalen Modell abzubilden und ein Gefühl für die reale Situation zu entwickeln. Virtual Reality schafft darüber hinaus die Gelegenheit, das Modell nicht nur über den Bildschirm zu betrachten, sondern sich mithilfe einer VR-Brille scheinbar tatsächlich in der geplanten Situation zu befinden. Volumen, Raumeindrücke, Materialien und Lichtverhältnisse können auf diese Weise nicht nur für den Planer erfahrbar gemacht werden, sondern auch in Echtzeit evaluiert und verändert werden.

3D-Stadtmodellen waren hier seit jeher, beeinflusst durch die Gaming-Industrie, in Kombination mit hochwertigen Modelling-Software-Tools eine eher den technischen Experten vorbehaltene Anwendungsdomäne. Game-Engines und klassische 3D-Design-Software wie die Kombination aus Maya 3D / 3D Studio Max und C++ Game-Engine (Zeile et al., 2005), Quest3D (Kretzler, 2005), Torque Engine mit verknüpften Geodaten oder Unreal-Editor (Jones and Lowe, 2005) waren die ersten „einfacheren Ansätze“ zur Echtzeitmodellierung. Ein Paradigmenwechsel geschah mit der Einführung von "Lumion" im Jahr 2010. Hier konnten ganze Modelle schnell importiert und unkomplizierten zu qualitativ hochwertigen Visualisierung ohne spezielles Expertenwissen bearbeitet werden (Mach, 2018). Mit der Vorstellung von „Enscape“ und dem aus dem Gaming-Bereich kommenden Twinmotion können gängige 3D-Programmen nun direkt aus dem Arbeitsprozess gekoppelt in den VR-Entwurfsprozess eingebunden werden.

3.4.2 Enscape3D

Als Purgin ist Enscape mit den CAD-Programmen Revit, ArchiCAD und SketchUp kompatibel. Vectorworks Unterstützung ist für März 2020 angekündigt. Das Programm bietet dabei schwerpunktmäßig Echtzeitplanung und Visualisierung an. Änderungen im bestehenden 3D-Modell werden direkt in Enscape dargestellt und in einem separat erscheinenden Fenster sowohl in der gleichen Perspektive angezeigt, als auch in Echtzeit synchronisiert.

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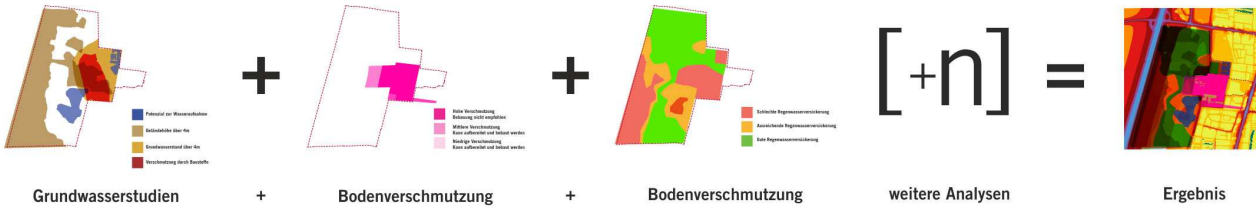
Durch die detaillierte Ausgestaltung des Modells mit Materialien und Objekten wird es mit dem Plugin ermöglicht, entweder am Bildschirm, oder über eine VR-Brille einen möglichst realen Eindruck der Situation zu gewinnen. Wird das Modell über den Entwurfsprozess hinweg konsequent gepflegt, so kann Enscape dazu beitragen, nicht nur den Entwurfsprozess dynamisch zu gestalten, sondern erleichtert das Generieren von Präsentationsmedien wie Perspektiven, Videos auch erheblich und minimiert die grafische Nachbearbeitungszeit auf ein Minimum.

3.4.3 Twinmotion

Im Gegensatz zu Enscape legt Twinmotion seinen Schwerpunkt auf die Präsentation des Entwurfs in belebten Szenen und Videos und eignet sich weniger gut für die Planung und Anpassung des Entwurfs in Echtzeit. Die Problematik ist hierbei, dass das bestehende 3D-Modell nicht wie bei Enscape über ein Plugin bearbeitet wird, sondern alle Anpassungen direkt in Twinmotion vorgenommen werden. Ein bestehendes 3D-Modell kann also zwar mühelos in Twinmotion importiert, angepasst und mit zahlreichen Objekten realistisch gestaltet werden, jedoch werden diese Änderungen nicht in das Ausgangsprogramm überführt. In der VR-Ansicht ist lediglich eine Änderung der Materialtextur möglich, dies aber direkt im virtuellen Raum.

Im Unterschied zu Enscape ist es in Twinmotion aber möglich dynamische Objekte über einen Pfad im 3D-Modell zu verorten. Auf diese Weise kann das Modell über nur wenige Klicks mit beispielsweise sich bewegenden Fußgängern, Autos und Vegetation angereichert werden. Es entsteht ein höchst realistisches Raumgefühl, weshalb sich das Programm bestens für die Erzeugung von Videos eignet.



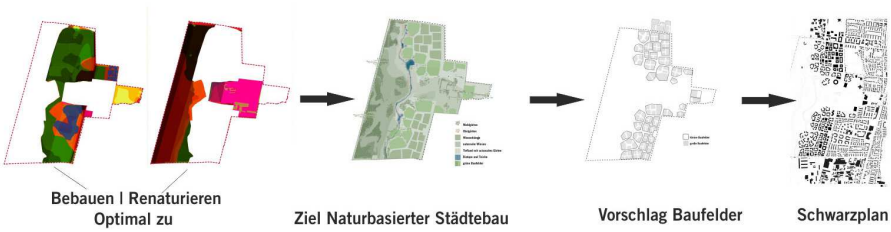


Abb 1: Ablaufschema des Entwurfs „Growing a City – Haunstetten Süd“ von Cobe Architects – durch konsequente Analyse und räumlich umgesetzten Zielvorgaben entsteht im digitalen Workflow der Entwurf bis hin zum 3D-Modell, Film über QR-Code [Eigene Darstellung unter Verwendung von Cobe auf Stadt Augsburg 2019]

4 WETTBEWERB AUGSBURG HAUNSTETTEN

Der im Jahr 2018 gestartete Beteiligungsprozess zur Zukunft des Augsburger Stadtteils Haunstetten kann in vielerlei Hinsicht als ein Beispiel für die heutigen Anforderungen städtebaulicher Planungsverfahren dienen. Aus vorangegangenen Informationsveranstaltungen, Expertenworkshops und Arbeitstreffen ging ein städtebaulicher und freiraumplanerischer Wettbewerb hervor, der sich, unter Einbeziehung neuer Formate und Medien, mit der sensiblen Erweiterung des bestehenden Stadtteils Haunstetten um einen neuen, südwestlichen Teil „Haunstetten Südwest“ widmet. Nicht nur das Verfahren selbst, sondern auch der erarbeitete Maßnahmenkatalog definierte für die geplante Erweiterung des bestehenden Stadtteils die Anforderung, die beiden Quartiere eng zu verzahnen und dadurch gleichermaßen für beide Teile den größtmöglichen Nutzen zu erzielen. Mit dem Maßnahmenkatalog soll darüber hinaus auch die Stärkung von lokaler Zentralität, Nahversorgung, öffentlichen Freiräumen, sozialen Einrichtungen sowie einer nachhaltigen Mobilität gefördert werden. Unter den 25 Planungsteams, die im Frühjahr 2019 aus ganz Europa dazu eingeladen wurden, Vorschläge für die Entwicklung des zukünftigen Stadtquartiers zu erarbeiten, wurden im Juli 2019 neun Planungsteams für die Bearbeitung in der zweiten Stufe ausgewählt (Stadt Augsburg, 2019).

Der vorhergehende beispielhafte Wettbewerbsbeitrag „Growing a city“ des dänischen Büros COBE zeigt auf, in welcher Form Geodesign dazu beitragen kann, eine belastbare Grundlage für städtebauliche Entwurfskonzepte zu bilden.

Nach der Analysephase, in der alle für die Abwägung relevanten Belange eingepflegt wurden, sofern sie einen Geobezug besitzen, konnte eine erste Aussage über das optimal zu bebauende und das für Grün freizuhaltende Areal getroffen werden. Die Planungsziele wurden danach räumlich formuliert, sodass erste Baufelder entstanden. Der gesamte Prozess ist in einem gut verständlichen Video aufbereitet (https://youtu.be/6FvRkeSIlOA).

5 WORKFLOW ECHTZEITPLANUNG

Mit dem Master-Entwurfsstudio zum Thema “Die digitale Linde– Wie entwerfen wir Zentren für die zukünftige europäische Stadt?” im Sommer 2018 auf dem Gebiet des Patrick-Henry-Villages in Heidelberg wurde erstmals der erarbeitete Workflow zum digitalen Entwerfen in der Lehre methodisch vermittelt und von den Studierenden angewandt (s. Abb.1). Das Projekt bewegte sich in enger Kooperation mit der Internationalen Bauausstellung “Wissen schafft Stadt”, die bis 2022 in Heidelberg stattfindet.

5.1 Die STQP Toolbox

Angeleitet durch wöchentliche Betreuungen und Arbeitstreffen erlernten die Studierenden nicht nur neue Software und Methodiken, sondern waren dazu angehalten, ein digitales dreidimensionales Modell ihres Entwurfs über den gesamten Projektverlauf hinweg zu pflegen. Analog dazu wurde auch als Abgabeleistung von den Studierenden kein physisches, sondern ein digitales Modell des Entwurfsprojekts samt einem kleinen Image-Video zur Veröffentlichung gefordert.

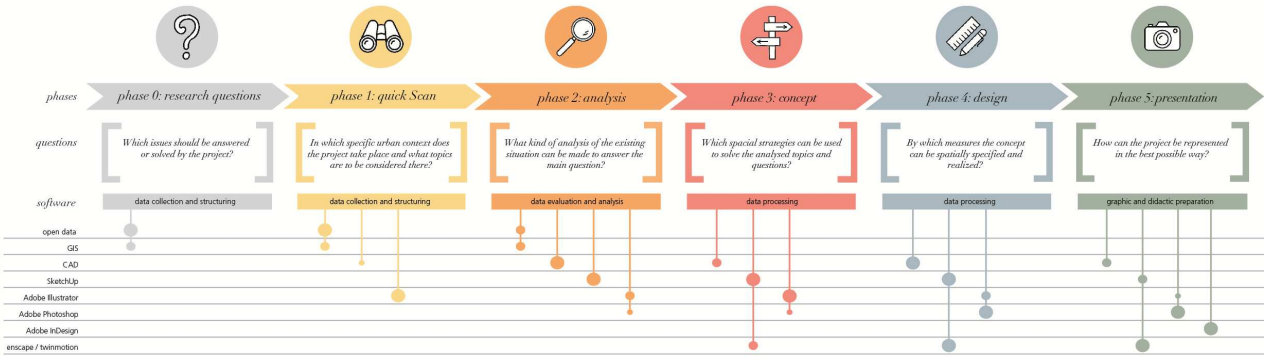


Abb. 1: Ablaufschema des „Digitalen Entwerfens“, unterteilt in 6 Phasen mit den zugehörigen eingesetzten Technologien.

5.1.1 Research Question und Geo-Design

Bereits von Beginn an wurde den Studierenden mit dem Workflow vermittelt, dass Digitales Entwerfen bereits in der Phase 0 mit wichtiger Grundlagenarbeit beginnt. Für diesen wichtigen, ersten Schritt im

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Entwurfsprozess bedeutet das einerseits, sich der Aufgabenstellung bewusst zu werden und andererseits aber auch, sich mit den Datensätzen über das Entwurfsgebiet vertraut zu machen, sie zu strukturieren und zu vervollständigen.

Wichtig ist die richtige Fragestellung, wie Russell Ackoff treffend formuliert hat (Ackoff, 1974):

„Successful problem solving requires finding the right solution to the right problem. We fail more often because we solve the wrong problem than because we get the wrong solution to the right problem“.

In der Arbeit mit den Studierenden bedeutet dies vor allem, ein hohes Maß an Eigenständigkeit und Bewusstsein über Datenquellen und Methodiken zu vermitteln. Wo erhalte ich frei verfügbare Geodaten über mein Entwurfsgebiet? Wie kann ich mit den Informationen arbeiten? Welche Möglichkeiten können Geografische Informationssysteme darüber hinaus für die Analyse und die Konzeption des Projekts bieten?

Mit dem neu erlernten Werkzeug GIS, im Speziellen die frei verfügbare Software QGIS, erhielten die Studierenden Zugang zu den gigantischen Mengen an frei verfügbaren Geodaten und erlernten Schritt für Schritt, die Daten zu strukturieren und GIS als ein Werkzeug im eigenen Entwurfsprozess zu nutzen. Mit den Geodaten strukturierten die Studierenden ihre Plangrundlage für die weitere Arbeit in ihrem individuellen CAD-Programm und erstellten erste räumliche Analysen.

Die Vorteile, die ein überlegter Einsatz von Geografischen Informationssystemen in dieser Anfangsphase dem Entwurfsprozess bieten kann, erschloss sich den Studierenden schnell - Die mit GIS angestellten Analysen waren deutlich weniger anfechtbar und erwiesen sich auch für die eigenständige Konzeptentwicklung als eine konsistente Argumentations- und Entscheidungsgrundlage.

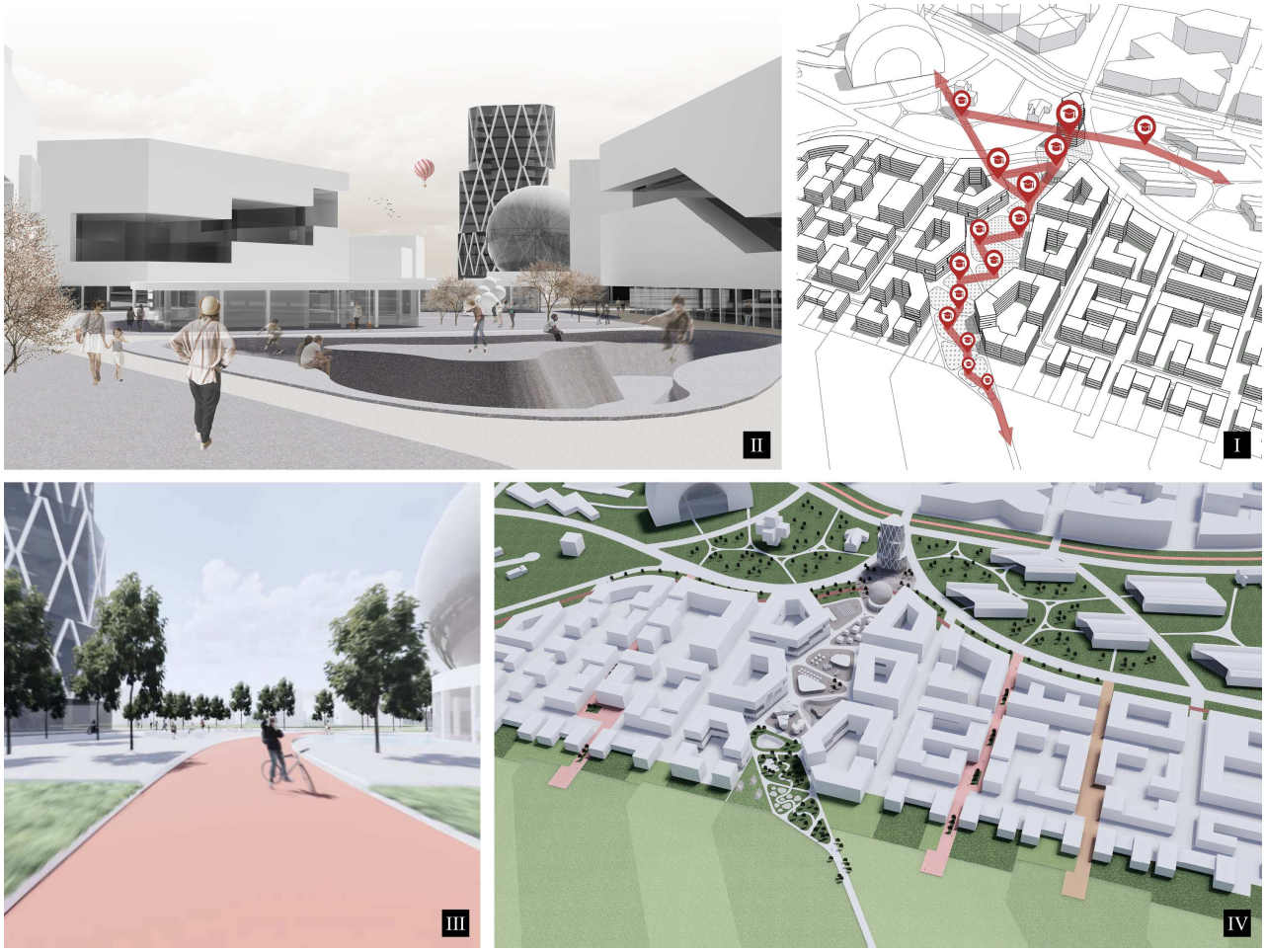

Abb. 2: Vom Funktionsmodell (I) über die Collage (II) zur virtuellen Entwurfsprüfung in VR (III) und dem fertigen 3D-Gesamtmodell (IV)

5.1.2 Schwarz- und Lagepläne

Die eigenständig mit QGIS erstellten Grundlagenpläne wurden im fortlaufenden Prozess als Basis für die weitere Bearbeitung im jeweiligen CAD-Programm der Studierenden dazu genutzt, um Lagepläne und

Schwarzpläne der Entwurfssituation zu erstellen. Ergänzend zu den thematischen digitalen Workshops, in denen sowohl der strukturierte Umgang mit den diversen Ebenenstrukturen der diversen CAD-Programme, als auch wertvolle Tipps zum zeitsparenden Arbeiten mit Bildbearbeitungsprogrammen vermittelt wurde, waren auch Inputs zur Darstellungstiefe mit Beispielen diverser Wettbewerbe ein fester Bestandteil des Lehrplans für das Entwurfsstudio.

5.1.3 Modelling

Um die konsequente Arbeit mit dem digitalen 3D-Modell bereits in den ersten Phasen des Entwurfs fest im Workflow zu verankern, wurde schon in den ersten Wochen damit begonnen, die Studierenden in wöchentlichen Arbeitstreffen und Übungen mit SketchUp vertraut zu machen. Im Rahmen dieses kollaborativen Settings entstand, im Vergleich zu den bislang von den Studierenden verwendeten Workflows, in kurzer Zeit ein differenziertes 3D-Modell der Bestandssituation, in welchem die Volumina der eigenen Entwurfsidee schon bald erprobt werden konnten (s. Abb. 2).

Ergänzend zu der analogen Betreuung des Entwurfs anhand maßstäblicher Pläne, wurden die Studierenden in diesem Semester erstmals auch dazu aufgefordert, ihren Entwurf gemeinsam mit den Dozenten direkt mit dem digitalen Modell zu diskutieren. Als besonders effizient stellte sich dabei die Vorbereitung verschiedener Varianten heraus, die den Diskurs auf anstehende Entwurfsentscheidungen lenkten und eine zielgerichtete Evaluation ermöglichten.

5.1.4 Virtual Reality (für interaktives Entwerfen)

Mit zunehmender Detaillierung und Sicherheit im Konzept, wurden auch die 3D-Modelle realistischer mit Materialien, Objekten und Personen gestaltet und in Verbindung mit den Programmen ArchiCAD und SketchUp das Plugin Enscape als Werkzeug für den Entwurfsprozess dazu genutzt, ein Gefühl über die geplanten Dimensionen, Materialien und Raumeindrücke zu schulen. Die wöchentlichen Betreuungen konnten nun von den Studierenden und Dozenten dazu genutzt werden, mit der VR-Brille über die reale Situation zu diskutieren und etwaige Änderungen in Echtzeit vorzunehmen (s.Abb.3).

Abbildung 3: Exploration des ersten Entwurfs bis hin zur Echtzeitkorrektur im HLS-Modell

5.1.5 Werbefilm

Der anschaulichen und präzisen Vermittlung architektonischer und städtebaulicher Konzepte wird zukünftig eine immer größere Bedeutung beigemessen werden. Längst ist in diesen Disziplinen der Trend zu beobachten, Wettbewerbe nicht länger anhand von analogen Präsentationen an Plakaten zu entscheiden, sondern den Sieger über kurze, pointierte Image-Videos auszumachen. Ein Entwurf, dessen zugrunde liegendes Konzept sich nicht innerhalb weniger Minuten erläutern lässt, hat innerhalb dieser Verfahren kaum eine Chance.

Die Studierenden wurden zur finalen Präsentation deshalb dazu aufgefordert, ihre Ideen für das Patrick-Henry-Village nicht nur anhand von Plakaten zu erläutern, sondern ein zweiminütiges Image-Video zu erstellen. Darin sollten neben den wichtigsten Konzeptskizzen, einem aussagekräftigen Titel und den verschiedenen Layern des Entwurfs auch einige Überflug-Videos und Perspektiven Platz finden.

Durch die konsequente Pflege und die zunehmende Detaillierung, die die Studierenden über den gesamten Entwurfsprozess an ihrem digitalen Modell vornahmen, bedeutete die Produktion des Videos - und das war

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auch für die Studierenden selbst eine große Überraschung - nur einen geringen Aufwand, bzw. umfasste nur die Konzeption der Ausschnitte und die Bearbeitung des Videos in gängigen Filmschnittprogrammen, wie zum Beispiel iMovie.

5.1.6 Lern-Repositorium

Um eine möglichst große Reichweite der Lerninhalte zu erzielen, wurden die wöchentlichen Betreuungen und Inputs sowohl durch eine Online-Lernplattform, als auch durch einen analogen Reader in Broschürenform ergänzt.

Neu erlernte Methodiken und Software konnten die Studierenden mithilfe dieser beiden Medien zu Hause nachbereiten, oder auftretende Fragen gezielt nachschlagen. Die Online-Plattform bietet den Studierenden darüber hinaus auch die Möglichkeit, die Inhalte in kleinen Tutorials und Übungsdateien nachzuvollziehen. Sowohl die Lernplattform, als auch der Reader befinden sich selbstverständlich in stetiger Rückkopplung mit den Studierenden und werden in regelmäßigen Abständen aktualisiert und um neue Themenfelder ergänzt.

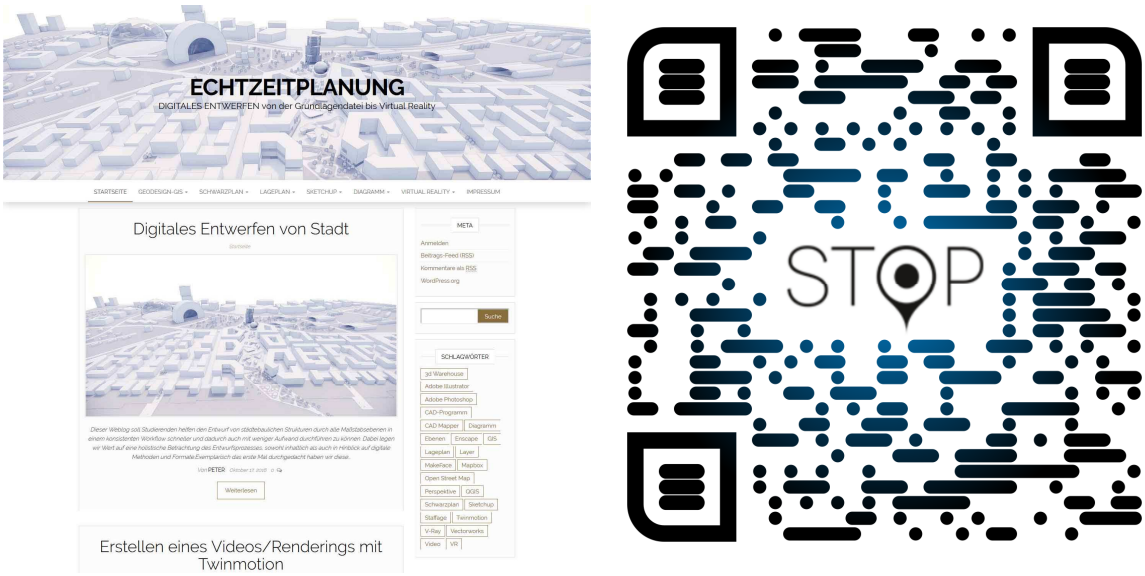

Abb.4: Übersicht über das Lernrepositorium und smartphone-freundlicher Zugang über responsive Design

6 DISKUSSION & AUSBLICK

Der hier vorgestellte Workflow ist die Grundlage für eine konsequente digitale Entwurfsmethode, vom Plangebiet bis zum fertigen (virtuellen) Modell. War in den ersten Entwurfsprojekten Geodesign als Entwurfswerkzeug noch wenig ausgeprägt und beschränkte sich das Arbeiten mit Geodaten noch auf das Erstellen von Kataster- und Schwarzplänen, so ist die methodische Integration des „Geo“-Aspektes zukünftig vermehrt integriert werden. Das systematische Analysieren räumlicher Gegebenheiten wird hinsichtlich der immer mehr an Bedeutung gewinnenden, belastbaren Argumentationsketten im Entwurfsprozess zunehmend an Wichtigkeit gewinnen, da mit Geodesign die Grundlagenermittlung auf eine breiter anerkannte, wissenschaftliche Basis gestellt wird. Gerade die entwerfenden Disziplinen diskutieren gerne über „Schönheit“, das Eingehen auf den „Genius Loci“ sowie das Einhalten von formalen Aspekten, die in einer objektiven Beurteilung schwer zu fassen sind. Der vorgestellte Workflow soll auch diese Eigenschaften nicht negieren, sondern ähnlich der Begründung bei einem Bebauungsplan zu einer stärkeren Argumentationstiefe verhelfen. Sind die richtigen Fragen zu der Entwurfsaufgabe gestellt und die Rahmenparameter für das Gebiet abgesteckt, so bietet das Arbeiten im virtuellen Modell und der Diskussion in Gruppen besser Möglichkeiten sogenannter „iterativer Loops“ zur Anpassung und Entwicklung an die ästhetischen als auch an die „harten“ Fakten.

Der hier vorgestellte Ansatz ist ein erster Versuch, das digitale Entwerfen konsequent über alle Maßstabsebenen und auch Planungshaltungen hin konsequent durchzuziehen. Er ist kein abschließendes Ergebnis, sondern ein Gerüst, an das immer wieder neue Technologien angedockt werden können. Jedes Design-Studio ergänzt in der Zusammenarbeit zwischen Lehrenden und Studierenden den Prozess, ähnlich im Entwurfsprozess selbst, wird auch der Workflow immer wieder kritisch hinterfragt.

Diskussionspunkte sind häufig der Umstand, warum soll den eine schon erlernte Software verlassen bzw. mit anderen Technologien ergänzt werden, wenn es denn auch anders schon digital gut klappt. Dabei werden Trends im digitalen Bauen und Planen wie BIM, XPlanung, CityGML, allgemein das (gewünschte) Zusammenwachsen von GIS und CAD oftmals außer Acht gelassen. Ein weiterer Umstand ist oftmals, dass viele VR und GIS Anwendungen keine „große Tradition“ auf iOS besitzen, und deshalb von den Studierenden übersehen werden. Eine weitere Frage wird sein, wie kann mit Parametrischen Entwerfen und Lösungen in dem Workflow umgegangen werden?

Die Frage nach dem „richtigen Workflow“ kann und wird wahrscheinlich nie abschließenden geklärt werden können, jedoch sollte bei jeder räumlichen Fragestellung als auch beim Einsatz der Technologie immer der „Problems First“ Ansatz beherzigt werden, um zielgerichtet zu einer guten Lösung auf die richtige Frage zu finden.

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🏆 *reviewed paper*

"Digital.Labor" – Co-Creation for the Digital City of Tomorrow

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1 ABSTRACT

In ordert to design and develop urban solutions successfully, the need to include a wide and diverse range of stakeholders is becoming evermore apparent. These tasks must be recognized as a societal task and perceived jointly, and provide a platform for bringing together several actors to colaborate effectively. Digitization is providing new orrprtunities to integrate a large number of (local) actors into decision-making and implementation processes, relevant to urban development through both conventional and innovative participation methods (HANZL;2007). But, how might such new integrated approaches look? How is it ensured that the impulses of a heterogeneous stakeholder landscape are equally taken into account? Moreover, how is it guaranteed that cities integrate the results of open idea processes into traditional urban planning?

One such emergent approach is that of co-creation (ALVES;2013), which focuses on the collaboration of transdisciplinary actors who jointly address challenges in a "process of creation" to develop new and successful solutions to existing problems. Practical experience are combined with expertise knowledge and specialized skills and solutions are developed "on the ground", regardless of professional background. In such a co-creation process, all backgrounds and approaches are recognized as equally valuable and accompany all stages of the process, from the initial idea to (prototype) implementation. Thereby such approaches promise the creation of holistic and sustainable (systems´) solutions with a high innovation potential. They offer a new format for stakeholder participation in urban processes, given the wide variety of urban challenges we are currently facing.

The Fraunhofer Institute for Industrial Engineering IAO, in cooperation with the Institute of Human Factors and Technology Management IAT of the University of Stuttgart, has launched the Municipal Innovation Center (Kommunale InnovationsCenter (KIC@bw)). The focus is on creating experimental spaces and new innovation partnerships between administration, business, science and civil society. The goal is to develop and implement innovative solutions for cities, towns, counties and regions. The Municipal Innovation Center is funded by the Ministry of the Interior, Digitization and Migration Baden-Württemberg as part of the digitization strategy of the state government of Baden-Württemberg digital@bw.

To test the possibilities of digitization for cities, the Fraunhofer IAO has developed a process for prototyping. Central is the "Makeathon" (from "to make" and "Marathon") as a format in which local actors from the city administration, politics, civil society, business and the creative sector are brought together in a limited period of time. In the process, which is moderated by Fraunhofer IAO and Tinkertank, not only ideas are developed and conceptualized, but also implemented as prototypes. The format can be individually adapted and enables almost all questions relating to urban digitization to be tackled jointly. In total, eight of these digital laboratories, in cities and municipalities, will be completed by mid-2020.

Keywords: Future, City, Mobility, Scenario, Planning

2 CO-CREATION - CREATING SOMETHING TOGETHER

The origin of the Digital.Labor is the endeavor to establish a format to support all urban actors around the topic of digitization. It builds on the principles of co-creation and participation, which is why these principles are considered in more detail below.

The step model of the participation of Sherry Arnstein, the "Ladder of Citizen Participation", which defined eight intensity levels of participation, clearly shows that participation not always means participation. Arnstein defines the lowest form of participation as the provision of information, which is countered by the complete relinquishment of decision-making power (ARNSTEIN;1969). According to the authors' understanding, participation should be interpreted as a color palette: for each question, an individual mix of participation intensities is necessary to achieve a successful result.

The central aspects of co-creation are generating ideas and cooperation. In order to develop new solutions according to urban challenges, the co-creation approach focuses on the cooperation of transdisciplinary

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actors who jointly address challenges in a "process of creation". Regardless of the professional background, something is created together at eye level, from the first idea to the concept, to the (prototype) implementation. The following three basic rules are considered essential for co-creation by the authors of this article:

- Creativity: Finding answers to complex questions and challenges requires a correspondingly complex set of skills, (everyday) knowledge and expertise. Co-creation formats promote creativity in the development of innovative and diverse solutions by integrating heterogeneous actors.
- Identity: When designing new digital services or physical urbane environment, the identification of users with the public space is relevant. By addressing needs and jointly developing solutions, the identification potential can be maximized, which in turn leads to a sense of responsibility for what has arisen and its context and is accordingly relevant for the acceptance of new solutions.
- Solidarity: For the integration of heterogeneous skills, expertise and knowledge, the cooperation of the various actors is necessary at eye level. The "learning from each other" in the creative process is in the foreground and relates to the everyday knowledge of residents and users, the knowledge of formal urban development processes (legal restrictions, process flows) and technology knowledge.

We can encounter co-creation in different contexts. In this article, the Makeathon will be discussed later as an event format, which takes up and applies the principle of co-creation.

3 DIGITAL.LABOR - PROTOTYPING PROCESS FOR DIGITAL URBAN SOLUTIONS

3.1 Makeathon-Format

To test the possibilities of digitization for cities, the Fraunhofer IAO has developed a process for prototyping. Central is the "Makeathon" (ZHANG;2012) (from "to make" and "Marathon") as a format in which local actors are brought together in a limited period of time. In the process, which is moderated by Fraunhofer IAO and Tinkertank, not only ideas are developed and conceptualized, but also implemented as prototypes. The format can be individually adapted and enables almost all questions relating to urban digitization to be tackled jointly.

3.2 Actors

One of the special features of the process is the heterogeneous mix of participants. The aim is to mix as many actors of the city society as possible and to win them over as participants. These range from city administration, politics, civil society, business to the creative sector. They all represent a differentiated set of skills and knowledge while sharing a local identity.

The selection and invitation will be made in coordination with the cooperating municipality. Targeted addressing by the city administration can lead to a limited representation of the group of civil society participants. Against this background, cooperation with the local adult education center is sought where possible. It includes the format in its program and offers the opportunity for interested people to apply.

3.3 Process

The Digital.Labor also lives from the active participation of all attendees and their exchange, not only during the implementation itself, but from the very beginning. The process from the first contact to the continuation of the project can be divided into four phases, each of which has a corresponding scope: On the one hand, the preparation of the Digital.Labor with the identification of the main topics, as well as the implementation and the processing of the Digital.Labor itself. On the other hand the continuation. For the Digital.Labor and the participants themselves is it essential, that not only ideas are developed and conceptualized within this process, but that they are also implemented as prototypes.

3.3.1 Preparation

The biggest challenge when preparing a laboratory is to understand the respective municipality and local conditions. In order to guarantee this as best as possible, a core team is defined in a first step, which accompanies the entire process. This includes representatives of the city administration and the Fraunhofer Institute. The city administration is responsible for the selection and addressing of the participants, the provision of suitable rooms and the catering during the event.

Fig. 1: Digital.Labor localities Illertal und Constance[1]

In joint coordination meetings on site, up to three questions are set which need to be dealt with in the laboratory. It is important to find the right framework between a specific challenge and creative freedom. The selection of questions is based on experience from previous laboratories and can be refined as the number of events progresses. Experience has shown that not every question is suitable for the process. If these are spatially too extensive or thematically too complex, targeted processing by the participants is unlikely. The same applies if the questions were chosen too specifically and there is no longer any space for creative approaches.

Each selected issue is accompanied by a responsible person from the city administration. This supports the participants in the process with comprehensive information and prevailing framework conditions.

3.3.2 Implementation

The 1.5 day or about 15-hour makeathons are divided into three phases: idea generation, experimentation and prototype development. Each participant is welcome to find a challenge that suits his/her interest. Continuous dialogue between the working groups and exchange with the assigned mentors ensure the integration of the results.

An exemplary process of a Makeathon can be divided into four phases, which can be flexibly adapted to the circumstances in the respective municipality, the participants and the premises.

(1) Thematic introduction and background information

(2) Idea development and conception

(3) Experimentation and prototype development

(4) Presentation

The focus of the overall process lies in the area of "Experimentation and prototype development", which takes up 70 to 80 percent of the time. Iterative testing of the designed approaches without intellectual restrictions is essential. Mentors support the participants in the implementation with technical and procedural know-how. Regular exchange between the individual thematic groups helps to refine solutions and to solve possible problems with a new approach.

The conclusion of a digital laboratory is the final presentation in front of top administrators, community council members and other interested parties. It is important to clarify that the developed products are prototypes and not finished products, so that there are clear expectations.

3.3.3 Processing and continuation

All of the results will be prepared appropriately after the event and made available to the participants as well as to those responsible for the municipality. Developed digital prototypes are handed over to the city and analog exhibits remain with the organizing municipality immediately afterwards.

All results are also presented to the city council. Not only are the prototypes presented, but parts of the laboratory are also exhibited and the process can be experienced. Every laboratory is committed to putting at least one prototype into practice. Appropriate funding programs at federal and state levels are identified and the municipality is supported in the application process. This forms the basis for the fact that the laboratory was not a one-time beacon, but a continuous process.

[1] Photos: © Ludmilla Parsyak, Fraunhofer IAO

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4 MOBILE LAB

4.1 The development and necessity

In order to create an experimental space and to initiate innovation processes in different cities, communities and districts, a mobile lab has been developed, which makes it possible to carry out the format on site. For this purpose, a scenario simulation was carried out in the first step of the development process. In the next step, the toolset was defined, whereby the requirements for the mobile laboratory were derived and thus the individual modules determined. Afterwards all modules were transferred into an overall concept.

4.2 Modules and field of activity

In total, the digital lab consists of four modules; a planning table, a sensor station with LoRaWAN transmission technology, a Virtual Reality station with multiple VR-Headsets and a coffee station. All modules were installed in flight cases with castors, whereby the individual walls of the flight cases as well as the flight cases themselves functionally serve as station or tables.

Fig.2: Digital.Labor modules setup[2]

4.2.1 Planning Table

The module "planning table" contains a notebook, a projector with digital pen, Lego Serious Play and various materials with which building, handicrafts and haptic work can be done. At the planning table the participants should be able to plan and replant different areas, sites and buildings together by drawing changes with the digital pen into projected maps or by tinkering and building with the different materials available to them.

4.2.2 Sensor system for recording real-time data

[2] Photo: © Ludmilla Parsyak, Fraunhofer IAO

On the basis of an open LoRa infrastructure and an intelligent sensor system, municipal and economic actors are enabled to codesign their future city. This infrastructure is provided by the Fraunhofer IAO within the mobile labs in order to develop new sensor applications with local actors and ultimately to be able to implement them in the field. The resulting prototypes can, for example, record environmental data (particulate matter, NOX, humidity, noise) but also more complex movement data of the city in order to generate new data-based value-added services.

4.2.3 Virtual Reality Station

The “VR Station” is another experience station within the Digital.Labor. Here the participants can experience their own city, streets, houses, regions, areas in 3D. They can walk through their streets, draw buildings, change paths or build bridges within virtual reality. It is also possible to create your own virtual reality environments using 360° photography. The corresponding camera technology and software are available for this, which are accompanied by the simplest possible process. The aim is to reduce fears of new digital tools and changes and increase their creativity.

4.2.4 Coffee Station

The module of the "Coffee Station" will serve as a meeting point for the participants within the Digital.Labor, inviting them to a further relaxed "group-spanning" exchange and thus offering the experimental space even more room for creativity and innovative ideas.

Fig. 3: Impressions Tools and Prototypes[3]

[3] Photos: © Ludmilla Parsyak, Fraunhofer IAO

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The Digital.Labor should not only create added value for the local players, but should also provide all interested parties with an insight into the participating community and access to the prototypes developed. For this purpose, the so-called "digital road show", a web-based story telling with map elements, is currently being developed. All the laboratories, the process, and the prototypes are shown there. Completion is scheduled for summer 2020.

5 PERFORMED LABS

In order to be able to spread and replicate innovative solutions, it is necessary to clarify their potential and added value and to make them tangible. In this way, possible barriers to entry can be reduced and a broad understanding of the added value and applicability of solutions can be gained. The digital roadshow of the mobile laboratory is thus intended to illustrate the opportunities and possibilities of municipal digitization using concrete exhibits and prototypes. For this reason, seven digital labs were carried out in different regions, cities and districts within one year. Explicit attention was paid to a healthy variety of different thematic focuses such as mobility, tourism, data infrastructure, the living space per se with air quality, traffic and noise as well as regional needs. The Digital.Labor travelled from the very rural areas to the more or less well connected rural areas and into cities. Design thinking workshops were held in the Black Forest, Illertal, Baden-Baden, Constance and Tuttlingen.

The Digital.Labor in the northern Black Forest for example was preceded by the Oberwolfach mobility project "Mitfahrbänkle", which impresses with its uncomplicated and simple application. Pure red-marked benches along certain streets of the community signalise a need for a ride along by a citizen. The content of the Digital.Labor workshop was to develop solutions that would make the offer more attractive and visible. Initial problems were the late visibility for car drivers, the sometimes too long waiting times and the lack of information about where to go. In order to make the offer generally more visible and to increase the attractiveness of the bench with its functionality, the group designed an induction sensor for the bench, which signals to approaching drivers that someone is sitting and waiting on the bench. In addition, a display with a timer was intended to increase the awareness of passing cars to the waiting ridesharer. In addition, extensions to the bench's range of functions, such as QR codes for information about the communities and their bus schedules, which would also be accessible without the network, were also considered. This further developed idea of the mobility project won a call for proposals after the Digital.Labor, so that it can be turned into reality.

In Baden-Baden the topic of volunteering and the digital flow of information was addressed. Associations and voluntary institutions should achieve more visibility. Therefore, the participants came up with the idea of a "digital flow", i.e. to install a media installation of screens in public space, on which Instagram or Twitter feeds, for example, 'flow' along. Associations and institutions can be added to the stream and thus send their own current Twitter or Instagram content on its journey through the digital flow. The aim is to raise awareness of the associations and their content among Baden-Baden's passers-by, regardless of age, and to create broad accessibility with an artistic installation.

In Constance, the Digital.Labor with the participants dealt, among other things, with the topic of concept development of a multimedia communication of urban development and urban planning processes. A concept was developed to visualize urban development projects and to follow their progress virtually. In the first virtual step, Constance should be considered in its entirety, the second level then leads into the district which is currently planned and/or already under construction and provides more detailed information and descriptions of the district design. It should offer the citizens of Constance and all interested parties the possibility to inform themselves about individual concepts and to observe their progress virtually and digitally visually. This concept will now be implemented in the city of Constance and made possible for citizens who are interested in this media communication.

In the municipal administration association of Illertal, consisting of the municipalities of Erolzheim, Berkheim, Kirchberg a.d. Iller, Kirchdorf a.d. Iller and Dettingen a.d. Iller, the Digital.Labor with its mobile modules focuses on mobility in the context of digitization and rural areas. Four ideas could be presented as a result, the autonomous local bus, the RegioMove App, the crawlways and the traffic evaluation, one of which, the idea of the local bus, is to become more permanent. The idea of the "autonomous local bus" developed from the desire to have a more "lively" public transport system. The idea of the "autonomous local bus" was born out of the desire to have a more "lively" public transport system, acting like a shuttle service,

travelling the same route every day, stopping at nodal points such as the kindergarten, the shopping center and various residential areas to allow people to get on and off. One should never have to wait longer than 30 minutes for the shuttle. The concept is currently being examined for feasibility, discussed and made realizable with experts from business, science and politics and should be submitted as an idea within an application if the call for proposals is suitable.

Part of the Digital.Labor is not to let ideas and built prototypes be forgotten after the workshop, but to examine their suitability for current and future calls for proposals and to consolidate them within a joint draft proposal. Furthermore, it should be possible to realize individual prototypes directly.

6 CONCLUSION

Digitization offers great opportunities and also serves as an instrument to "overcome economic and social challenges". (HABBEL;2017) It enables all those involved to have easier access to knowledge by making it easier to use information sources and the resulting possibility of simplified networking. The use and generation of data can open up far-reaching options for action at the federal, state and local levels and thus help to prevent and avert problems and change situations. The central element is the citizen, because he is the user and resident of a city. Their interaction with the various systems is significant for an overall urban view. If citizens are the central element of an overall urban view, then their opinions, ideas and fears should play a significant role in planning and development and urban concepts should be developed through citizen participation - including those who will live in the city in the long term (e.g. the younger generation). Just as companies and platform operators have been using personal data for many years to provide "commercial offers based on individual preferences", cities should try to provide citizen-specific offers using new technologies and analysis methods of individual needs. Therefor privacy and data protection must play a central role. Only in this way, as well as by raising citizens' awareness of certain risky issues and by transferring knowledge, can a city achieve its development goals and generate acceptance and support. Citizen participation in times of digitalization should, in addition to the classical participation formats, "take into account alternative forms of participatory urban development with socio-economic relevance". Participation independent of location and time of day - owed to digitization - has a positive effect on this process and should be used even more as an advantage. With this background, the Digital.Labor wants to help cities and municipalities to use digitization as an opportunity and to think about and integrate possible developments. However, since analogue and physical participation procedures should not be completely replaced by digital tools, since both personal and direct exchange will continue to be of high relevance, "multimodal solutions" will be all the more important in the future, as will the case-oriented use of suitable participation instruments. (BBSR;2017)

The Digital.Labor combines both variants. The handling and work with digital tools and the physical and analogue work on the tools, with a group experience as a further factor. In order to be able to continue to generate new knowledge and new insights, the Digital.Labor should not and must not be allowed to rest in its existence and must be continuously developed. This is one of the reasons why the mobile laboratory of the Digital.Labor will be given a stationary counterpart so that this format can also be carried out in the premises of the Fraunhofer Institute with other target groups. The so-called Next.Lab (stationary counterpart) was developed and is currently built with the help of the knowledge generated and the findings of the mobile labs roadshow.

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🏆 *reviewed paper*

E-Scooter as Environmentally Friendly Last Mile Option? Insights on Spatial and Infrastructural Implications for Urban Areas based on the Example of Vienna

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1 ABSTRACT

We recently face an e-scooter hype in Europe. More and more e-scooter sharing offers are provided in cities and towns which are marketed as a last mile option. At the same time, a greater extent of private households has their own equipment. This trend is two-fold as e-scooter offers not only provide benefits (e.g. in terms of accessibility) but also pose certain risks (e.g. in terms of road safety).

To find out about spatial and technical implications and to assess the potential of e-scooters for urban areas, we used a 'triangulation' research strategy using different sources. Based on the insights from a trend and target group analysis and focus groups with users and non-users we conducted 1-week tests with persons using e-scooters on everyday routes (N=51), a survey of users and non-users (N=128) and course exercises carried out with pupils (N=94) in the city of Vienna in Austria.

Against widespread assumptions that e-scooters can use existing infrastructure, we found that the preconditions are not necessarily suitable for e-scooters. Infrastructure elements would have to be adapted to enable a safe use of e-scooters. It was revealed that e-scooter usage should be recommended for the last mile in suburban areas and not the city center as the density and infrastructure (e.g. cubblestone) do not correspond to preconditions essential for a safe e-scooter usage. In addition to that, we found that labeling e-scooters as an environmentally friendly option is the subject of controversial debate.

Keywords: e-scooter, urban areas, infrastructure implications, spatial implications, Vienna

2 PROBLEM STATEMENT

At present, the e-scooter is an indispensable part of the cityscape of many European cities. There has been a e-scooter hype, which has led to an increasing number of suppliers of this trend vehicle. This includes on the one hand sales to private individuals and on the other hand free floating sharing offers in urban areas. No less than eight suppliers have to struggle for acceptance on the market in Vienna (Gruber/Wiederwald 2019); in Germany seven suppliers offer their services in different cities (t3n 2019). The deployment does not stop at smaller city scales or regions with challenging weather conditions (e.g. Nordic countries). In Norway, e-scooter sharing suppliers entered the market in early 2019 providing services in cities such as Trondheim, Oslo or Helsinki (Lime 2019) under the guise of the green transportation trend. Even though a year-round use of rental systems is not planned, the harsh climate itself is a challenge for the material and the safe use on the roads and cycling paths.

The popularity of e-scooters is due to its relatively easy handling, low physical activity required and flexible everyday use. The new means of transport is promoted as an ideal addition to the existing transport network. It is marketed as an environmentally friendly alternative to motorized individual transport or at least as a supplement for the first and last mile in urban areas (Zarif et al. 2019). Therefore, the said potential of e-scooters unfolds above all in the combination with other transport modes, as a first or/and last mile option for short distances and opportunity for the road users' extension of range.

We know from the past that new trend vehicles are regularly entering the market, which are promoted and advertised differently by retailers. Individual vehicles are strongly accepted by consumers, create a long-term establishment and become everyday means of transport (e.g. inline skates, micro-scooters), others have disappeared from the market after a few sales seasons. It is clear by now, that e-scooters not only offer opportunities for road users. There are manifold problems attached to the implementation of the vehicle in the overall transport system. Lack of parking space, problems with handling, lack of a legal basis and excessive speeds are only some of the factors that contribute to the displeasure of the city administration (Hunstable 2019). Furthermore, it remains unclear whether e-scooters will actually be used as a supplement

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in the transport system or whether they replace footpaths, cycle paths and public transport. The marketing as environmentally friendly must be critically questioned. Not least because of the production of the vehicles and power consumption which receive little or no attention.

3 METHODOLOGY

The complexity of the effects of e-scooters requires further research. To assess the potential of e-scooters for urban areas, we need to find out about spatial and technical implications. First insights could be gained from a trend and target group analysis and focus groups with users and non-users. Based on this knowledge, we used the 'triangulation' research strategy proposed by Robert K. Yin (2003, 2009) using different sources to capture different aspects of the topic. 1-week tests with subjects using e-scooters on everyday routes (N=51), a survey of users and non-users (N=128) and course exercises carried out in a school (N=94) were performed for the city of Vienna in Austria (see Fig. 1).

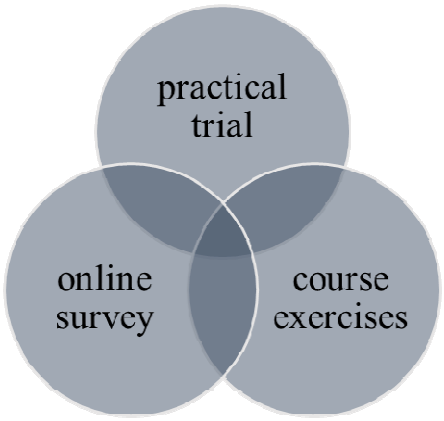

Fig. 1: Triangulation approach covering different aspects.

The approach described provides insights on the usage of e-scooters in terms of spatial ranges and preferred applications, suitability as a last mile option and technical implications (vehicle itself as well as the infrastructure).

3.1 Practical trial

The practical trial took place from September to June 2019 (including a winter break) with no spatial restriction but a focus on the Vienna region. 60 persons participated in the 1-week tests using e-scooters on everyday routes which resulted in complete data sets for 51 participants. The data collection was performed via a Smartphone App called 'SmartSurvey' which collects all the spatial information and offers additional features such as the localization of problem areas, route evaluations, type of infrastructure used as well as requests and proposals.

3.2 Online survey

To obtain a general picture of the population's opinion, an online survey was conducted from May to July 2019. A total of 147 people took part in the survey, which resulted in 128 fully completed questionnaires that were used for an evaluation. In the survey, a broad public was asked about their attitude towards small electric vehicles, their previous experiences and the resulting requirements. Users, non-users and occasional users were interviewed in order to survey the different aspects of road use and to allow different perspectives on this mode of transport. In order to obtain a general opinion, the survey has been advertised via social media, the event 'Radgipfel' in the city of Graz as well as the channels of the LOI partners.

3.3 Course exercises

The course exercise took place on two days in June 2019 in the secondary school "De La Salle" in the north-east of Vienna. Three parcours were designed and placed on an even surface outdoors on the school ground (see Fig. 2):

- straight driving (10 m length; 60/40/20 cm lane width)
- slalom (20 m length, distance between the little hats: 4/3/2 m)

- target braking (speed at least 20 km/h, stop after 4 m, the target area is 1 m long, the front wheel has to stop in this area)

Fig. 2: Examples of the three course exercises: „straight driving“, “slalom” and “target braking”.

The aim of the various tests was to assess the handling of e-scooters in relation to age, gender and previous experience for adolescents. Since it was a closed area, accidents with other road users could be excluded. Furthermore, all tests were explained to the children in detail and special attention was paid to their safety. Their participation was only possible with the consent of the legal guardian and with safety equipment like helmets.

4 RESULTS

The main focus of the study is to investigate the potential of e-scooters as a last mile option for urban areas. Insights on spatial and infrastructural implications were gained using the ‘triangulation’ research strategy described in chapter 3, namely the practical trial, the online survey and course exercises.

4.1 Practical trial

The evaluation included 533 paths and 398 trips which reveal that a combination with public transportation was performed in 53 trips and on 94 paths (see Table 1). A trip implies at least one, more likely several paths.

Category	Trips	Paths
e-scooter	180	200
e-scooter & public transport	53	94
e-scooter & motorized individual transport	2	4
e-scooter & motorized individual transport & public transport	4	6
undefined	159	229
sum with undefined	398	533
sum without undefined	239	304

Table 1: Distribution of trips and paths.

The analysis of the data shows that the participants who drove the 200 e-scooter paths had an average speed of 9.5 km/h during the trial and covered an average distance of almost 2.7 km. Compaired to the second categorie “e-scooter & public transport” were participants drove much shorter distances. If an e-scooter was used in combination with public transport, the average distance of the e-scooter paths were only 1.6 km long while the average of the driven speed is 3 km/h higher. (see Fig. 3).

63% of the respondents stated that their routes had changed as a result of using the e-scooter. 18 respondents (33%) stated that their travel time was shortened by using the e-scooter, while four respondents stated that their travel time was extended. The e-scooter most often replaces cycle and footpaths and in almost 19% of cases it also replaces the use of the private car.

The majority of the test persons (70%) had no experience with e-scooters before the test week. Only 11% said they use e-scooters regularly. About two thirds of all respondents (67%) had a very good or rather good

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overall impression of e-scooters after the test week. 9% of the respondents rated the experience as "rather bad" or "poor". 78% of the respondents stated that they consider e-scooters suitable for everyday use.

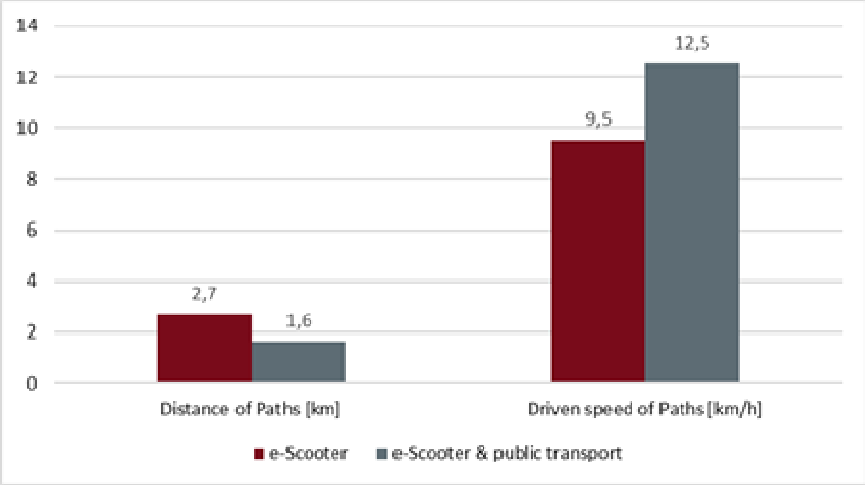

Fig. 3: Distance and speed per category.

With 65%, the majority of problems reported are infrastructure-related. Missing or insufficient infrastructure is classified as serious in only three of 41 cases (7%). In contrast, damage to or defects in existing infrastructure or problems with the vehicle are much more often (14% and 17%) rated as serious. The high speed, as well as damage to the surface of the carriageway or tracks etc. are often classified as a high safety risk. Requests mentioned by the respondents for infrastructure improvement measures mainly concern the surface of the road. On the one hand, this includes the repair of road damage, on the other hand, the avoidance of edges or tram tracks in the direction of travel along cycle routes. It should also be avoided to equip cycling infrastructure with uneven flooring (e.g. paving).

Time saving, flexible use and the possibility to combine with public transport are the three most frequently mentioned advantages of e-scooters. The lack of secure storage opportunities and the weight of the e-scooters were mentioned as the most common disadvantages.

During the practical trial 174 problem areas, including safety relevant issues with the e-scooter itself, were tracked by participants (see Fig. 4).

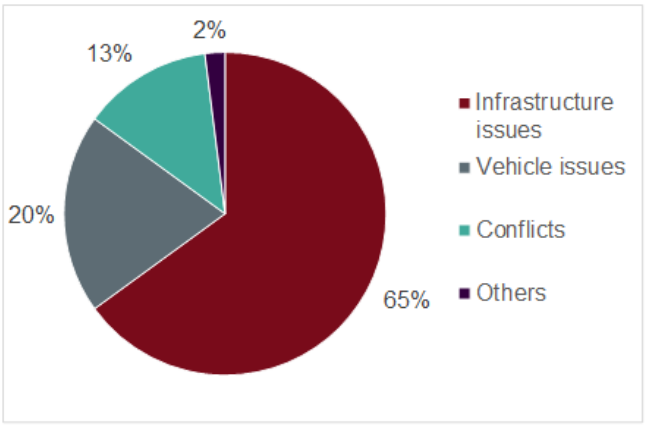

Fig. 4: Problem areas per category.

65% of the problem areas concern infrastructure, of which the majority are missing or insufficient cycling facilities. Reported problems with the e-scooter itself are the second largest category with 20%. Participants mentioned issues with the breaks of e-scooters, as well as the size and weight of the vehicles especially when travelling on public transport. A frequently mentioned problem is giving handsignals. Conflicts with other road users are in third place (13%). Almost two-thirds of them occurred between e-scooter drivers and pedestrians, but none took place on a sidewalk. Conflicts between scooters and motor vehicles have mainly occurred in the intersection area during turning operations, as well as at driveways. Throughout the practical test, no conflict was found between cyclists and e-scooters, although they use the same infrastructure.

The pressure on the infrastructure for cyclists has increased considerably due to the new group of e-scooter riders. On the one hand, this can result in decreased traffic safety, e.g. increase of conflicts. On the other hand, this is also a chance to gain more space as well as more ressources for this road user groups.

4.2 Online survey

With regards to household equipment, it was found that only a few people have access to small electric vehicles. Scooters are owned by only 34 respondents and e-scooters by nine persons. Other small electric vehicles are only available in households to a very limited extent. According to this, the e-scooters are borrowed from various rental providers, with Lime leading the way (20 entries).

After all, 45% have already tried out a small electric vehicle, of which 81% have already been on the road with an e-scooter. Use on everyday routes is still the exception. Only four people stated that they used an e-scooter every day. In contrast, other small electric vehicles are used significantly less frequently. Nevertheless, the predominant purpose of use for e-scooters was still everyday journeys before leisure time activities.

The majority of those questioned stated that the environmental alliance (public transport, cycling, walking) had been replaced by e-scooter driving. Only twelve respondents replaced a car ride with an e-scooter ride. E-scooters were mainly driven on cycle paths/cycle lanes and the road. Sidewalk/pedestrian pathways were also frequently mentioned and only very rarely other surfaces such as play streets. As expected, the survey participants preferred shorter distances with the e-scooter. At the same time, everyday routes hardly differ from leisure routes. 22% of the survey participants use it for a maximum of five minutes on everyday or leisure paths, another 49% and 42% for five to ten minutes respectively.

37% of all respondents perceive e-scooters as an attractive means of transport. The approval among users of small electric vehicles (n=57) is significantly higher here than among those who have not yet had any experience with small electric vehicles (n=71). Among e-scooter users (n=46), e-scooters are perceived as particularly attractive. Here it is 65% who regard e-scooters as an attractive means of transport.

E-scooters are perceived as a very individual, pleasant, fast means of transport. There is a need to catch up on the safety aspect and integration into everyday life. E-scooters are not seen as a cheap means of transport. The previous experiences among all respondents are mediocre to poor. Only 33% of the 128 respondents stated positive experiences. Here again there is a big difference between people with experience in handling small electric vehicles (n=57) and those without this experience (n=71). Only a quarter of the non-users report more or less good experiences. If only the e-scooter users are considered (n=46), 65% have had consistently positive experiences. The fun factor, time savings, flexibility and combinability with other means of transport have been highlighted as particularly positive. The barrier-free access (booking process, availability in the room, etc.) and the driving experience have been highlighted. Critical remarks have been made about mutual consideration and compliance with laws and regulations.

The reasons for switching to small electric vehicles in general were once again cited as alternatives to other means of transport (80 entries), rapid progress (75 entries), taking passengers on public transport (72 entries) and flexibility (70 entries). Coolness, on the other hand, is a secondary topic and received only 19 entries. There is no reason for as many as five people to switch to small electric vehicles.

The main reasons cited against the changeover were the risk of injury (91 entries) and the lack of safe traffic areas (71 entries), followed by other reasons with less than 60 entries. From the point of view of the users of e-scooters (n=46), these aspects also speak against use, followed by the lack of barriers (23 entries). Other reasons given by the users were high weight, lack of battery capacity, the availability of service points, weather dependency, legal aspects and environmental pollution.

22% of all respondents were already involved in a conflict or accident as road users and 4% as e-scooter drivers. 30 people described the conflict situation in detail, often involving pedestrians. 30% of all respondents also stated that they had already observed an accident or conflict. 35 persons described conflicts/accidents caused by reckless driving and/or the combination e-scooter/pedestrian. In contrast, conflicts on the road are rather sparsely represented.

Problems with e-scooters were already experienced by 17% of all respondents. Present topics were speed dosage while driving (14 entries), problems when turning and with uneven ground (10 entries each). Other problems mentioned were lack of equipment due to a change in the law, defective equipment, no

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homogeneous speeds on cycle paths, not enough power of the rental e-scooter (heavy backpack and gradient) and too slow speed.

More than half of the respondents stated that they were poorly informed about the legal framework of e-scooter use. Only 40% feel sufficiently informed. The legal situation is clearer for users of small electric vehicles (n=57) than for non-users (n=71), two thirds of whom have little knowledge of the legal framework. Among e-scooter users (n=46), more than half of them are largely aware of the legal situation.

When asked about the traffic areas that may be used by e-scooters, cycle path/bike lane received 111 entries, followed by 87 entries of the roadway and 13 entries of sidewalk/pedestrian path. Other areas listed were meeting zones, private ground and approved sidewalks. As a minimum age for unaccompanied use, 44 persons correctly stated 12 years or 10 years with passed bicycle test. If one takes only the 46 users of e-scooters into account, then almost half of them are aware of the minimum age (22 entries).

When asked about the alcohol limit for e-scooter drivers, 58 entries that the 0.5 per mille limit applies and 46 entries 0.8 per mille (actual alcohol limit). After all, there were 15 entries of 0.1 per mille and 14 entries stating that there is no alcohol limit. There are hardly any differences between users of small electric vehicles and non-users answering this question. Among the users of e-scooters (n=46) the level of information was slightly better. 18 entries related to 0.5 and 0.8 per mille and 7 entries to 0.1 per mille. Four e-scooter users assume that there is no alcohol limit.

59% of all respondents see the combination of e-scooters and public transport as an attractive mobility option. This contrasts with 9% who do not like it at all. However, most respondents do not regard the e-scooter as a replacement for a car. Only 44% would assign potential for the e-scooter to replace the car at the first/last mile in the long run. A restriction in the use of e-scooters would be supported by 60%. The regulation of parking areas is particularly present here with 57 nominations, followed by 40 nominations for reducing the existing speed limit. The same tendency can be read for the users of e-scooters. Proposals for other regulations addressed safety aspects, the design of the rental equipment, the regulation of loading responsibility and the areas to be used.

The concluding question about the wishes for the future has been answered extensively by no less than 70 persons. The wishes concerned integration into the transport system, environmental and safety aspects, legal regulations and technical details.

The gender ratio of the interviewees was almost balanced with 45% female persons. All age groups between 14 years and older were represented. 95% stated that they are not restricted in their mobility. The school education of the respondents was above average with 51% holding university degrees. Most of them are employed (69%) and the majority live in households with two persons (45%).

4.3 Course exercises

94 pupils (40% females) took part in the course exercises with a maximum of ten points awarded per course (three attempts per test in order to see their improvement) for comparing the participants and rounds objectively.

After a the welcoming and a general explanation per class giving insights on the project goals, the research questions, the handling of the e-scooter and the tests, the first student was able to start driving.

After performing all exercises, the pupils have been asked about their previous experience with scooters, e-scooters, bicycles and e-bikes, as well as their opinion on e-scooters. After that, they should announce suggestions for improvement to increase safety from their point of view.

The results are evaluated according to age groups and experience with scooters. The course tests show no significant differences in the points achieved between the sexes. Interestingly, the 13- and 16-year-old pupils performed better than their 14- and 15-year-old colleagues (see Fig. 5). A comparison of points between the three courses is not conducive because the criterias for reaching the maximum points were different.

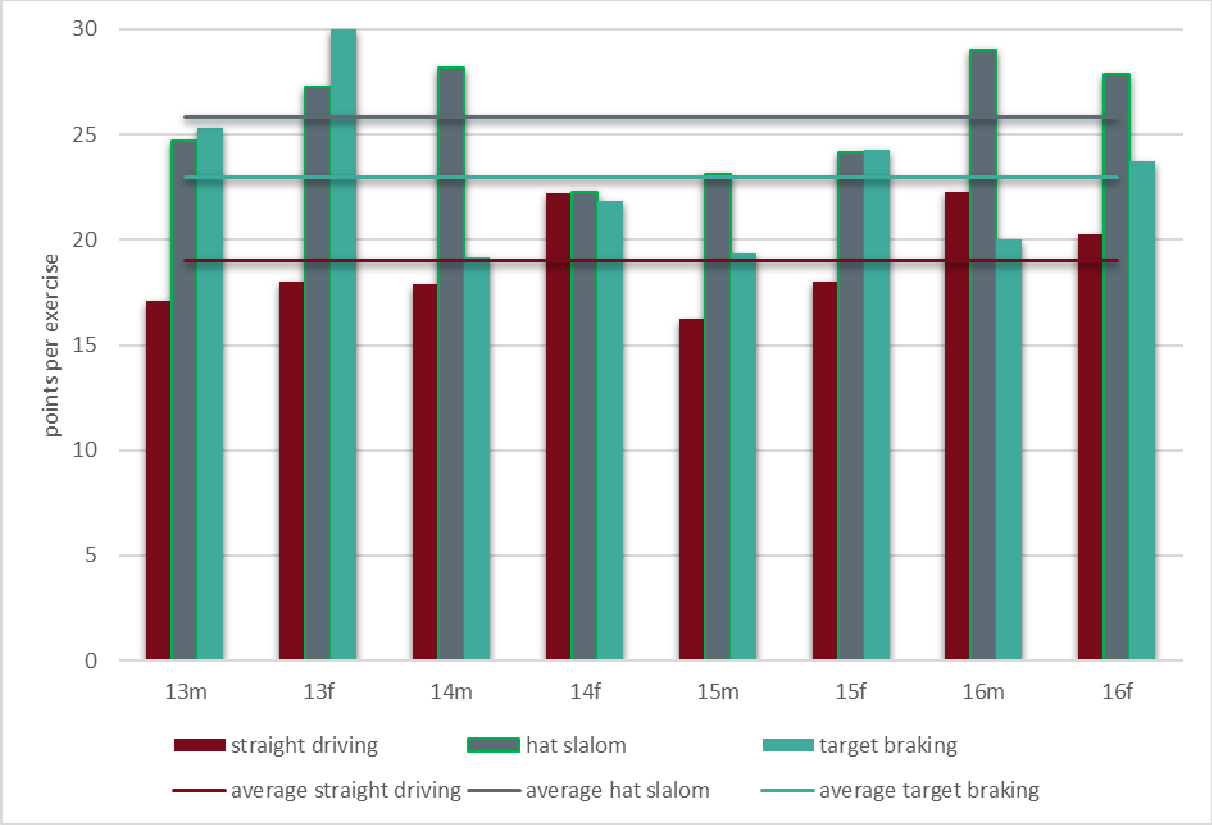

Fig. 5: Points per exercise per age and sex.

The students hardly had any previous experience with electric small vehicles (e-bike and e-scooter), but many of them had experience with normal bicycles and scooters. It was revealed that the experience with e-scooters and normal scooters does not clearly affect the points achieved in the various tests. The students seem to learn how to handle e-scooters very quickly (see Fig. 6).

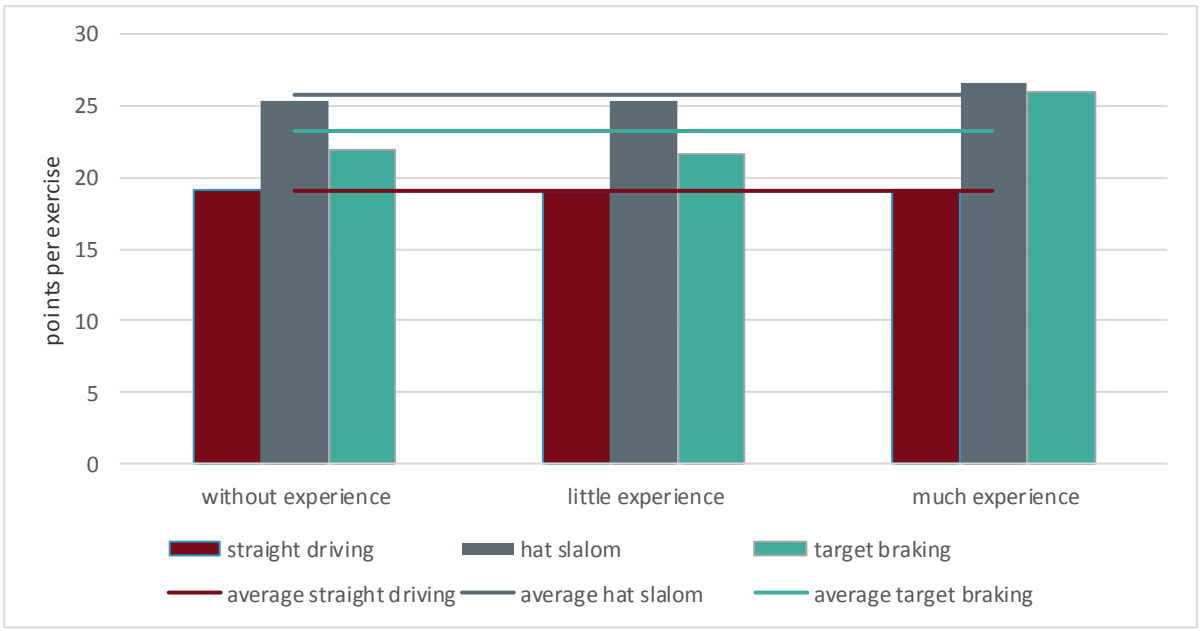

Fig. 6: Points per exercise according to experience with e-scooters.

Only about two-thirds of the total points were achieved in the "straight driving" course. This suggests that keeping a (narrow) track with e-scooters is a challenge. Otherwise the lower value could also be related to the fact that the course was the first to be traversed by the pupils. Slight improvements in the individual tests during the three rounds can be found in "straight driving" and "slalom". During "target braking" the improvement from the first to the third attempt is only visible on average.

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The results of the questionnaire show that young people have a positive attitude towards e-scooters, they say that "it is fun". They are aware that driving e-scooters "requires practice" and feel safe riding e-scooters on separate cycle paths, wearing a helmet and after receiving training on the handling of the devices.

5 CONCLUSION

E-scooters are trend vehicles flooding the European market for a few years now. They have proven to be not just a flash in the pan as sales of private vehicles are still high and sharing providers are conquering more and more new cities. So far, they have been treated like bicycles or conventional scooters which means that they share the same urban space. However, they differ considerably in terms of speed and weight. A closer look is necessary to find out which requirements are really needed in urban areas and how suitable they are as an environmentally friendly last mile option.

A more detailed analysis shows that the use of e-scooters in their current form poses several challenges at different levels. Handling the equipment presents difficulties, as do shared areas with other road users and uneven surfaces especially in combination with bad weather conditions. Furthermore, the inner city is a difficult area to use them. On the one hand, decorative surface structures are often used that are not compatible with the small wheel diameters, and on the other hand, these streets are often narrow and very busy areas.

In addition to the infrastructural and organisational (space distribution) challenges, there are major uncertainties regarding the legal aspects. Not everyone is aware of applicable legal regulations. This lack of knowledge can have an impact on traffic safety.

Another striking detail of e-scooter usage is the environmental aspect meaning the perception of the e-scooter as an environmentally friendly alternative for short distances, the promotion of the e-scooters as ‘green transportation trend’ and the users' assessment to that effect. Unexpectedly, many survey respondents pointed out that e-scooters are not environmentally friendly for stating several reasons (e.g. manufacturing, battery, comparison with active mobility).

Measures would have to be taken in different areas (infrastructural, legal, etc.) to promote the positive aspect of use for the last mile focussing on the group of motorized individual transport users. In addition, it becomes clear that it is a much more promising approach to use it as a feeder to public transport stations in poorly developed urban areas than, for example, in a pedestrian-friendly city center.

6 ACKNOWLEDGEMENTS

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Enterprise BIM: A Holistic Approach to the Future of Smart Buildings

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1 ABSTRACT

This paper presents Enterprise BIM (EBIM), which is the utilization of Building Information Modeling (BIM) in a holistic organizational aspect structure during the entire life cycle of a building. EBIM acts as a virtual comprehensive representation of the buildings and infrastructure that is aimed to optimize and improve business management, knowledge sharing, digital interaction and connection in the different phases of the building life cycle. This study shows how EBIM could support an organization's core business operationally and strategically. In fact, EBIM is aimed to support the building's entire life cycle and in this approach facility management (FM) is considered as a necessity. This paper demonstrates that FM is not a dedicated or a separate system and it uses exactly the same data as those required for business operations. Hence, we have surveyed the role of EBIM at St. Olavs Hospital as a case study for further consideration. St. Olavs Hospital uses EBIM to realize the goals of better and cheaper construction projects and real estate operations management with the aim of more efficient use of resources. The case study highlights the details and benefits of this approach both with respect to processes, tools and techniques. Furthermore, we demonstrate how EBIM may support interoperability, transparent communication and collaboration among the core business, facility management, the project organization and the different stakeholders throughout the building life cycle.

Keywords: Facility management, IFC, Model server, Enterprise BIM, BIM

2 INTRODUCTION

Digitization, if used wisely, provides a new and optimal way to view business structures and processes. The engineering and construction industry is one of the largest sectors of a country's economy, and real estate is a major economic challenge for any business. Therefore, the present study through describing EBIM as part of the business strategy for digitization, focuses on how to achieve optimum information sharing, collaboration, utilization and management of building-related data across disciplines and systems.

The building configuration and layout constitutes only a small part of the total body of useful information about a building. A really comprehensive and all-embracing building information model should cover and involve not only geometry and properties, but all the information about a building created during its life cycle and its relation to other systems and processes. The building information should be accessible to many different types of users — building owners, builders, operators, administrators, facility managers, portfolio managers and even emergency responders — via user interfaces that are available and approachable to each other (Smith and Tardif 2009). Principally, BIM aims to digitally represent the physical and functional features required to improve and document building designs. Today, BIM applications support walk-through visualizations, collision detection, energy performance estimation, heating-ventilating, air-conditioning systems, lighting design and the assessment of safety and generally issues related to security (Van der zwart 2014). A single building model creation is not only the proper and expected result of BIM; instead, the target is gathering and collecting comprehensive, accessible, reliable and readily exchangeable building information for everyone who requires it during the building lifetime. The value of distinct pieces of data — and with it, the commitment of different parties to compiling and preserving it — varies considerably during the building lifetime. Collecting and maintaining building information and history in a single storage for the whole lifetime of a building is useful and fruitful to individual users only insofar as it supports the many individual business processes during the lifespan. Building information modelling can potentially affect every aspect of business enterprises. Therefore, the implementation of BIM is recognized as an integral part of any business process, and not just as an isolated effort that only relates to a few specific tasks or projects (Smith and Tardif 2009).

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As will be discussed, while BIM is a method based on digitizing different parts of a building, EBIM focuses on all information management throughout the entire building lifecycle. This paper presents a study utilizing EBIM with St. Olavs Hospital as a case study. The EBIM concept obeys and follows the strategy of the openBIM standard during the building lifecycle and it is aimed to optimize and improve business management, knowledge sharing and digital interaction. Hence, the main objective of this study is to demonstrate how the EBIM can supports decision making during different phases of the building lifespan.

The Central Norway Regional Health Authority (HMN) is a state regional health enterprise that owns and operates hospitals. It consist of three hospitals, in total 700.000m2, where St. Olavs Hospital with approximately 350.000m2, is the biggest one. In 2012, St. Olavs Hospital, together with HMN initiated a project entitled Life Cycle BIM based on facility management. As a result, an EBIM philosophy was adapted where all buildings are an integral part in the entire portfolio of buildings, as well as the aspect structure defined in the hospital business structure. Using such a solution enables the integration of core business and the various processes of the hospital. Today EBIM is an extensive information database at St. Olavs Hospital and Central Norway Regional Health Authority that supports important aspects of the user, such as Facility Management (FM), Virtual Design Construction (VDC) and Property Management (Van der Zwart, Elkhuizen, and Evjen 2016). In this process, St. Olavs Hospital has pioneered using database technology to describe virtual building models according to the openBIM standard. The database is made up of many buildings which both old and new buildings have been incorporated in it. It implies that, the database should be kept updated during the decades of building lifetime and independent of proprietary data systems. The present study describes the transition from BIM to EBIM and indicates how EBIM is used as a digital platform to support building projects, facility management and core business of the enterprises.

3 FROM BIM TO EBIM

3.1 BIM and the Building Lifecycle

BIM acts as a transition of methods and technology from a single traditional consecutive form to a modern multiple parallel form of data integration. BIM is the procedure of data sharing and distribution with the capability to use the data via abundant applications for managing several multidimensional tasks and activities in architecture, engineering, construction, maintenance and different types of operation all along the building lifespan. In fact, utilizing BIM technology is essential for all sized enterprises which are active in the building construction industry and also it is inevitable and imperative for the companies who are seeking to enhance their levels of competitiveness and even their existence in the future cycle of the industry. To mitigate lacking productivity and efficiency in the building industry, BIM plays an efficient role to provide and offer the required information and precise data to be employed for model simulation in different phases in the building industry (Kouch, Illikainena, and Peräläa 2018). In fact, BIM stands at the core of digital transformation throughout the built environment and it provides a vital opportunity and pivotal role to develop and improve performance considerably in innovative ways of delivery and operation. It creates a collaborative method of working that facilitates early supply chain involvement, underpinned by the digital technologies which opens up more effective ways of designing, creating and maintaining assets and resources. It also provides a digital representation of the physical and functional characteristics of an asset to support reliable decisions and information management during its lifetime. For this purpose, at its core, BIM employs three-dimensional model and collective data to access and share information efficiently throughout the supply chain and increase the productivity and efficiency of activities and reduces the risk of errors and maximizes the team capability and potency to innovate (Leader: Cardiff University 2018).

Indeed, BIM makes virtual prototyping as a three-dimensional models and semantic representation of the building for better understanding and comprehension of the project and its components, by all the users and it can be used for the whole lifecycle of the building from the primary design and sketch to the construction, operation and maintenance phases (Lebègue et al. 2013).

3.2 BIM as a Facility Management Tool

Facility management (FM) is an organizational function that supports maintenance of buildings and their services during operation. As such, FM is a multifaceted, complex task that is often challenged by the lack of updated building information. The implementation of BIM can improve facility management tasks by providing related and appropriate data during the buildings operational period. BIM offers a platform for

data exchange between stakeholders in the architectural, engineering and construction fields (Mohanta and Das 2016). However, as a result of rebuilding and partial replacements of building elements on a day-to day basis, FM is continuously faced with the challenge of updating the building information and its quality. Hence, it implies that the FM function may not provide reliable data to building owners for lifecycle management and continuous planning. Therefore, as a emerging technology, BIM is prepared for offering a new level of serviceability and operability to manage buildings and the physical assets in them. (Association 2013). This advantage is a direct result of being able to perform multiple analyses and generate the various documents required by the BIM and information will be more available through increasing the interoperability and collaboration process.

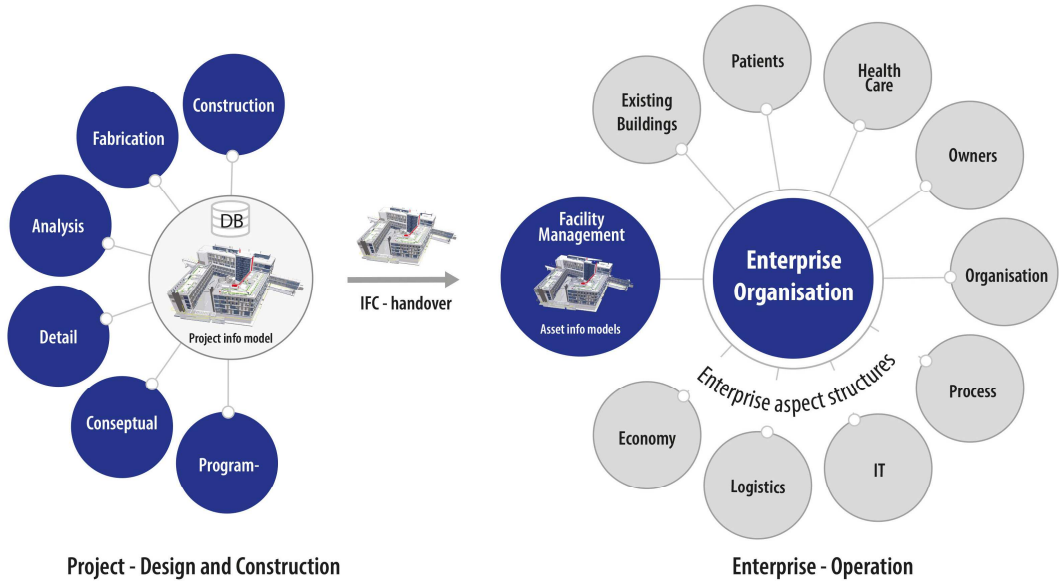

Fig. 1: Description of a classical "BIM-project". The project information model (PIM) developed during the design and construction phase of a project. The asset information model (AIM), IFC files, according to the specifications, are delivered to the Facility Management System.

BIM offers facility managers and building owners/operators a powerful means to retrieve information from a visually accurate, virtual model of a physical facility. BIM also strengthens interactive information improvement and development and has the ability and capability of supporting the full building lifespan from planning through operation and maintenance. However, BIM will not necessarily replace the wide range of information technologies in use by facilities and organizations but it can support, leverage, and enhance these technologies (Association 2013).

The common process for transferring BIM information developed in a building project to FM is illustrated in Fig. 1. The BIM model of a building project is created during the construction phase by applying a Computer Aided Design program (CAD) with product data from various product catalogues. The building owner has to specify the BIM requirements to ensure that the BIM model meets the specifications of the FM system and its applications. During the assignment, the building project exports the BIM model as IFC files as part of the BIM delivery specification to the FM organization. From this point forward, the FM organization is responsible for importing and implementing the IFC files and product documentation into its FM system. This corresponds to the outline of a traditional project delivery and the way of operation was applied before establishment of BIM. This way of organizing collaboration and handover has many difficulties that naturally prohibits the building owner, FM and the core business from participating in the development of the building project as a customer. The project is developed as a virtual building that is disconnected from the enterprise virtual environment and aspect structures such as economy, logistics, FM and IT organizational processes. Therefore, after handover, the customer is faced with conditions that causes significant problems related to insufficient and incorrect data for the operational phase. In addition, the as-built BIM lacks information related to the system tools and aspect structures applied during the building project. These are different from those in use by the enterprise. In addition, there are very few (if any) FM systems on the market that import BIM files for using in FM. As a matter of fact, most of current FM

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systems only replace traditional 2D/3D DWG files with 3D IFC files. This situation requires other solutions, which Enterprise BIM is an option.

3.3 Enterprise BIM (EBIM)

EBIM is based on the understanding that the world is three-dimensional, holistic, process-oriented and object-oriented. This means that both the real and the digital built environments with all objects and interrelated objects and processes are connected in a complex interlinked network, realized as an Authoritative Data Source (ADS) in a model server. ADS is defined as the repository or system that contains the cohesive set of data and features that are considered as the primary source for this information and it provides reliable, proper, and secure information to support a business process. BIM's major transition to EBIM involves processes and activities as integrated parts of the building's digital life cycle information along with the BIM model. The task of creating a holistic three-dimensional digital representation reflecting the real built environment is daunting and it can not be entirely realistic. EBIM simplifies and clarifies the inherent complexity by creating an enterprise specific aspect structure that is related to other enterprise aspect structures and all end-users, as shown in Fig 2a. As illustrated, this implies that EBIM contains three-dimensional geometrical data and other building information, which in turn are interrelated to other aspects structures, such as economy and facility management.

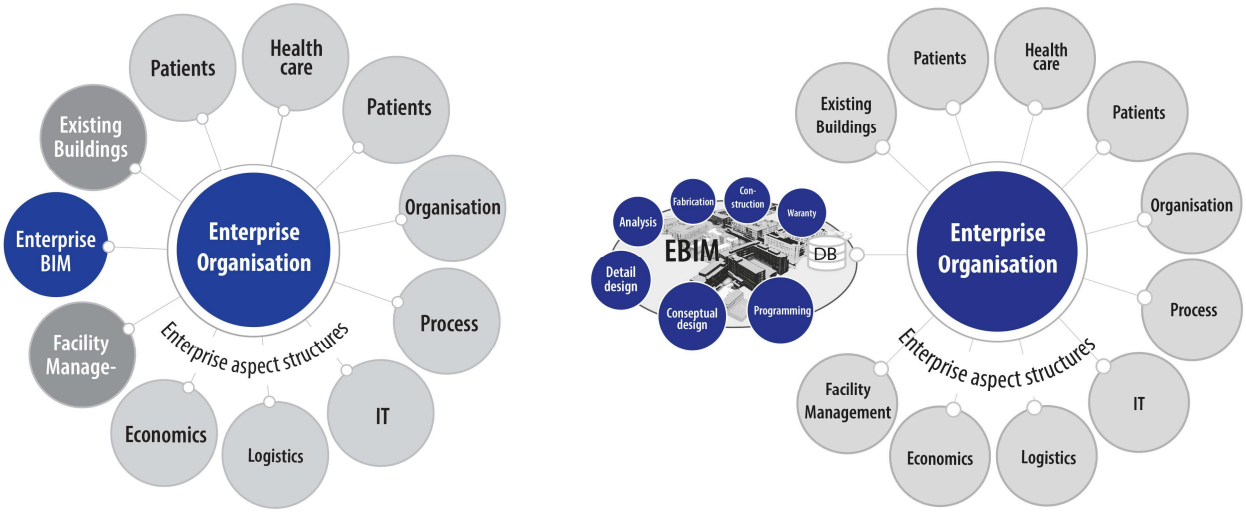

Fig. 2: Enterprise BIM as an authoritative data source aspect structure. a: EBIM is represented as a unique aspect structure in the organization. b:The illustration shows how a building project uses the same data infrastructure as the enterprise itself.

By treating EBIM as a business aspect structure for building information, and as a platform for open project integration with the organization, it is expected to lead to cost efficiency, customer satisfaction and prevention of data loss. EBIM is essential when rebuilding or when major renovation of the physical building requires round-trip of the digital building data. In most cases the builder, owner, managers or employees have little or no access to the BIM building project, despite the fact that the access potential of customers, users and operational organization to the virtual building in all phases of the project will have a major impact on quality, knowledge transfer and user interaction (Helse Midt-Norge 2017).

By considering EBIM as a digital interaction paradigm for all types of documents and properties through all building phases, where all users and stakeholders can initially share and obtain insight through different digital interfaces, the focus is shifted from the project-centric BIM to view EBIM from an enterprise perspective. One of the most important concepts of EBIM is emphasizing the integration, information sharing and openness across business structures that prevents vendor lock-in. Vendor lock-in occurs when a company becomes constrained and restricted due to its relies on a services provided by a vendor or builder. Fig. 2b shows an overall view of the concept and illustrates the relationship between the real building, EBIM and the building processes. In this concept, it means that all information is shared and EBIM reflects the real building complex as far as possible, regardless of phase (Helse Midt-Norge 2017). Collaborative design must support the sharing of data as knowledge rather than just the transfer of data as information in documents associated to business processes. Therefore, EBIM facilitates a new way of digital interaction and is an important step towards creating a future with smart buildings where the enterprise uses realtime

simulation during the construction projects and in daily operation. As a case study, St. Olavs Hospital has established an organization and a technology platform that supports this approach.

4 ENTERPRISE BIM AT ST. OLAVS HOSPITAL

St Olavs Hospital is an integrated university hospital, which means that Faculty of Medicine and Health is located all over the hospital. The hospital provides leading clinical care for Mid-Norway and is organized in a center model, which divides the hospital layout into seven distinct units around an open square (Van der zwart, Elkhuizen, and Evjen 2016). As already stated, St. Olavs Hospital encompasses of many buildings, both old and new, which should be maintained during their several decades of life cycle. Accordingly, a homogeneous standardized open digital platform for developing, improving and maintaining their facilities and amenities efficiently (Øgård Aksnes 2016).

The project life-cycle BIM, established in 2012, aimed for creating a real life-cycle BIM based on a facility management platform of existing buildings (Kristian Jørstad 2017). The EBIM philosophy established during the project, builds on a model server, where each old, new, and future building are integral units in the overall portfolio of buildings (Van der Zwart and Evjen, n.d.). The platform incorporates all old and new buildings, with existing documentation, lease management and work orders from the previous FM system, in a openBIM database platform (Kristian Jørstad 2017). This requires that the health care institution must have full ownership and control of all building-related information throughout the building life cycle, from early phase to demolition. The most important aspect of employing EBIM is the concept that EBIM virtually represents the real buildings, at a sufficiently detailed level and quality, and the relationships with the various stakeholders (Monsen 2017). It also defines which stakeholders can benefit from the information contained in the model. St. Olavs Hospital applied the following definition for EBIM: „EBIM is a virtual holistic representation of buildings adapted for optimized business management, knowledge sharing and collaboration“.

Fig. 3 outlines how stakeholders are related to each other and the physical buildings which are linked again to the virtual environment through the sensors. An important factor in the ownership of the virtual built environment is that the owner of the building must have the knowledge and tools to assist and control properly the entire digital process (EBIM IT).

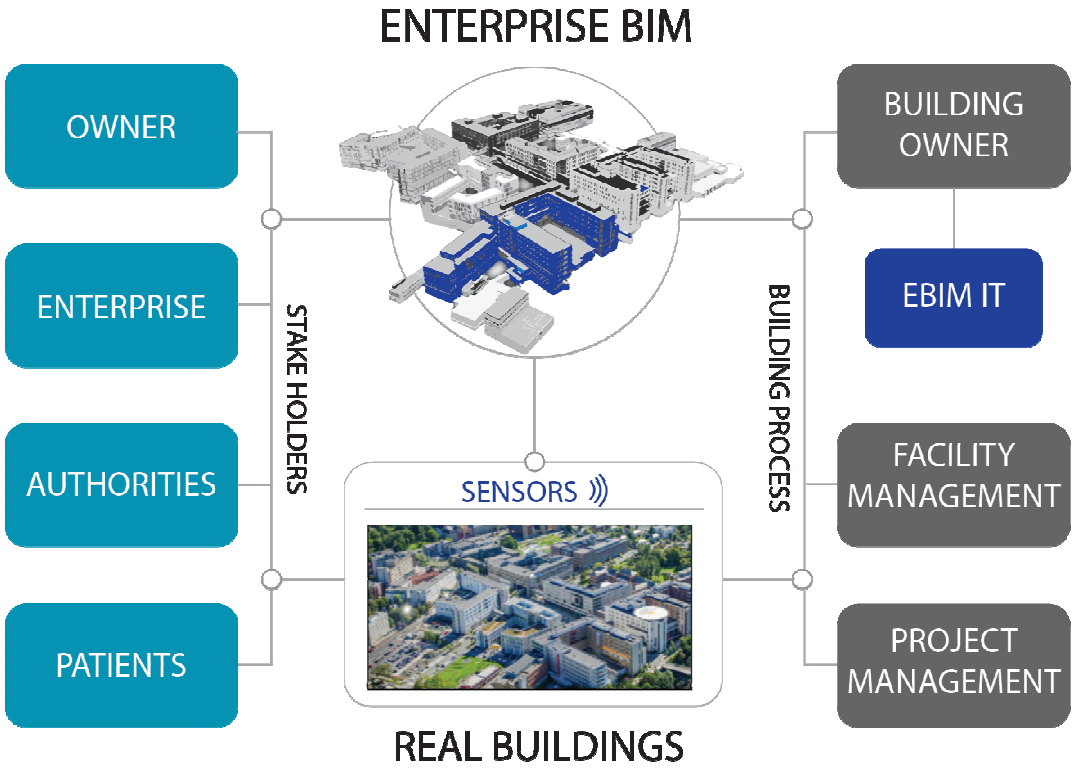

Fig 3: EBIM stakeholders. The relationship between the real building, EBIM and the actors are indicated.

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EBIM is a virtual environment with a common data sharing repository where all stakeholders share and collaborate on the same data in real time.

St. Olav Hospital currently uses EBIM to realize the goals of better and cheaper construction projects and real estate operations management with the aim of more efficient use of resources. Buildings where EBIM is used throughout the process have a better quality of operation and maintenance and they offer a higher level of service for employees and visitors than buildings that have been designed and built traditionally. In this respect, other advantages are proper functionality, easy benchmarking against other projects, faster execution, fewer construction errors, cost reduction, reduced energy consumption and carbon footprint, harmonizing and streamlining of operations (Helse Midt-Norge 2017).

Technically, the model server with all building-related data and embedded systems, shown in Fig. 4, is referred to as the EBIM aspect structure. When the BIM server imports new IFC files and documents from a construction project, the IFC files are validated by the BIM server according to given rules, in such a way that the building owner receives the virtual building model at specified level of detail and quality. In addition, the documentation is also checked against the existing infrastructure of the model server to be compatible with the EBIM aspect structure and internal classification.

EBIM replaces traditional facility management systems through featuring functionality supporting operation, management and maintenance. The end user interface is a web-based real estate portal tailored for the end user disciplines. Moreover, the connection between the three-dimensional models and the sensors and transmitters in the buildings enables and facilitates tracking and retrieval of mobile equipment and people, among other things (Lien and Evjen 2017).

Communication with other aspect structures and systems are primarily done through application protocol interfaces (API). A simple example of such integration, are printers that are used to label patients medications. In this case, the information is held digitally by the IT database, but the printers locations are displayed on the real estate portal. This is a small example of minor improvements in the functional efficiency of daily hospital work.

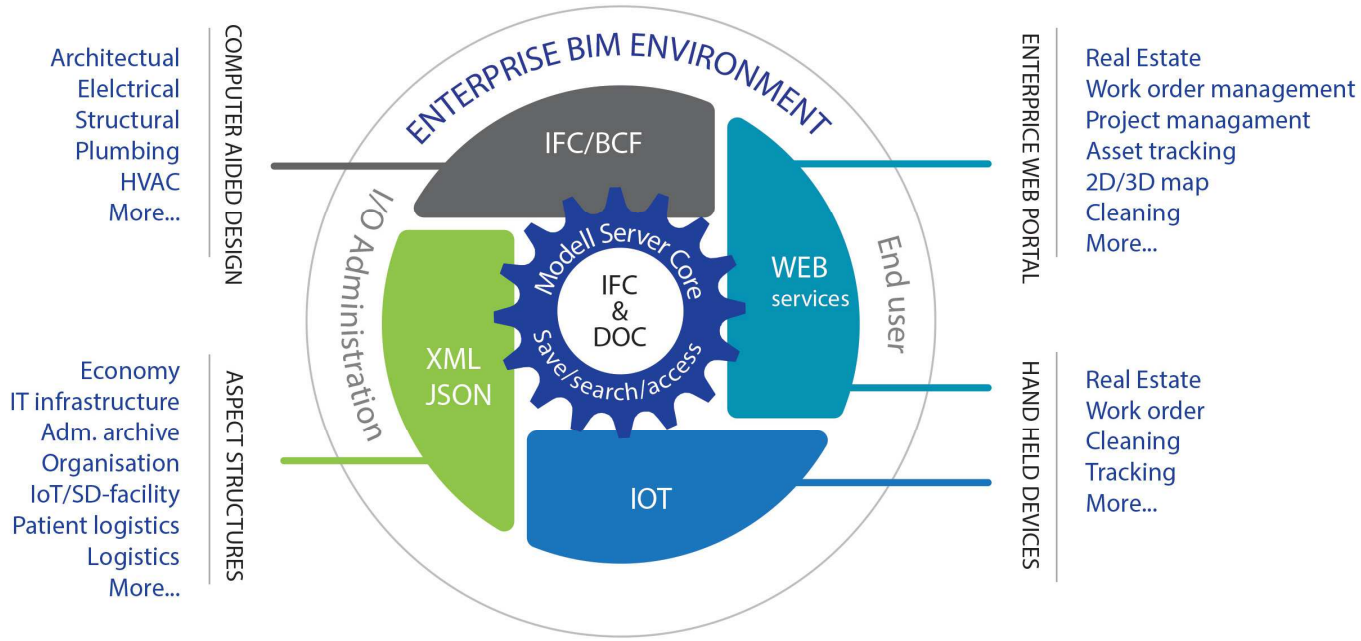

Fig 4: Schematic image of a model server that supports EBIM aspect structure, Web-based real estate portal, wireless and handheld devices.

A model server in itself is a complex digital environment, but the model server client gives the professional staff almost free access to configure and develop new functionality and applications, as shown in Fig. 5. In a hospital with many computer systems, abundance of data and the continuous need for improving and supporting daily routines, a flexible database solution is essential. One of the most complex and challenging tasks is maintaining an existing digital building while different parts of the building are being rebuilt.

Fig 5: The model server consists of a collection of integrated BIM models with property sets, documents, methods for evaluating and checking the models and other turn key functions.

The following two figures show examples of functionality presented to the hospital through the real estate portal. Fig 6 presents a report page where all employees at the hospital can report and follow the status of various working orders from requested repair of a broken door to application for additional space for specific functions. The user only navigates through the map and selects rooms or objects in a 2D/3D map to identify the rooms or objects for the selected task. By entering the data of interest, a work order will be established and submitted to support the designated facility management staff who will execute the work order with all related data. The work order itself is connected directly to the specific rooms or objects in the model server.

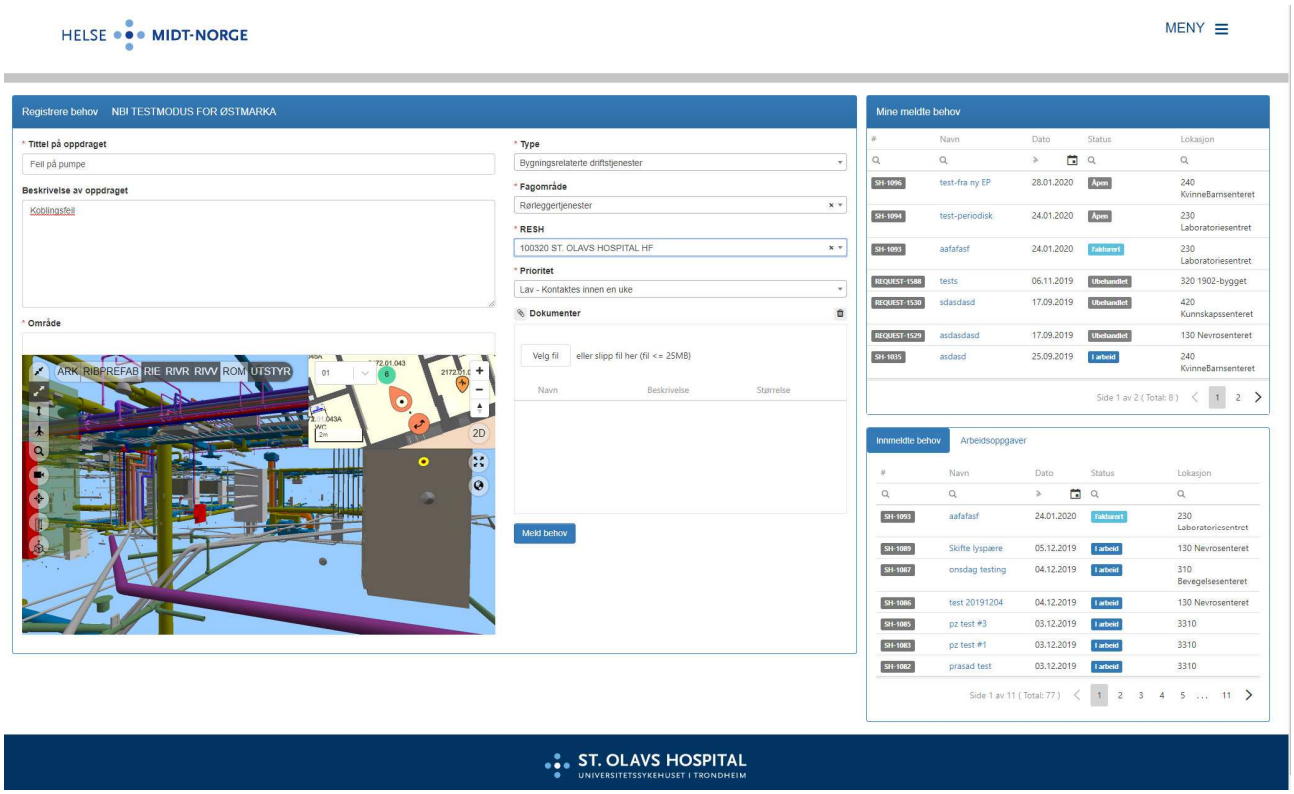

Fig. 6: A snapshot from the real estate portal showing the interface presented for the staff at the hospital for reporting and following up a work order.

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Fig 7 displays a 2D view map which demonstrates how the real estate portal presents, in color, different types of room functions in the buildings based on the hospital classification system. The same web page can be used to display rental agreements related to a room.

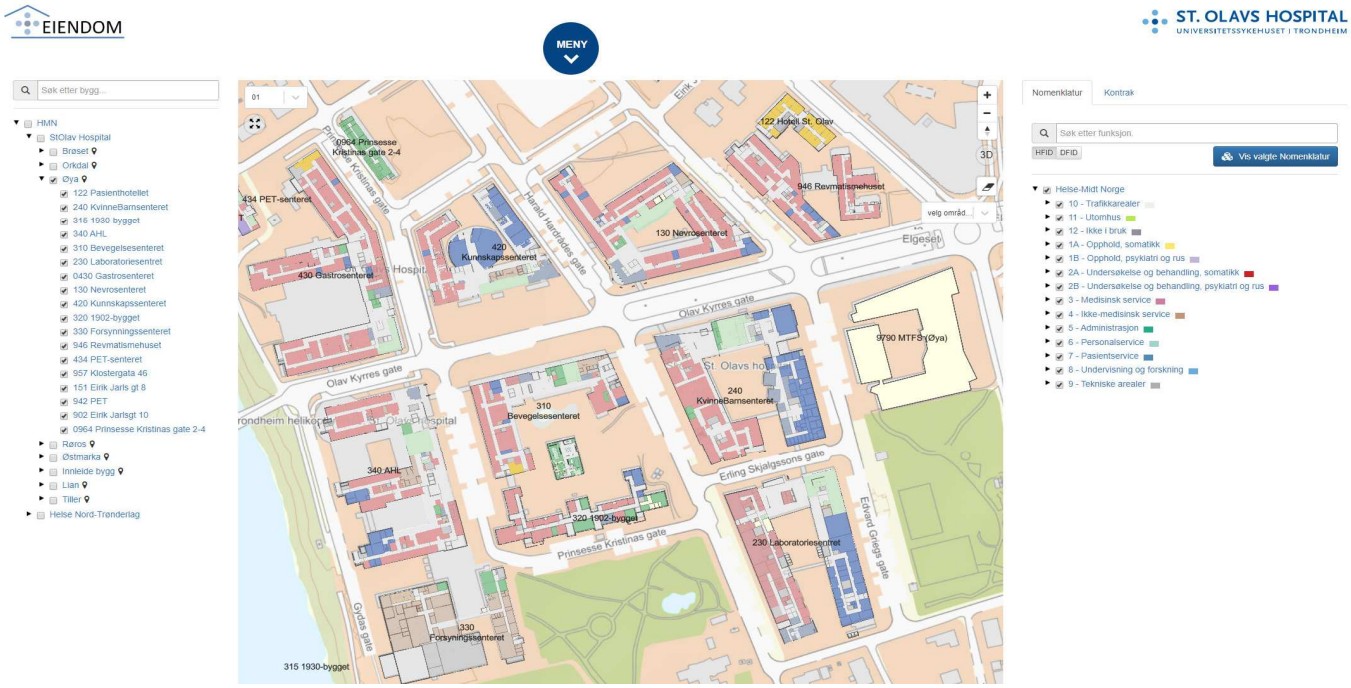

Fig. 7: Visualization of all partial functions in a set of buildings. The different functions are color-coded. Their distribution across the wing and floor is clearly visible throughout the facilities.

5 DISCUSSION AND PERSPECTIVES

As previously noted, EBIM is an extensive information database at St. Olavs Hospital that supports important aspects for the user, including FM, Virtual Design Construction (VDC), tracking and property management. EBIM facilitates essential and major tasks of the core business and is an important source for strategic management analysis in the near future (Øgård Aksnes 2016). In addition, central operations monitoring and sensor technology support EBIM to be more knowledge based. These tools have a significant role in decision making, object tracking, optimizing inventory space and operational costs (Van der Zwart and Evjen, n.d.). In this regard, a common basic information functionality for handheld devices, VR and Web, has been established in St. Olavs Hospital but they are still in the beginning of robotization and automation based on EBIM.

However, the hospital's EBIM platform does not support a user-friendly process modeling tool that supports project planning and other types of workflow.Even though, work order workflow is fully implemented and gantt charts are realized as part of the periodic maintenance, the EBIM platform lacks important and powerful functionality to claim to be a knowledge-based system that supports project planning in full detail with reflective views, roles and tasks (Lillehagen and Krogstie 2008).The implementation of EBIM at St. Olavs Hospital is still in its infancy. The advantage of using a model server based on openBIM standard to obtain all the building data and the capability to develop new functionality is a major competitive advantage, especially for an enterprise of a certain size. New applications and connection to other aspect structure systems are under development. The complexity and the pure size of the data collected makes it necessary to start using technologies like Augmented Reality (AR) to discriminate data in order to provide accurate data delivery to the end user and to apply Artificial Intelligence (AI) to process data.

In fact, the approach and strategy of EBIM is built on its use in organizational processes in the course of the whole building's lifecycle where all buildings will be described and communicated in openBIM standards in relation to other business aspect structures (Lien and Evjen 2017). openBIM is built on workflows and open standards which are used to gain collaborative design, performance and operation of buildings(Øgård Aksnes 2016). Thus, openBIM supports a transparent and open workflow and permits stakeholders and users to take part in and join the project regardless of their software tools. It permits government and industry to obtain

projects with transparent business interaction, ensured data quality and Service evaluation by establishing a common language for extensively referenced processes. (Graphisoft - A part of the Nemetschek Group, n.d.).

The beneficiaries include the owners, managers, users of buildings and all actors that are involved in the project (Kristian Jørstad 2017). Therefore, it expects to achieve EBIM for a better decision based on strategic management, user participation and implementation at all levels. It strives also to get transparent communication and knowledge sharing across the organizational structure (Monsen 2017). Hence, EBIM provides unique opportunities for users as a business to use the available information to manage, operate and develop the buildings throughout their lifetime. The projects must support the business by providing correct information during the planning and construction. Therefore, the projects will be organized so that all relevant information flows to and from the model server. In practice, it is said that the project organization with advisors and contractors will save and develop data (including documents) in the model server.

Introducing new technology that challenges data ownership, existing systems, collaboration, efficiency change, new way of working and motivating to achieve a greater goal, is what that needs to be greatly motivated by the enterprises and organization related to these processes. In this regard, St. Olavs Hospital has a strong focus on how EBIM can support its core business operationally and strategically. At the national level, EBIM supports government and other enterprises in real-time monitoring of demand through web services and it avoids unnecessary reporting and data replication.

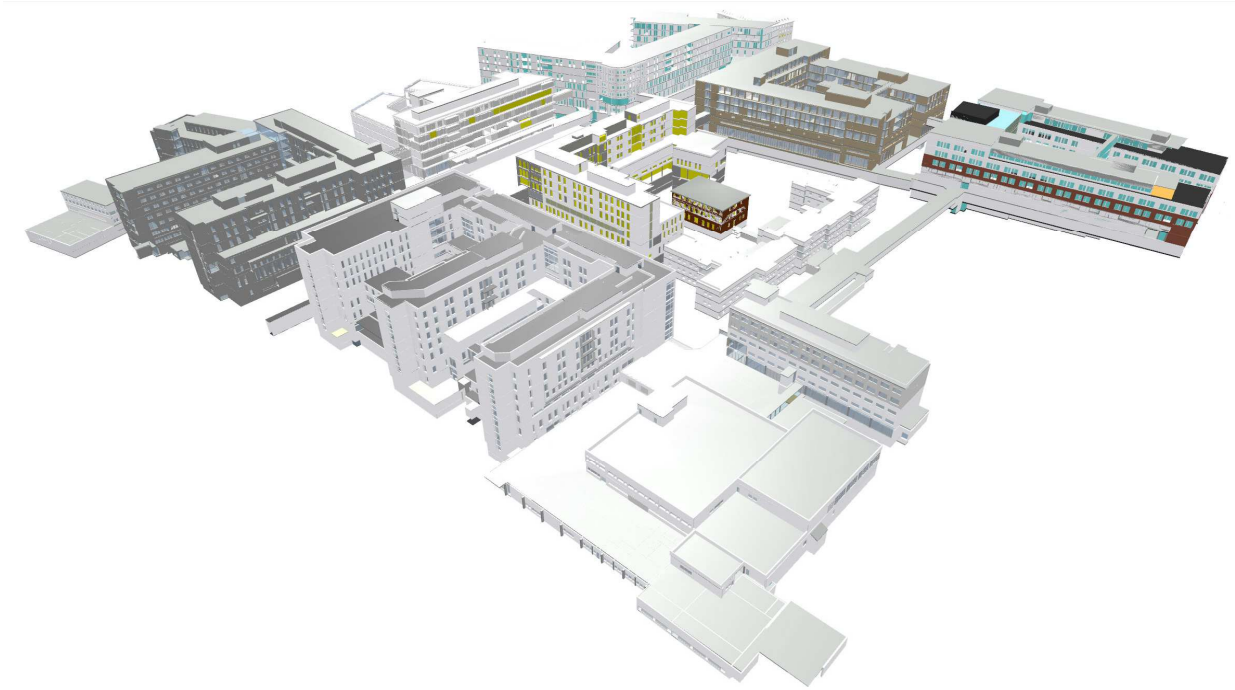

Fig 8: St Olav's hospital site with 220.000 m² – Image taken from EBIM system.

6 CONCLUSION

EBIM obeys and follows the strategy in which all buildings and infrastructure in an enterprise are described and communicated in a uniform openBIM standard during the building lifecycle. EBIM seeks to establish clear and transparent communication and knowledge sharing throughout all organizational structures. Using the EBIM method, the traditional boundaries between project and owner are eliminated by the way in which, the owner implements the project into the digital platform of the enterprise and not as a single standalone building project. This ensures rational and logical digital management of buildings which can reflect engineering structures, performance of buildings and infrastructure from registered demand to demolition. Accordingly, by using EBIM approach, St. Olavs Hospital establishes a virtual building information structure that is capable to support day-to-day maintenance, tracking objects and providing different views to the end user. The work done at St. Olavs Hospital is based on anticipated benefits and so far there is clear evidence of improved data quality and new approaches are emerging. The next step in the advancement of EBIM is to establish additional abilities and capabilities that support the projects in their development towards complete construction in relation to the enterprise aspect structures in real time. EBIM has the

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potential to become the next step in the process of building business-centric smart buildings that reflects and support the real-world processes, games, social interaction and knowledge sharing across all enterprise disciplines.

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Environmental Analysis of the Residential Sector in Cairo

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1 ABSTRACT

Rapid demographic increase and transition in governmental policies influenced the patterns of Egyptian residential sector, services and urban fabric. The housing stock in Egypt is dominated by private owners, informally and high consumption rates. Studies attempted to classify historic periods that created the current urban pattern and led to an uncontrollable expansion of a metropolis. Political and demographic changes had a major role in the city's urban, architectural and legislative transformation, especially after the change of government policies in 1953. The article aims to evaluate the development milestones of the housing stock in Cairo before and after 1953, from an environmental sustainability perspective on a building and urban scale. Based on official statistics, maps from various periods and literature, the urban development of the city is assessed. The impact of governmental policies and strategic plans is analyzed, taking into consideration demographic growth, urban sprawl and environmental aspects. The residential stock is classified in two time phases (before and after 1953) and three dominant typological -urban and architectural- criteria. Based on this classificatory model, representative characteristics of different periods are assessed in terms of morphology, construction materials and environmental design. The results provide a critical analysis of Cairo's environmental and sustainability policies in the second half of the previous century. It provides an evaluation base for comparison with the city's current built environment and offers guidance for future scenarios.

Keywords: Building typology, Informality, Urban built environment, Residential consumption, Housing stock

2 INTRODUCTION

Greater Cairo Region (GCR) is composed of three governorates: Cairo on the east of the River Nile, Giza on the west and Qalyubia in the north. Each governorate has its own administration, governor, and boundaries. According to the national Central Agency for Public Mobilization and Statistics, GCR's surface are is 290km2, its population in 2016 was 22.9 million inhabitants divided as follows: 9.7 million in Cairo, 8.9 million in Giza and 4.3 million in Qalyubia. However, GCR is physically inseparable and it is hard to define a precise barrier that separates the governorates' environmental, physical and social boundaries.

Historically, urban growth started in the core city, Cairo; it is one of the most ancient parts of Egypt. The city's history is long and the region's background goes back to the times of ancient Egypt (31st century BCE) when its capital - Memphis - was not far away from the current location of Cairo, and GCR still hosts the great pyramids of Giza.

Like in many old civilisations, ancient Egyptian buildings were used as a source for construction materials and their stones were adopted to build the houses of Islamic Cairo (Singerman 2011).The first attempt to declare a city with a defined administration and boundaries, after Memphis, goes back to the 10th century. Cairo was founded as a capital for the Mediterranean empire of the Fatimids in 969AD with the arrival of Jawhar Al-Siqilli. Then, the Caliph Al Moizz a few years later made it his basis of rule. Thus, the first city was created according to the urban patterns and features of Islamic architecture (Abu-Lughod 1971).

3 CAIRO BEFORE 1953 | BACKGROUND

3.1 Islamic Cairo

Islamic architecture in Cairo passed through different periods: Fatimid, Ayyubid, Mamluks and Ottomans. In the beginning, the Fatimid architecture combined elements of eastern and western architecture and was strongly influenced by Mediterranean cultures. The city fabric was characterised by a human compact form with low-rise residences and narrow streets, which has the advantage of providing solar shading but minimises wind flows for urban health and social purposes (Sharon L. Harlanan December 2006). Compact cities have environmental, social and fiscal advantages; and in similar climates, the compactness of the city fabric proved to result in lower energy demand for artificial climatisation and have a positive influence on

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energy savings on a building and city scale (Frey 2003). In Islamic Cairo, the streets were oriented North-South to take advantage of prevailing wind that came from the north; it was characterised by winding streets of different sizes to decrease the potential effect of wind storm carrying dust/sand and provide shaded spaces. Early residential buildings were made with clay brick, which was and still is a commonly used building material in Egypt, then stone gradually took over and it became a major construction material. Morphologically, a typical dwelling apartment in the Fatimid period had a rectilinear plan that revolved around a central courtyard that provided natural lighting and ventilation (Safran 2000). Private houses included a ground floor and one or two upper floors. Exterior windows included sophisticated shading systems – Mashrabeya – that decrease light glare and block visual access from the exterior, providing privacy for households.

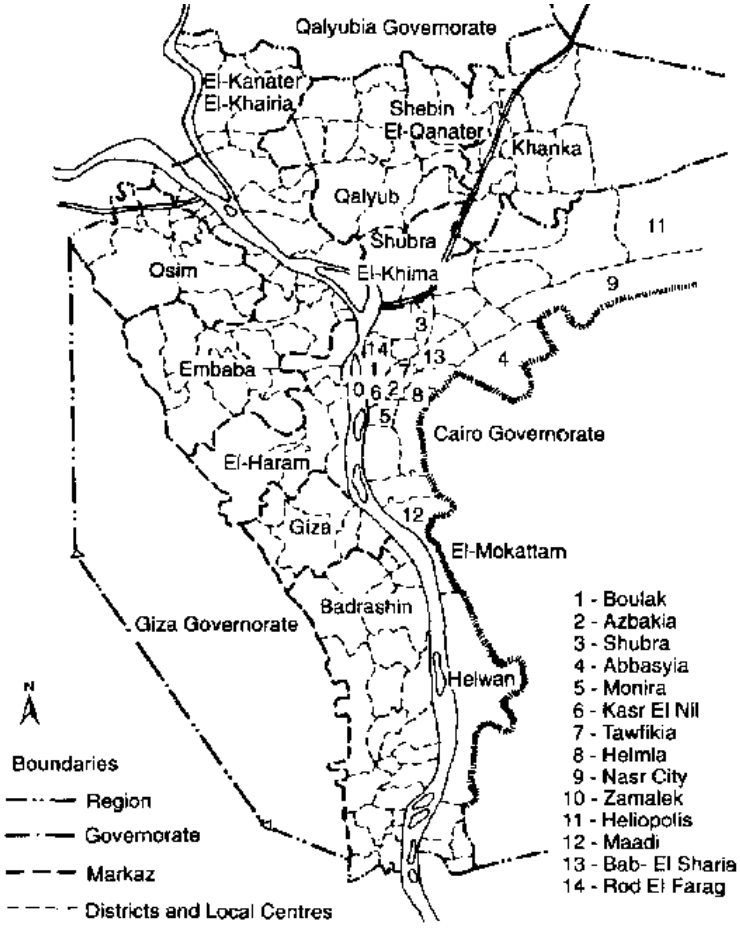

Fig. 1: Greater Cairo Region (Yousry, 1997)

The inexistence of advanced technological tools forced architects to develop solutions that guaranteed thermal comfort without affecting the surroundings negatively. Islamic architecture did not oversee the important concepts of physics and fluid dynamics like air buoyancy and thermal convection. It was based on the use of solar energy, heat conduction and convection, ventilation, evaporation and passive cooling methods to provide high comfort levels for inner spaces (Nermine Abdel Gelil Mohamed 2014) (Yahya Lavafpour 2011); In addition, the correct application of local building materials worked as an efficient way to increase comfort levels and drastically reduce the environmental impact of construction (J.C Morel 2001).

Light-coloured materials with high reflectivity were chosen to decrease the temperature and decrease the dry weather effect. Nermine Abdel Gelil and Waleed Hussein listed the materials commonly used in Cairene Islamic architecture: Stone was a widely used construction material during the Ayyubid and Mamluk eras (12th-16th century), and marble was used by the Mamluks (13th-16th century). Traditionally, limestone was used for the construction of ground floor load bearing walls. External walls were built of at least 50cm thick limestone, which contributed to the thermal insulation of indoor spaces and provided high thermal mass effect. During summer, the heat was stored in the walls during the day and released into indoor spaces at night when temperatures were lower, and spaces could be cooled by natural ventilation (cross ventilation and stack effect). In addition, due to the light colour – and the high reflectivity- of the limestone, it deflected

solar radiation during hot days. Wood was used for building flat horizontal roofs, mashrabeyas, takhtabushes, windows, malqafs, shokhshekhas and scaffolding during the construction of walls; it was also used for shading purposes (Nermine Abdel Gelil Mohamed 2014). Red Brick was used for compact forms, like vaults and domes, which have low surface area to volume ratio and hence provide minimum heat gain and minimum heat loss through the building envelope and imply higher thermal comfort conditions.

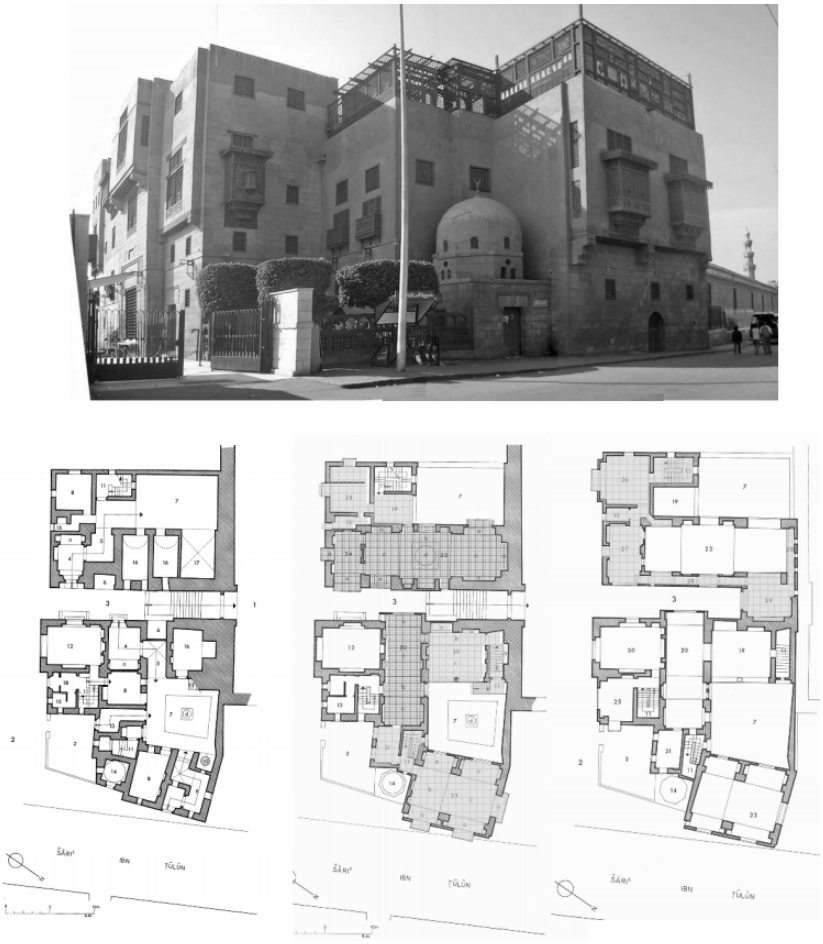

Fig. 2: Manzil Amna bint Salim (back) and manzil al-Kiridliya (front), located adjacent to Ibn Tulun Mosque on Ibn Tulun Street. Above, photo from the street by Nermine Abdel Gelil Mohamed; below, ground, first and second floors (Nermine Abdel Gelil Mohamed 2014)

3.2 European Cairo

The end of the Islamic architecture era in Cairo can be considered to be at the beginning of the 19th century (1805), after the expulsion of the last Ottoman governor by Mohamed Ali, who announced the virtual independence of Egypt from the Ottoman court. This was the beginning of „Modern Egypt“ with comprehensive efforts and mega infrastructure projects to modernise the city and the country in general. In 1863, the Cairene population had barely passed 300,000 (Raymond 2000). Khedive Ismail - who received European education in Paris - showed more effort for social and cultural modernisation of Egypt. A completely modern western city emerged from a small neighbourhood ‘Azbakia’ and the physical and urban patterns of Cairo changed. His famous saying was “My country is no longer in Africa; we are now part of Europe. It is therefore, natural for us to abandon our former ways and to adopt a new system adapted to our social conditions". (Haag 2003)

The first city plan presented by a French architect was inspired by Haussmann’s plans for Paris. It ignored the existing compact patterns of Islamic Cairo and produced new radial grids of large wide streets. English, Italian and Greek architects presented proposals and participated in the construction of a new part of the European city. Cairo was nominated as “Paris along the Nile” and this area – constructed by the Khedive- is now known “Downtown- Wust El Balad”. Utilities and services like water, electricity and trams were developing on a huge scale (Myntti 2000). The new elegant city centre offices, shops, restaurants and cafés gave a new identity to the city. Traditional Islamic architecture was abandoned, and in some cases the use of

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its elements like mashrabiyya was prohibited and replaced by glass window panes and wooden shutters. Styles ranged from Baroque, Neo-classical and Rococo to Bauhaus, Italian Renaissance and Arabesque until the 1950s (Elshahed 2007).

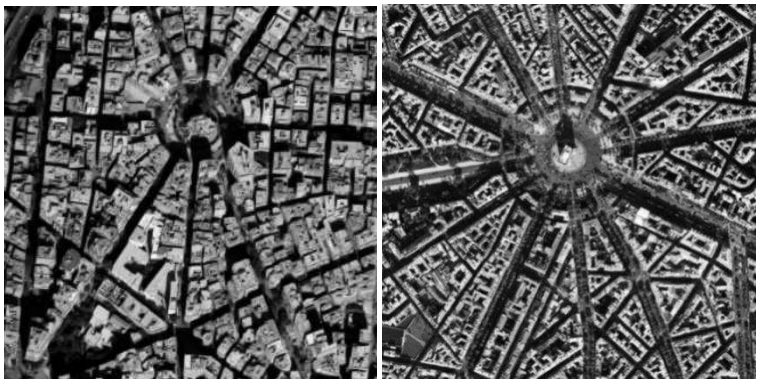

Fig. 3: European Cairo urban fabric (left) vs Paris urban fabric (right)

By the beginning of the 20th century, new lavish neighbourhoods (e.g. Garden city and Zamalek) were already developed. Urban expansion later took place along the north (towards Shubra), then the first satellite cities – like Heliopolis- were designed to host up to 100,000 inhabitants. In the 1940's roads, bridges and water system projects started to take place to provide a solid base for further urban expansions. Cairo became an attractive pole for all Egyptians that came from rural and surrounding areas. The first industrial slums were developing in nearby Boulak, where spot densities reached world records (4000 person/hectare). From 1937 to 1947 the population of Cairo doubled from 1,300,000 to 2,800,000 inhabitants and moving out of the slowly degrading old city centre became a trend by the higher income groups which could afford to buy property in more modern neighbourhoods (Cresti 1987).

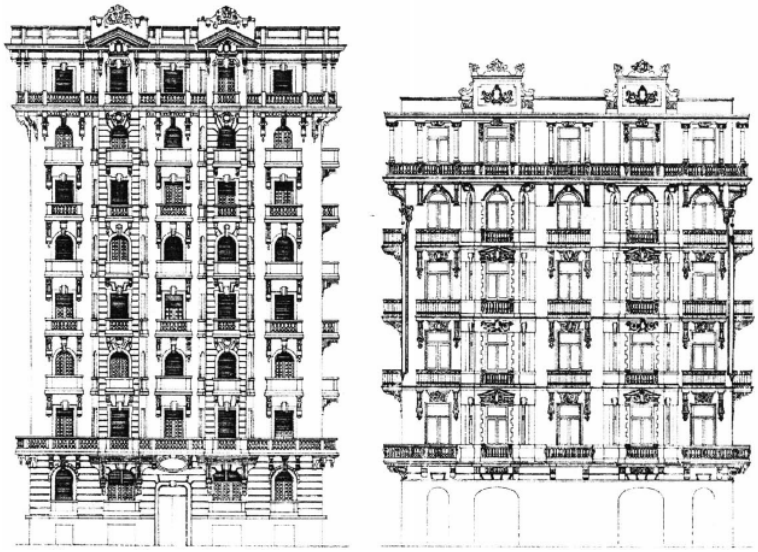

Fig. 4: Change in architectural elements - Downtown Facade from European Cairo 1927 (Elshahed 2007)

Fig. 5: Buildings from European Cairo (photographs by Alain Bonnamy) (Galila El Kadi 2006)

Until today, published work that analyses the architecture of European Cairo from an environmental and passive design perspective is not evident. It is obvious that not until building with reinforced concrete started to take place during the first decades of the 20th century, thick load-bearing stone and masonry walls with high thermal mass was the main building and structural technology used for residential buildings. In addition to the function of articulating the space, load bearing walls ensure the stability of the building to enable it to withstand vertical loads and horizontal thrusts.

This structural function is associated with thermal and acoustic insulation. Therefore, construction materials of poor thermal conductivity were chosen for the construction of thick heavy walls; they provided thermal flywheel effect resulting in a cool environment in summer and a warm environment in winter. This guaranteed higher comfort levels in comparison to slim envelopes of reinforced concrete beam-column structures that started to spread later for residential blocks. Typically, apartment block heights started to be 4, 5, 6 floors. Average floor-to-ceiling height was 4m; this is higher than average floor-to-ceiling height of residential buildings built today – and in the last 40 years- which is typically 3m. This allowed better air movement and higher comfort levels. Through the phenomenon of convection, fluids have a natural movement in which hot air tends to rise allowing the lower part of the room to have lower temperatures that could reach up to 1°C less in warm days. Therefore, in hot climates, a higher floor-to-ceiling distance means a greater distance of the hot air layers from the users, guaranteeing higher comfort levels. (R. P. Guimarães 2013)

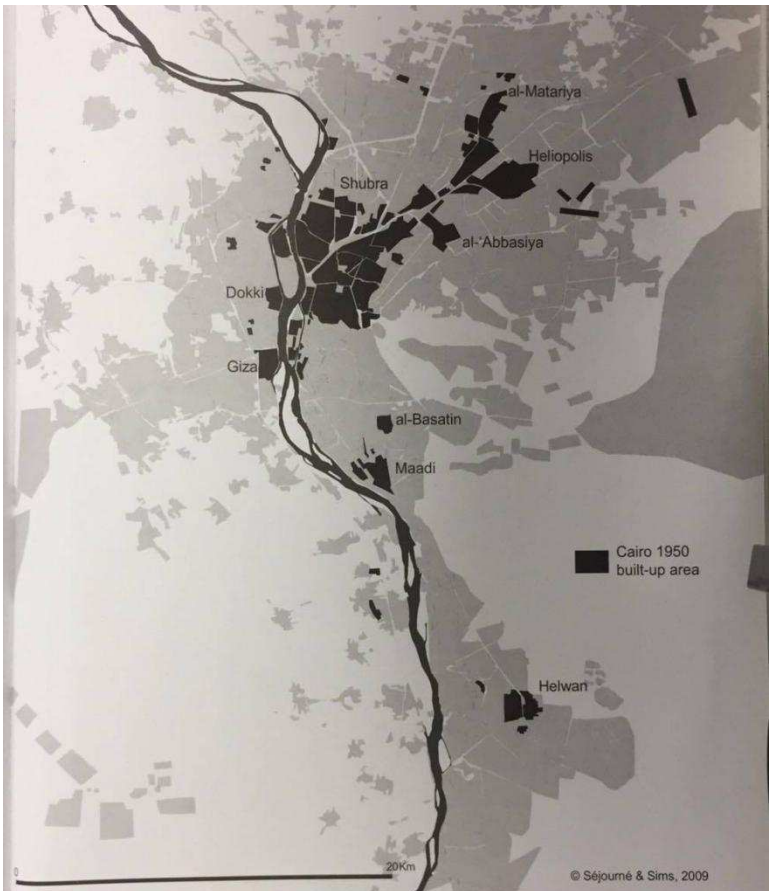

Fig. 6: Cairo built-up area before and after 1950 (Sims, 2012)

Thick wood was used for window frames and shutters on the outside, which worked as a good insulator of solar radiation as wood has low thermal conductivity. Metal was used sparingly for façade ornaments and balcony fences, but it was not a dominant material. Facades included elaborate decorative ornaments, balconies and overhangs which had a shading function that varied in relation to the orientation of the façade. However, the void-to-solid ratio in residential facades of European Cairo was higher than that of the hosues of Islamic Cairo; allowing major solar access through openings and reducing comfort levels during the hot season. Light hues of colours were used to reflect solar radiation, decrease heat absorption and conduction, which guaranteed lower radiant and operative temperature of internal spaces. Many residential blocks included inner courtyards, which permitted higher air cross ventilation between outer façade openings and

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the ones overlooking the interior courtyard. In addition, weather conditions in Cairo were moderate compared to extreme temperatures reached in the last couple of decades due to global warming, urban heat island effect, and climate change.

4 MODERN CAIRO

4.1 New phase with new policies

In 1949 the Municipality of Cairo was created as the official local administration responsible for managing the city resources and development. The Ministry of Housing, Utilities and Urban Development (MHUUD) issued its first housing and building statutes and laws regarding conciliation, and law amendments. In 1953, the King was deposed by a revolutionary command council and a republic was declared. This was an announcement of a new phase in Egyptian history and led to Cairo's total change. The building sector and the urbanism were directly influenced by those political changes. The new government followed new policies:

- Subsidised public housing
- Applying social housing programmes
- Condominium investments were encouraged to provide the possibility of growth in new areas of Cairo (e.g. Mohandessin neighbourhood)
- New laws were issued regarding improving fees on the real-estate that was upgraded due to the improvement of public utilities and others to reduce rents on housing units
- European Cairo neighboorhoods were Egyptianised (mixed land use and commercial zones were created; elegant villas were replaced by high apartment blocks).

Until 1940, Cairo represented 6-8% of the national population. Between 1950 to 1960, Cairo's percentage of the national population inflated from 11.2% to 18.4%. Rural settlements - of migrants to Cairo - were expanding around the actual city with no planning, architecture or construction reference at all (Yousry 1997); with reinforced concrete as a fast and convenient solution, the city started to grow at a fast pace.

Year	**Cairo**		**Egypt**		**Cairo as % of national population**
	Population ('000)	% growth rate	Population ('000)	% growth rate	
1800	200	2.0	3,000	1.2	6.7
1900	600	2.3	10,000	1.3	6.0
1920	875	3.1	13,000	1.4	6.7
1930	1,150	2.2	15,000	2.3	7.7
1940	1,525	4.1	19,000	1.0	8.0
1950	2,350	4.1	21,000	2.2	11.2
1960	4,784	2.2	26,000	2.4	18.4
1976	6,776	3.5	38,200	2.8	17.7
1986	9,514		50.500		18.8

Table 1 Population growth of Cairo and Egypt, 1800-1986 (Yousry 1997)

4.2 Master plans (1950s -1960s)

In 1956 a master plan that included east and west desert flank expansions was prepared and in the 1960s new industrial zones were identified - Helwan, Shubra, Imbaba and Giza- enhancing the appearance of Cairo as a future mega metropolis. The government financed the design of new settlements like Nasr city (designed to cover 6,300 acres of vacant desert and later extended incorporating additional 14,000 acres) allowing the growth of areas like Abbasiya and Heliopolis. MHUUD issued a new law in 1964 (Law No.6) defining design criteria and rules for structural and building works. It issued ministerial decrees to regulate building execution because of informality; this was followed by other laws and decrees that regulate the restoration, maintenance and elevation of existing buildings (Ministry of Housing 2015). Cairo's population was 6,113,000 inhabitants in 1966 and new master plans had to be created again to include the extension of the industrial area of Helwan and new towns like the 6th of October, Al Badr, El Obour and a West Bank project

that was not realised. Later additions included distant extensions towards the north and east: unsuccessful town examples namely Sadat City and 10th of Ramadan new town. These plans had the objective of sccommodating future population growth until 1990 (Sutton 2001).

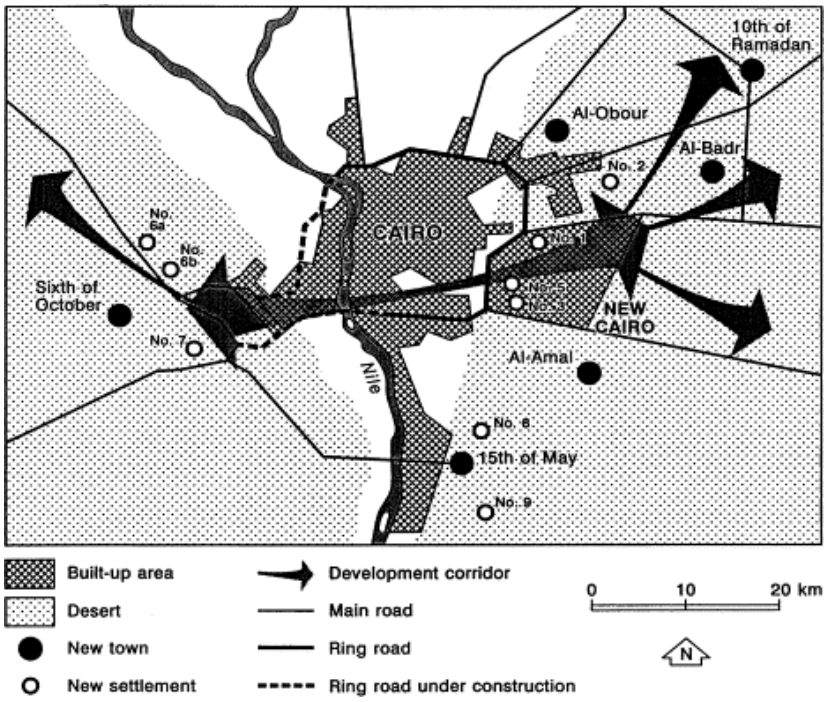

Fig. 7: 1970 and 1983 master plans for Cairo: new towns, new settlements, ring road, and east–west axes of development (Sutton 2001)

4.3 New laws and informal housing (1970s)

In the 1970s the MHUUD issued a new series of laws aiming to regulate the growing building sector and control rising illegality:

1. Law No. 62 of 1974: Provisions for reconstruction, 1974
2. Law No. 66 for in 1974: Establishment of Engineers' Syndicate, 1974
3. Law No. 49 of 1977: Sale and lease regulations between owners and leasers.
4. Law No. 59 of 1979: Indications concerning new urban communities and settlements.

However, the war of 1967 had a negative influence on the national economy and the city's urban development. The government was unable to fulfil the new urban aspiration, shelved the planned projects and turned a blind eye on the illegal growth of the informal sector caused by fast demographic growth. In Greater Cairo, more than 80% of new units built during the 1970s were considered illegal (Sharaf 1999). The official public constructions that started in the 1970s aimed to reach different economic groups and they accelerated the city's expansion towards the east through new settlements and towns like Nasr City and the 10th of Ramadan. Spontaneous urbanisation was promoted west of the Nile towards existing neighbourhoods like Giza, Dokki and Mohandessin. A process of "demolition-reconstruction-densification" was the reason for the transformation of elegant neighbourhoods in the city centre „e.g: Mohandessin". Between 1980 and 1992 a third of the villas and smaller blocks have been demolished and were replaced by tower blocks (Galila El Kadi 2006). Today in neighbourhoods like „Mohandessin", it is hard to find a trace of the old villas or planned low-rise residential blocks built according to regulations. Instead, they have been replaced by tall blocks built by private –mostly the illegal – sector and contractors with a main target: increasing financial profit margins (Sutton 2001). The spread of reinforced concrete as a fast and efficient construction material had a direct influence on the pace of urban growth; new settlements and towns were planned to reach different social groups. High residential blocks of reinforced concrete - column and beam structure and bricks for walls and interior partitions - were built, increasing the average height of residential and commercial blocks. 10-12 story buildings with elevators were starting to become more common and were often built for social housing in the new satellite towns and settlements.

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4.4 New city and local divisions (1980s)

In 1982 Greater Cairo was defined by the General organisation of physical planning, located within the jurisdiction of the 3 Governorates: Cairo on the east, Giza on the west and Qalyubia on the north. The total built-up area of GCR was 32,600 hectares with 21,690 hectares for residential use representing 67% of all land use. So, it was necessary to prepare new plans again and one year later a new master plan was made to house 2-3 million people (Luloff 2001). Egyptian authorities confirmed infrastructure development plans and the city was divided into 16 homogeneous sectors for the first time. The division aimed to decrease the suffocating high densities, transfer the population to outer areas of the centre and decrease the pressure on central areas. The census of 1986 had a major impact; the city's ring road plan was changed, and this allowed a better connection with new settlements like 6 October and New Cairo and gave the way for later development outside the centre on both the east and west flanks of the desert.

4.5 Master plans and their impact (1990s)

In the early 1990s, the urban form, size, and fabric of GCR had already developed in a random and spontaneous manner, instead of following a planned strategy. Sutton and Fahmi listed a series of factors behind, what they considered the failure of the previously mentioned master plans and strategies (Wael Fahmy 2008). They observed the following main factors:

- The dominance of the unplanned "spontaneous urbanisation" over three decades (probably referring to the 1960s, 1970s and 1980s).
- Failure of new towns/settlements to attract residents and alleviate overcrowded conditions in central Cairo.
- Financial constraints on government expenditure and growth of the private sector involvement.
- The strengthening of Cairo's polycentricity
- Negative impact of the 1992 Earthquake
- Vacant city dwellings in a situation of housing crisis
- The role of the new ring road and its influence on land use and population.

The impact of the failure of the master plans (made in 1956, 1970, 1982 and 1983) was evident in the 1990s. Since the 1970s till the end of the 1990s, because of a spontaneous rather than a planned land use transformation, central Cairo witnessed a contradictory movement, namely the consolidation of its central place tertiary functions and the fragmentation of these functions over multi centres. Due to the financial constraints on the government expenditure, the government was incapable of providing suitable or economically convenient housing solutions that responded to the fast demographic growth and migration to the capital. Most of the planned new towns failed completely to attract residents and provide them with suitable housing solutions (e.g. 10th Ramadan, Al badr, El Obour, Mobarak housing). It is estimated that in 2006, 25-30% of units were presumably vacant, especially in the new towns ((USAID) 2006). This opened a wide door to the private investment and illegal sector to gain momentum with a market economy approach. Studies propose that up to 84% of constructions over the 1970s and 1980s have been illegal. By illegal, for the most part, studies do not refer to slums or shanty town dwellings. Instead, it is referred to modern formal housing built illegally or without any formal planning permission, possibly with violations of floor plans, land use and construction materials (Sutton 2001).

This led to two main results:

- The spread of informal housing with no design or planning, built by local contractors under no strict administrate control or building regulations of any type.
- The spread of a standard poor construction procedure served to meet people's housing needs. This procedure ignored sustainable or environmental design and produced repetitive minimalistic rectilinear (linear and tower) apartment blocks with no consideration of passive design strategies like quality material selection, shading, natural lighting and ventilation. (Wael Fahmy 2008)

Fig. 8: Residential buildings from Modern Cairo "Mohandessin" and a construction site with traditional technologies (Author)

Due to material availability, common knowledge, easy application, time efficiency, and economic convenience: reinforced concrete column and beam structural system and bricks (slit, clay, cement) for walls and interior partitions is the dominant method used for residential construction since the 1950s and almost exclusively used with the flat slab structural system for residential sector and apartment blocks. Double and triple glazing technologies for windows are not common and single glazed windows with wooden shutters are widely used for openings.

Informal settlements (either semi-legal or illegal residences built on private and public land) are where 70% of the inhabitants of GCR live. Apartment blocks is the dominant housing system in GCR and most of it is owned by the private sector which represents more than 97% in housing construction, with no energy efficiency or renewable energy awareness (Hanna, Sustainable Energy Potential in the Egyptian Residential 2013) (Ahmed Abdin 2006). According to HSE in Greater Cairo, building median height is 5 floors with an average total surface area of the building (building footprint) 157m2. Some structures could reach a height of more than 12 stories, but it is uncommon to find low rise buildings and villas (David Sims 2008). In Egypt, 99% of the households receive electricity and the national demand is on a continuous rise (Singerman 2011).

The 2006 national census showed that the Egyptian building stock comprised about 16.5 million buildings and 11.5 million were used residential purposes in 2006, representing more than 60% of the Egyptian building stock. The Organisation for Energy Planning (OEP) conducted energy surveys between 1998 and 2002 in major cities like Cairo, Alexandria, Port Said and Asyut to represent 2634 apartments in GCR. The research revealed that the average annual end-use energy consumption was 2866kWh/m2 per apartment with 17% as the degree of saturation of air conditioners (Hanna, Sustainable Energy Potential in the Egyptian Residential 2013). The residential sector represented 36% of electricity consumption and about 21% of the total energy consumption nationally in the period 1990-2000 (International Energy Agency 2015). The residential consumption continues to rise 5-10% annually and it is necessary to adopt new efficient policies (Mohamed Edeisy, Energy Efficiency for Egyptian Housing: Code Compliance and Enforcement 2018).

Fig. 9: Satellite images of (from left to right) Islamic (in by informality), European and Modern Cairo

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Fig. 10: Buildings (from left to right) Islamic, European and Modern Cairo (Nermine Abdel Gelil Mohamed 2014) (Galila El Kadi 2006)

5 DISCUSSION

The Islamic residential stock represented compact morphological characteristics. On a building scale, this provided minimum heat gain and minimum heat loss through the building envelope and implied higher thermal comfort conditions. On an urban scale, this provided higher shading and lower temperatures. Islamic Cairo is characterised by using local materials. Stone was widely used – especially limestone - (12-16th century) for the construction of thick walls. Wood was used for building roofs, furniture and window shades (mashrabeya). In terms of environmental sustainability, the compactness of the Islamic urban fabric provided more shading and a low surface area to volume ratio – on an urban and architectural scale, which guaranteed higher indoor and outdoor thermal comfort levels.

European Cairo residential morphology is dominated by apartment blocks inspired by European - Baroque, Neo-classical and Rococo to Bauhaus, Italian Renaissance and Arabesque – architecture. On an urban scale, European Cairo witnessed a significant infrastructure development. It is characterised by wide streets for cars, lighting and open space. European Cairo residences were mostly built with thick load-bearing stone and masonry walls and then with the development of the concrete technologies, it started to become widely used. European Cairo residential blocks' thick heavy walls had low thermal conductivity and high thermal mass. Internal courtyards allowed good cross ventilation on hot summer days. On an urban scale, the city's infrastructure was developed significantly.

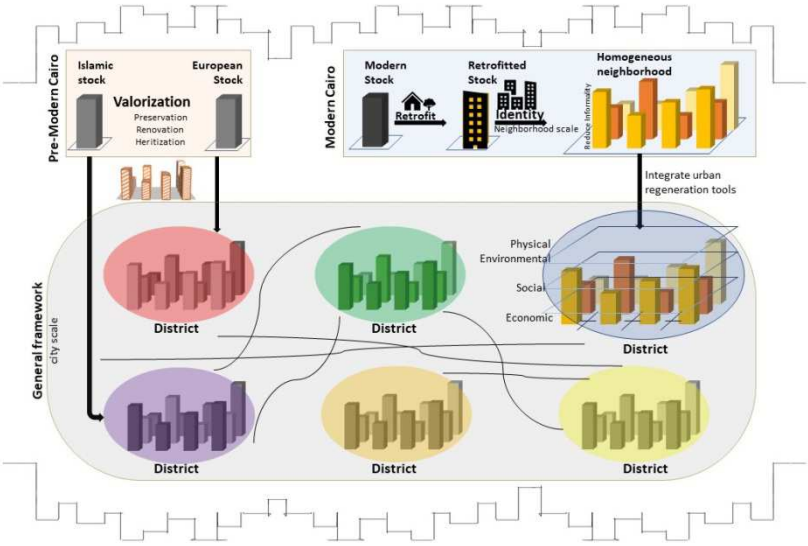

Fig. 11: General framework for future strategies prioritizing the problems of the existing built environment (Author)

After 1953, modern minimalistic apartment blocks - linear and tower – started to become more common gradually and it became the dominating building morphology. The impact of the failure of the master plans was evident and lead to a spontaneous transformation rather than planned land use. The informal settlements (either semi-legal or illegal residences built on private and public land) are where 70% of the inhabitants of GCR live (Hanna, Sustainable Energy Potential in the Egyptian Residential 2013). Modern Cairo blocks were built in a reinforced concrete column and beam structural system and bricks (slit, clay, cement) for walls. Modern Cairo (after the 1950s), is dominated by informality and illegality. Building skeletons of reinforced concrete and red brick filling have high thermal conductivity and thermal bridges are present. In

addition, in the last decades, reliance on artificial acclimatisation is rising accompanied by high consumption levels and greenhouse gas emissions.

6 CONCLUSION

New public policies should take into consideration the factors that led to the failure of previous masterplans. The continuous rapid growth and load on GCR made it extremely complex to manage the numerous actors of physical change of the built environment. The public sector should consider strengthening the attractivity of other Egyptian poles/cities to attract the population there, take advantage of the resources available in unused land – 99% of Egyptians live in 5.5% of land area (Erin H. Foubery 2009)- and decrease the pressure on the capital region.

Future strategies should give priority to solving the problems of the existing built environment through urban regeneration and requalification strategies on urban, neighbourhood and building scale. It is important to valorise the existing building stock of Islamic and European Cairo through urban preservation movements, heritage conservation, and renovation.

Moreover, it is necessary to foresee applicable tools that -while upgrading and maintaining the identity and services of the existing stock- work on upgrading the current state of the informal and illegal existing building stock of Modern Cairo. Passive retrofits have a high environmental potential in GCR; envelope retrofit in Cairo can lead up to lower energy consumption, increase in indoor comfort levels and lower greenhouse gas emissions (Mohamed Edeisy, Envelope retrofit in hot arid climates 2017) (Mohamed Eledeisy 2016); it provides an added aesthetic value through renovating the façade and helps cover gaps or cracks. When applied on a neighbourhood scale, it can be an instrument that contributes to decreasing informality and disorder between buildings in each district. It can be used as a tool to give harmony in the buildings' external aspect (similar colours, materials, etc.) and kick start an urban regeneration movement that begins with the household and expands to reach the neighbourhood within a general framework that integrates the actors of change on a city scale.

The article identified three significant styles of Cairene architecture. It evaluated the development of the housing stock on an urban and building scale before and after 1953. It is obvious that the built-up area of Cairo increased sharply after the 1950s (figure 6). GCR reached an uncontrollable size; the instability of governmental policies and regular change of decisions led to unsuccessful results on the urban and the building scale. The residential sector is mostly informal with a low effort in upgrading. This work presented a descriptive analysis of 3 typologies of a residential building; two of them are from the period before 1953 and the third is after. It analysed the development of housing stock after 1953 with common construction methods and their impact on the current built environment. In terms of technological, environmental and morphological quality of the housing sector -building and urban scale-, it is necessary to apply realistic solutions that reduce informal sprawl of the capital and encourage the private sector to adopt higher construction qualities in design, material selection and energy demand. The work provides an evaluation base and offers guidance in relation to the presented typologies within a general work frame on a wider scale. The indications given can support public policies for future scenarios of GCR and for Cairo vision 2050 strategies.

7 LIMITATIONS AND FUTURE WORK

This work understands that the Cairene housing stock is complex and it cannot be limited to three residential typologies and/or styles. However, the article aims to provide an inclusive overview of the main and most common architectural styles with a focus on their morphological and technological quality before and after 1950. Future work can further analyse the building stock in the period (2000-2020) and propose guiding indications for the vision of Cairo 2050 within the national vision of Egypt.

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Erweiterte typologische Betrachtung als Werkzeug zur Integration von Nachhaltigkeitsaspekten in Stadtplanungsprozesse

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1 ABSTRACT

Nachhaltigkeitsstrategien im Gebäudesektor fokussieren sich aktuell hauptsächlich auf quantifizierbare Effi¬zienzmaßnahmen. Daneben erscheint es notwendig, die Struktur von Quartieren selbst einer kritischen Analyse zu unterziehen und für die Entwicklung integraler Planungsansätze nutzbar zu machen. Als entscheidend für dessen Wirksamkeit muss die Anwendbarkeit unter Alltagsbedingungen gesehen werden. Dies beinhaltet notwendigerweise Schematisierungen, die sich in der Stadtplanung traditionell im Konzept des Typus reprä¬sentieren. Setzt sich dieser Ansatz – wenn er auf die Perspektive interner räumlicher Organisation beschränkt ist – der Kritik aus, Rückkopplungseffekte zu ignorieren, erscheint die Erweiterung des Typus-Konzepts durch eine Kombination von Nachhaltigkeits- und Raumstrategie als geeignetes Werkzeug das komplexe Bezie-hungsgeflecht nachhaltiger Stadtplanung handhabbar zu machen.

Ein zentrales Element dieses Ansatzes besteht in der Definition relevanter Parameter und deren Berücksich¬tigung in frühen Prozessphasen. Die Bewertung urbaner Räume nach Nachhaltigkeitskriterien stellt Planung vor vielfältige Herausforderungen, deren Ursachen in der Komplexität und der Kontextabhängigkeit des Unter¬suchungsgegenstands wurzeln. Dennoch kann nur ein systemischer Ansatz das notwendige transformative Momentum erzeugen, dass zur Integration von Nachhaltigkeitsaspekten in Planungsprozesse notwendig ist.

In diesem Spannungsverhältnis operieren Analysetools, wie beispielsweise Arups „City-Resilience-Index“. Sie zeigen Möglichkeiten auf, komplexe städtische Systeme zu erfassen und in ein Bewertungssystem zu über¬führen. Dabei liegt der Fokus weniger auf einem linear-wertenden Vergleich, als auf einer ganzheitlichen quantitativen und qualitativen Analyse der Ist-Situation. Diesen Ansatz nicht nur retrospektiv, sondern pro¬aktiv zu nutzen, bildet die Grundlage der im Rahmen des Forschungsprojekts EnStadt:Pfaff entwickelten Strategie zur Entwicklung nachhaltiger Quartierstypologien.

Aus der Überlagerung des skizzierten Analyseansatzes mit dem Konzept städtebaulicher Typologien auf Quar¬tiersebene – das nicht exklusiv, sondern systemisch mit Bezug des einzelnen Moduls zur Quartiersumgebung verstanden wird – lässt sich ein Entwurfstool ableiten, das trotz Schematisierung eine ganzheitliche Betrach¬tung städtischer Systeme und integrale Planung ermöglicht. Unterschieden werden dabei drei Arten von Quartierstypologien: Gebäude, Verkehr und Freiraum. Für jede Typologie wurde ein mehrstufiges Bewer¬tungsschema entwickelt, das für drei Betrachtungsdimensionen – Form, Programm und Kontext – Ziele de¬finiert und über eine indikatorenbasierte dreistufige Bewertungsmatrix Rückschlüsse auf deren Integration zulässt. Die Definition der Zielsetzungen gründet auf den aus den 17 SDGs abgeleiteten Anforderungen ökologischer, ökonomischer und sozialer Nachhaltigkeit, die durch punktuelle Integration von technischen und prozessualen Aspekten ergänzt werden. Die Grundlage hierfür bildet die Analyse erprobter Bewer¬tungs¬strategien der Integration von Nachhaltigkeitsaspekten auf Quartiers- und Gebäudeebene.

Dieses Vorgehen ermöglicht es, das Nachhaltigkeitspotential von Entwurfsvarianten bereits zu Beginn von Planungsprozessen sichtbar zu machen. Es liefert ein Instrumentarium, das Raum- und Nachhaltigkeitsaspekte in Abhängigkeit zueinander als gleichberechtigte Elemente von Planung definiert und für die Realisierung eines integralen Entwurfsprozess nutzbar macht. Daneben bildet es die Basis zur Entwicklung einer Toolbox exemplarischer Quartierstypologien, die in Anlehnung an Christopher Alexanders „Pattern Language“, das Konzept elementarer Bausteine der Stadtplanung durch die Integration von Nachhaltigkeitsaspekten in die Zukunft fortschreibt.

Keywords: Planungswerkzeuge, Quartierstypologien, Quartiersforschung, Planungstheorie, Integraler Planungsansatz

2 EINLEITUNG

„Technology is the answer. But what is the question?“ (Cedric Price)[1]

Es ist aktuell möglich klimaneutrale und energieeffiziente Gebäude zu errichten, weit über die gesetzlichen Standards hinaus. Gleichzeitig klafft eine Lücke zwischen dem technisch Möglichen und seiner Anwendung in der alltäglichen Baupraxis. Dieses Mißverhältnis resultiert zu großen Teilen aus dem − von Price zurecht angemerkten − Fehlen einer hinreichenden Problemformulierung. Nachhaltigkeit bedeutet nicht nur technische Innovation, sondern ganzheitliche Betrachtung, worin ihre kulturelle Dimension sichtbar wird, die auf „soziale Innovation“ zielt.[2] Dieser Imperativ muss zukünftig in der Bau- und Planungspraxis methodisch verankert werden, doch steht diesem Vorhaben die Methodenarmut zeitgenössischer Entwurfsroutinen entgegen, die sich als „iterative trial-and-error process“ verstehen.[3] Wie durch dieses schrittweise Annähern an Planungsprobleme einem ganzheitlichen und methodisch verankertem Verständnis nachhaltigen Gestaltens Rechnung getragen werden kann, erscheint bis dato unbeantwortet.

Architektur wird wirkmächtig, wenn sie Theorie oder Praxis in einem kreativen Prozess verbindet. Dieses Dazwischen-Sein begründet das Ideal architektonischen Entwerfens als „offener Theorie“, die „unvollständig, ständig erweiterbar“ auf kybernetischen Prinzipien der Selbstkritik über Rückkoppelungen aufbaut.[4] Ein idealer Planungsprozess kann als effektive Strategie im Umgang mit Komplexität verstanden werden, dessen entscheidender Erfolgsfaktor − wie Price es andeutet − im „Verbindungspunkt zwischen Zielformulierung, Problemdefinition und Fragen der Gleichheit [zwischen den Projektakteurinnen und Projektakteuren, Anm. d. V.]“ liegt.[5] Neben der Forderungen nach einer offenen Theorie der Gestaltung und der Anwendbarkeit unter Alltagsbedingungen, spielt die Erweiterung der Systemgrenze Gebäude eine zentrale Rolle für die Entwicklung einer Entwurfsstrategie der Nachhaltigkeit. Erst durch die Betrachtung in Quartierszusammenhängen können Wechselwirkungen mit anderen Systemkomponenten erkannt und in den Entwurfsprozess integriert werden. Die Arten von Problemen innerhalb eines solchen Systems-von-Systemen zeichnen sich durch „ihre Einzigartigkeit, […] die Vorläufigkeit ihrer Beschreibung, […] die Unendlichkeit ihrer potentiellen Lösungen, […] die Unmöglichkeit durch Versuch oder Irrtum zu lernen und durch das Fehlen von Überprüfungsmöglichkeiten aus.“[6] Dies verdeutlicht, warum eine umfassende Formalisierung von Planung ins Leere läuft, da sie letztlich für eine gegen unendlich sich erweiternde Variantenvielfalt Lösungen anbieten müsste. Eine Methode nachhaltigen Architekturschaffens muss die Komplexität der sie sich gegenübersieht, effektiv in ihr eigenes Wesen integrieren und als stimulierendes Merkmal kreativer und architektonischer Prozesse anerkennen und nicht versuchen diese durch die Kompliziertheit von Lösungen, die von außerhalb in den Entwurfsprozess getragen werden, auszugleichen.[7]

2.1 Strategieansätze

Ein offener Theorieansatz integriert möglichst viele Teilaspekte des Systems Gebäude und macht diese in einem Planungsalgorithmus handhabbar. Welche Paramater hierbei Berücksichtigung finden können, zeigt der Vergleich von Konzepten zur Entwicklung oder Evaluation von Gebäude- und Stadtplanungskonzepten im Nachhaltigkeitskontext: Im Bereich Gebäude das *DGNB-System Gebäude*[8] der Deutschen Gesellschaft

[1] C. PRICE: Technology Is the Answer, but What Was the Question? London, 1980.
[2] J.-L. REINERMANN; Behr, F.: Die Experimentalstadt*: Kreativität und die kulturelle Dimension der Nachhaltigen Entwicklung*, ed. Julia-Lena Reinermann and Friederike Behr: Vier Thesen für die Experimentalstadt Wiesbaden, 2017. pp. 3–4.
[3] B. TOTH: Energy Simulation for Decision Support in Early Architectural Design Dissertation, School of Design, Queensland University of Technology, 2017. pp. 52.
[4] J. FEZER: Vergessene Schulen*: Architekturlehre zwischen Reform und Revolte um 1968*, ed. Nina Gribat, Philipp Misselwitz and Matthias Görlich, 1. Auflage: Jürgen Joedickes Planungsmethodik: Die Funktionalisierung der Architekturtheorie Leipzig, 2017. pp. 262.
[5] H. RITTEL: Planen, Entwerfen, Design*: Ausgewählte Schriften zu Theorie und Methodik*, ed. Wolf D. Reuter and Horst W. J. Rittel: Dilemmas in einer allgemeinen Theorie der Planung, Facility management 5 Stuttgart, 1992. pp. 14–16.
[6] H. RITTEL: On the Planning Crisis: Systems Analysis of the "First and Second Generations". Bedriftsøkonomen, no. 8. 1972. pp. 392–94.
[7] K. MOE: Convergence: An Architectural Agenda for Energy. London, 2013. pp. 85.
[8] DGNB System: Kriterienkatalog Gebäude Neubau. Stuttgart, 2018.

für Nachhaltiges Bauen, das *Bewertungssystem nachhaltiges Bauen* (BNB)[9] der Bundesregierung, *SNARC - Systematik zur Beurteilung der Nachhaltigkeit von Architekturprojekten für den Bereich Umwelt* (SNARC)[10] des schweizerischen Architeken- und Ingenieurvereins, *SNAP-Systematik für Nachhaltigkeitsanforderungen in Planungswettbewerben des Bundes* (SNAP)[11] und das an der Hochschule München entwickelten *Bewertungssystem nachhaltiger Kleinwohnhausbau* (BNK).[12] Auf der Makroebene Stadt der *Morgenstadt-City-Index* (MCI)[13] des Fraunhofer IAO, der *City-Resilience-Index* (CRI)[14] der Rockefeller Foundation und ARUP und das durch den Stadtforscher Rudolf Giffinger entwickelte *Smart-City-Ranking* (SCR).[15]

Die Analyse der Bewertungssysteme zeigt neben einer prinzipiellen Unvereinbarkeit von Handhabbarkeit und detaillierter Datenerfassung die Problematik in der Analyse komplexer Systeme. Unterscheiden sich die Ansätze primär in ihrem Detaillierungsgrad, zeigt sich eine allgemeine Tendenz, diese nicht mehr ausschließlich auf quantitative Referenzwerte hin auszurichten, sondern im Sinne des Nachhaltigkeitsgedankens eine möglichst umfassende Abbildung des Ist-Zustandes unter Berücksichtigung qualitativer Kriterien anzustreben.[16] Analyse- und Bewertungstools dürfen nicht als abgeschlossene, sondern müssen als anpassungsfähige Systeme verstanden werden, wodurch dem Prozesscharakter von Nachhaltigkeit entsprochen und auf strukturelle und programmatische Innovationen reagiert werden kann.[17] Daneben zeigt sich ebenfalls eine Hinwendung zu einer Ausgewogenheit aller bewertbaren Kriteriengruppen.[18]

Analyseverfahren mit Gebäudefokus integrieren Wechselwirkungen mit dem städtischen System nur unzureichend und *vice versa*. Während sich gebäudezentrierte Analysen überwiegend auf technisch-strukturelle und damit quantitative Aspekte fokussieren, zeigen beispielsweise der CRI und das SCR eine Verschiebung von quantitativen Bewertungsmaßstäben zur Integration von qualitativen Faktoren als Grundlage eines ganzheitlichen Bewertungsansatzes.[19] Die Rolle des Individuums als zentrale Größe in der Analyse eines *Systems-von-Systemen* wird hierdurch entscheidend gestärkt. Ebenso eröffnet die hiermit verknüpfte Denkhaltung einen alternativen und ganzheitlichen Zugang zum Design von Analyse- und Bewertungswerkzeugen für Gebäude- und Quartiere im Nachhaltigkeitskontext, da Nachhaltigkeit zwar durch strukturelle und technische Strukturen (quantitativ) vorbereitet werden kann, aber erst durch die Artefakt-Nutzerinnen-Interaktion und Artefakt-Nutzer-Interaktion (qualitativ) ihre eigentliche Wirkung entfaltet.

2.2 Elemente der Nachhaltigkeit

Ganzheitlichkeit, Vergleichbarkeit (Lesbarkeit), Erweiterung der Systemgrenze, Handhabbarkeit, Abbildung von Komplexität, Prozessintegration und Nutzerzentriertheit bilden die Grundlage eines proaktiv handhabbaren Werkzeug in architektonisch-städtebaulichen Gestaltungsprozessen, die Nachhaltigkeit zum grundlegenden Element entwerferischer Praxis machen.

Das hier sichtbar werdende Paradigma von Entwerfen als „offener Theorie“ lässt sich jedoch nicht unmittelbar in eine undefinierte (generische) Architektur übertragen. Vielmehr muss das Spannungsverhältnis von spezifisch und generisch als *Komplementäre* in eine „spezifisch-generische Architektur“ integriert werden. Dieser Perspektivwechsel verschiebt den Betrachtungsschwerpunkt von Fragen des Raumes zu Fragen der *Temporalität*. Damit nähert sich entwerferische Praxis programmatisch dem Nachhaltigkeitsgedanken an, der Zukunft auf Grundlage von Handlungsentscheidungen in der

[9] Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) im Bundesamt für Bauwesen und Raumordnung: Leitfaden Nachhaltiges Bauen: Zukunftsfähiges Planen, Bauen und Betreiben von Gebäuden, 3rd ed. Berlin, 2019.
[10] Schweizerischer Ingenieur- und Architektenverein: SNARC - Systematik zur Beurteilung der Nachhaltigkeit von Architekturprojekten für den Bereich Umwelt, SIA-Dokumentation D 200. Zürich, 2004.
[11] M. FUCHS ET AL.: SNAP Systematik für Nachhaltigkeitsanforderungen in Planungswettbewerben: Endbericht. Bonn, Berlin, 2013.
[12] N. EßIG: Gütesiegel Für Die Nachhaltigkeitsbewertung Von Gebäuden: Vom Bürobau Bis Zu Ein- Bis Zweifamilienwohnhäusern. Mauerwerk 19, no. 3. 2015.
[13] A. von RADECKI: Morgenstadt City Index. Stuttgart, 2016.
[14] The Rockefeller Foundation, ARUP, eds.: City Resilience Index: Understanding and Measuring City Resilience. Washington DC, 2015, accessed January 31, 2019.
[15] R. GIFFINGER: Smart cities Ranking of European medium-sized cities Report, Technische Universität Wien, 2007.
[16] EßIG, Gütesiegel für die Nachhaltigkeitsbewertung von Gebäuden. pp. 228. und RADECKI, Morgenstadt City Index
[17] Deutsche Gesellschaft für Nachhaltiges Bauen, DGNB System.
[18] Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) im Bundesamt für Bauwesen und Raumordnung, Leitfaden Nachhaltiges Bauen. pp. 24.
[19] The Rockefeller Foundation and ARUP, City Resilience Index. pp. 8.

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Gegenwart denkt,[20] jedoch nicht als in sich geschlossenes Konzept, sondern als Haltung und lernendes System auf Grundlage definierter Handlungsanweisungen. Hierin zeigen sich Parallelen zur städtebaulichen Praxis, die einen Planzustand als Momentaufnahme innerhalb eines Prozesses ohne definierten Beginn und Ende versteht.[21] Durch Übernahme dieser prozessorientierten Haltung und die damit verbundene Integration von Nutzungs- und Programmpotentialen besteht die Möglichkeit Nachhaltigkeitsaspekte in architektonische Prozesse zu integrieren. Parallel forciert die aktuelle klimapolitische Debatte die Hinwendung zu prozessorientiertem Denken. Sie trägt das Potential in sich, die „Gewichte in der Waagschale der Architektur" elementar zu verschieben, indem sich „Gebäudeperformance" als grundlegendes Prinzip ökologischen Bauens und mit ihr der Faktor Zeit zur relevantesten Einflussgröße architektonischer Entwurfspraxis entwickeln wird.[22]

In Planungsprozessen unter Nachhaltigkeitsaspekten gewinnen qualitative Parameter an Bedeutung. Sie repräsentieren ein Verständnis von Planung nicht im Sinne eines Lösens von technischen, sondern von gesellschaftlichen Problemen. Diese Art von Problemen erscheinen von „Natur aus verschieden von den Problemen, mit denen sich Wissenschaftler und […] Ingenieurgruppen beschäftigen. Planungsprobleme sind inhärent bösartig." Diese „Bösartigkeit" beruht auf der Komplexität der Systemzusammenhänge und auf dem Fehlen übertragbarer Lösungsansätze. Dies führt zur Frage, wie ein auf quantitativen und qualitativen Parametern aufbauendes Bewertungssystem, gleichzeitig spezifische und allgemeine Relevanz entwickeln kann. Möglich erscheint eine an verschiedene Kontexte sich anlehnende *iterative Methode*, die durch die Formulierung von Indikatoren einen allgemeinen Handlungsrahmen schafft, ohne den Gestaltungsprozess einzuengen.[23] Zielkonflikte werden hierbei nicht aufgelöst, sondern im Sinne von komplementären Beziehungen bewusst zugelassen und dadurch die Widerstandsfähigkeit des Gesamtsystems erhöht.[24]

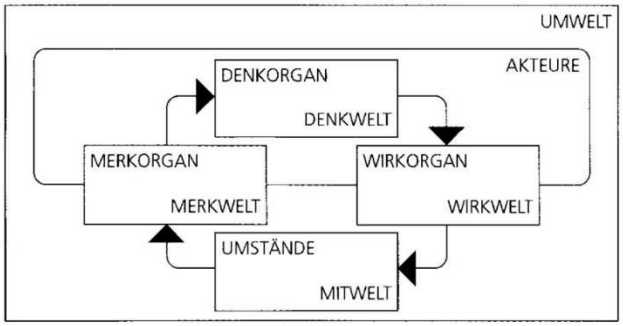

Abbildung 1: Funktionskreis nach von Uexküll 1928[25]

Ein Bewertungssystem der Nachhaltigkeit schafft einen Bezug zwischen Mikro- und Makroebene. Seine Elemente müssen die Wechselwirkung mit dem Gesamtsystem Stadt abbilden, wodurch Planung im hier skizzierten Verständnis ein *Denken in Systemen* und keine Reduktion auf Einzelaspekte repräsentiert.[26] Dennoch bilden bis heute lineare Planungsmodelle – Analyse, Festlegung der Ziele, Entwurf möglicher Handlungen und Beurteilungen der Konsequenzen – vielfach die Grundlage von Planungsprozessen. Einen alternativen Zugang bietet ein auf dem *System-Umwelt-Paradigma* basierender Planungsansatz, nach dem Modell des *Funktionskreises* Jacob von Uexkülls. Nach von Uexküll nehmen Menschen nur bestimmte Umweltreize wahr, auf die sie wiederum in bestimmter Weise antworten. Die Reaktion wirkt zurück auf die Umwelt, woraus ein geschlossener Kreislauf entsteht. Das Modell lässt sich wie folgt beschreiben: „Akteure, mit ihrer jeweiligen Gedankenwelt, agieren (in der Regel in Organisationen) als Systemkern im Kontext einer Umwelt und stehen auf bestimmte Art und Weise in ständigem Austausch mit den für sie relevanten

[20] MOE, Convergence. pp. 246.
[21] G. ALBERS: Städtebau - eine schöne Kunst? Vortrag in der Bayerischen Akademie der Schönen Künste, gehalten am 24. März 1969, 2. Aufl., Reihe der Bayerischen Akademie der Schönen Künste 2. München, 1974. pp. 6.
[22] S. KRAFT; Mende, J. von; Müller, A.: Editorial. Arch+, no. 184. 2007. pp. 2.
[23] RITTEL, Dilemmas in einer allgemeinen Theorie der Planung. pp. 17.
[24] Die Verwendung von quantitativen und qualitativen Kriterien wird auch durch die aktuelle Forschung zur Nachhaltigkeitszertifizierung empfohlen. Vgl. S. DRAEGER: Vergleich des Systems des Deutschen Gütesiegels Nachhaltiges Bauen mit internationalen Systemen. Endbericht, Bonn, Berlin, 2010. pp. 255.
[25] SCHÖNWANDT, Planung in der Krise? pp. 38.
[26] W. SCHÖNWANDT: Planung in der Krise? Theoretische Orientierungen für Architektur, Stadt- und Raumplanung. Stuttgart, 2002. pp. 35.

Komponenten dieser Umwelt."[27] Die durch die Akteurinnen und Akteure manipulierbare Umwelt (Wirkwelt) muss also als Bezugsraum des entwerferischen Handelns betrachtet werden (siehe Abb. 1).

3 TYPOLOGIE ALS METHODE

Eine Hauptforderung die durch die Analyse erhoben werden kann, besteht in der Erweiterung der Systemgrenze Gebäude durch die Nutzbarmachung der Wechselbeziehungen mit übergeordneten räumlichen System. Diese Ausweitung der „Wirkwelt" kann im Sinne Uexkülls bis zu jenem Punkt erfolgen, wie Manipulation der „Umwelt" durch Planungsentscheidungen wirksam sind. Quartiere weisen durch ihre Struktur sowohl eine durch Planung noch handhabbare Komplexität auf, während sie gleichzeitig als Mikrokosmos der sie umgebenden Stadt die Abhängigkeitsverhältnisse eines *Systems-von-Systemen* repräsentieren. In ihnen lassen die Effekte von „kulturellen Identitäten und sozialen Diffusionsprozessen beobachten", bei gleichzeitiger Überschaubarkeit des Untersuchungsraumes.[28]

Quartiere setzen sich strukturell aus den Elementen *Bebauung*, *Freiraum* und *Infrastruktur* zusammen. *Bebauung* umfasst dabei alle Arten von Gebäuden und die mit ihnen verknüpften Anlagen, *Infrastruktur* die Verkehrshierarchie und Erschließungsstrukturen, Entwurfselemente im Straßenverkehr, Entwurfselemente im Rad-und Fußverkehr und Lärmschutz, *Freiraum* die Gestaltung des öffentlichen Raums, technische Aspekte des öffentlichen Raums, Plätze in der Stadt, Grün in der Stadt und Wasser in der Stadt.[29] Diese drei *Quartierstypologien* stehen in wechselseitiger Abhängigkeit zueinander. Sie bilden die Bausteine eines alternativen Analyse- und Bewertungswerkzeugs der Nachhaltigkeit in dem sie es ermöglichen, Nachhaltigkeitsaspekte nicht nur für den Bereich Gebäude zu evaluieren, sondern für alle wesentlichen Bausteine eines Quartiers, worin sich die Forderung nach der Abbildung eines *Systems-von-Systemen* erfüllt.

Durch die typologischen Betrachtung als Grundlage von Entscheidungsfindungen wird auf eine spezifische architektonisch-städtebauliche Strategie zum Umgang mit Komplexität von Entwurfsprozessen zurückgegriffen, die Handhabbarkeit und Bearbeitbarkeit gewährleistet. Die Methode operiert im Spannungsverhältnis von klarem Definitionsrahmen und der Integration individueller und kontextabhängiger Charakteristika, wodurch sie als wirkungsvolles Instrument im Sinne der hier skizzierten Strategie gesehen werden muss.

Mit der Erweiterung des Typologiefeldes von einem (*Bebauung*) auf drei Komponenten (*Bebauung, Freiraum, Infrastruktur*) entsteht die Möglichkeit Wechselwirkungen von Systemen in einen entwerferischen Betrachtungsrahmen zu integrieren, ohne dabei die Handhabbarkeit des Modells durch einen erheblichen Komplexitätszuwachs zu konterkarieren. Gleichzeitig erscheint eine Forderung des uexküllschen Schemas erfüllt, die potentiell manipulierbare Wirkwelt der planenden Akteurinnen und Akteure abzubilden, ohne dabei dem Versuch zu erliegen, Umwelt in einem holistischen Verständnis manipulieren zu wollen.

Zusätzlich muss eine Typologie der Nachhaltigkeit Fragen der Performance und damit ihr Verhältnis zur Zeit adressieren. Dabei werden Typologien nicht als metaphysische Konzepte begriffen, sondern integrieren Lebenszyklusbetrachtung und Zirkularität. Die Erweiterung des Typologiebegriffs in diesem Sinne umfasst Aspekte der Energieversorgung und -produktion, der Soziokultur im Sinne einer Interaktion von Nutzerinnen und Nutzern und gebauter Umwelt, der Ökologie und der Wirtschaftlichkeit, wodurch sich die Möglichkeit eröffnet, Nachhaltigkeit in einem mehrdimensionalen Verständnis abzubilden. Typologie bedeutet in dem hier formulierten Verständnis weniger Form als spezifische Programmierung unter Nachhaltigkeitsaspekten.

3.1 Indizes Bebauung-Infrastruktur-Freiraum

Das *Instrument erweiterter typologischer Betrachtung zur Integration von Nachhaltigkeit in architektonische und stadtplanerische Prozesse* charakterisiert sich durch eine Fokusverschiebung von Objekthaftigkeit zu Aspekten der Zeitlichkeit, durch die Abbildung von Komplexität und deren Handhabbarmachung im Quartierszusammenhang, die Erweiterung der Systemgrenzen zugunsten eines *Systems-von-Systemen* und durch seine niedrigschwellige Verwendung in möglichst diversen Anwendungskontexten. Die kontextunabhängige Verwendung des Werkzeugs wird durch den Verzicht auf gestalterische Vorgaben erreicht.

[27] SCHÖNWANDT, Planung in der Krise? pp. 35.
[28] U. SCHEIDEWIND: Urbane Reallabore. Ein Blick in Die Aktuelle Forschungswerkstatt. pnd|online, no. 3. 2014. pp. 4.
[29] S. NETSCH: Stadtplanung: Handbuch und Entwurfshilfe, Handbuch und Entwurfshilfe. Berlin, 2015. pp. 6.

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Dies besonders im Hinblick auf symbolische und auch klimatisch-energetische Unterschiede zwischen Standorten, die eine Zieldefinition nach gestalterischen Kriterien von vorneherein ausschließen. Die drei Nachhaltigkeitsdimensionen *Ökologie*, *Ökonomie* und *Soziokultur* dienen als grundsätzliche Bewertungskriterien und tragen zu gleichen Teilen zur Urteilsfindung bei. Neben dieser programmatischen Synthese verbindet das Werkzeug verschiedene Phasen eines architektonisch-städtebaulichen Entwurfsprozesses und macht als Mittel der *design-control* eine Strukturierung von Entwurfsprozessen möglich, ohne das gestalterische Potential intuitiver und individueller Entscheidungen zu beschneiden.[30]

Die einzelnen Bewertungsräume orientieren sich am Modell der Quartierstypologien *Bebauung*, *Freiraum* und *Infrastruktur*. Jeder Bewertungsraum ist als Index konzipiert, der alle relevanten Parameter zur Realisierung eines ganzheitlichen Entwurfskonzepts im Quartierszusammenhang kombiniert und sichtbar macht. Jeder Index gliedert sich in drei Maßstabsebenen, die drei konzentrischen Kreisen zugeordnet sind, die miteinander in wechselseitiger Abhängigkeit stehen: *Dimensionen*, *Ziele* und *Indikatoren* (Abb. 2). Jede Dimension beinhaltet drei Ziele, deren Erfüllung wiederum anhand dreier Indikatoren nachgewiesen wird. Der Auswahl der drei Dimensionen *Gestaltung*, *Programm* und *Kontext* liegt ein radikal architektonischer Ansatz zu Grunde, in dem drei Grundelemente des architektonischen Entwurfsprozesses als grundsätzlich für die Erfüllung einer ganzheitlichen Problemlösungsstrategie betrachtet werden. Die Grundstruktur des Bewertungsschemas folgt also nicht einem außerhalb der Disziplin entwickelten Ansatz, sondern dockt an die Dynamik von Entwurfsprozessen selbst an.

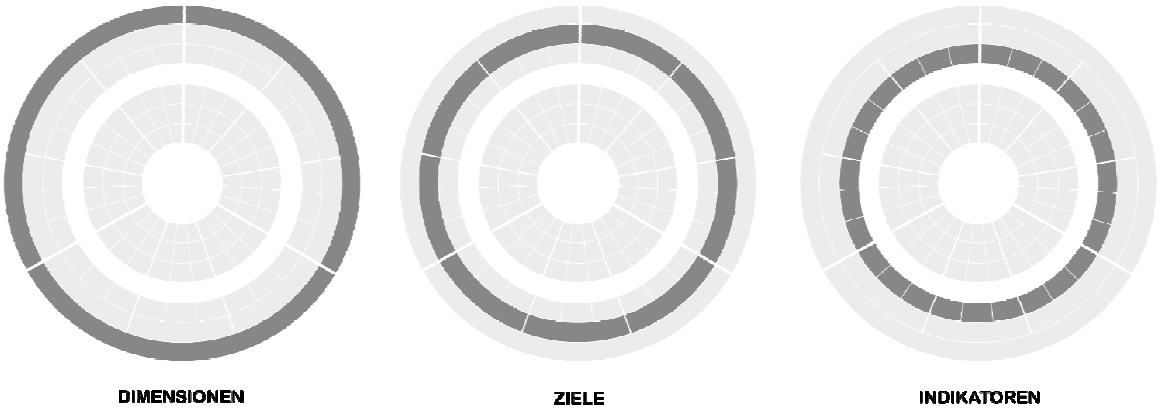

Abbildung 2: Strukturierung der Bewertungsindizes

3.2 Dimensionen der Nachhaltigkeit, Systemgrenzen und Parameter

Zur Abbildung eines ganzheitlichen Nachhaltigkeitsverständisses wurde jedem Index-Ziel eine Dimension der Nachhaltigkeit – *Ökologie, Ökonomie, Soziokultur* – zugewiesen. Es ergeben sich dadurch für jeden der drei Betrachtungsräume Bebauung, Freiraum Infrastruktur drei Ziele und neun Parameter für jede Nachhaltigkeitsdimension. Die gleichmäßige Verteilung und die damit verbundene Parität im Bewertungsverfahren unterstreicht den für die erweiterte typologische Betrachtung zentralen Aspekt der Ganzheitlichkeit. Untergeordnete Aspekte wie prozessuale und technische Nachhaltigkeit, sowie Standortqualitäten wurden als Komponenten einzelner Indikatoren in die Analysematrix integriert.

Die Dimension *Kontext* ist jedem der drei Bewertungsindizes zugeordnet. Sie dient dazu, die Wechselbeziehungen zwischen dem Gesamtsystem Quartier und den einzelnen Modulen – Bebauung, Freiraum, Infrastruktur – innerhalb des Bewertungsschemas zu verankern und für die Analyse fruchtbar zu machen. Die Bewertungsdimension *Kontext* trägt mit einem Drittel zur Beurteilung der Gesamtperformance bei (Abb.5).

[30] Das Ziel von *design-control* besteht in einer „Schritt-für-Schritt"-Kontrolle und der Gewährleistung einer hohen Prozessqualität durch systematische und zielgerichtete Vorgehensweise. Diese kontinuierliche Kontrolle „vom Planungsimpuls bis zur Planerstellung ist ein Muss, um qualitätsvolle, zielorientierte architektonische Lösungen und einen erfolgreichen interaktiven Prozess zu erreichen." M. SCHILL-FENDL: Evaluation der Planungs- und Entwurfsmethode MAPLE/D: Pre-Test eines Evaluationsmodells zur praktischen Überprüfung der Planungs- und Entwurfsmethode MAPLE/D für Architekten komplexer Aufgabenstellungen in interdisziplinären Gruppen Working Paper, Technische Universität Dresden, 2004. pp. 45.

Die in den drei Dimensionen verwendeten Indikatoren und Ziele bilden eine Synthese aus modulspezifischen (*Bebauung*, *Freiraum*, *Infrastruktur*) und systemischen (*Quartier*, *Stadt*) Elementen. Der überwiegende Teil der Parameter wurde nach einem Abwägungsverfahren, das auf Relevanz in frühen Planungsphase, ad-hoc-Bewertbarkeit und Bezug zur Nachhaltigkeitsthematik fokussiert war, aus den im Vorfeld analysierten Bewertungs- und Zertifizierungsmodellen destilliert. Für die Betrachtungsräume *Infrastruktur* und *Freiraum* mussten im Laufe des Analyseprozesses zusätzliche Indikatoren und Ziele entwickelt werden, da diese Quartiersmodule in den untersuchten Bewertungssystemen nur eine Nebenrolle spielten und daher nur wenige Indikatoren für diese Schwerpunkte identifiziert werden konnten.

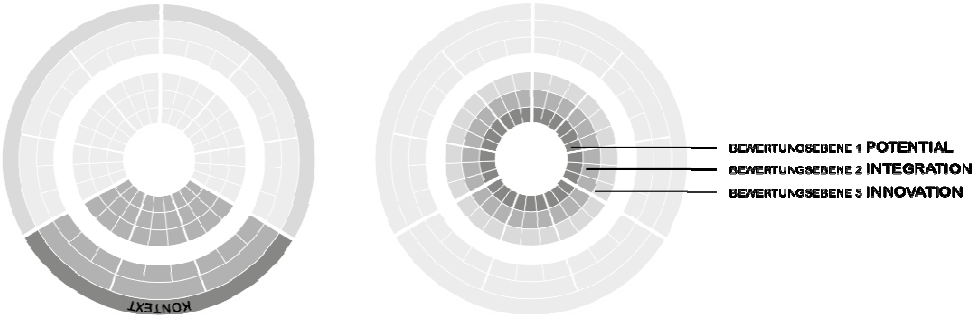

Abbildung 3: Kontextintegration und dreistufiges Bewertungsschema mit Innovationsanreiz

3.3 Bewertungsschema

Die Erfüllung der Indikatoren wird durch Leitfragen überprüft. Diese dienen nicht nur zur Beurteilung des Prozessfortschritts, sondern stellen zwischen Entwerferinnen, Entwerfern und Entwurfsgegenstand eine Rückkopplung her und garantieren eine beständige Auseinandersetzung mit dem behandelten Thema. Das Bewertungsschema ist drei¬stufig aufgebaut und verbindet die Forderung nach Prozessorientierung und nach Integration von Poten¬tialität, in dem es bereits die Möglichkeit zur Erfüllung von Indikatoren bewertet. Die einzelnen Bewertungs¬stufen gliedern sich wie folgt (Abb. 5): Stufe 1: Das Potential zur Erfüllung des Indikators ist vorhanden und kann gegebenenfalls im weiteren Verlauf des Entwurfsprozess aktiviert werden. Es stehen der Erfüllung des Indi¬kators keine Entwurfsentscheidungen entgegen. Stufe 2: Der Indikator ist in die Planung integriert und berück-sichtigt. Stufe 3: Der Indikator wurde auf innovative Weise – über etablierte Lösungsansätze hinausgehend – behandelt. Hierdurch wird zu einer Stimulierung von innovativen Ansätzen im Sinne einer Übererfüllung der Nachhaltigkeitsziele angeregt und gleichzeitig eine Fixierung auf Maximalwerte vermieden, worin sich die Haltung architektonischen und stadtplanerische Entwurfsverfahren als unabgeschlossene Pro¬zesse zu verstehen, manifestiert.

3.3.1 Gebäude

Der Index Bebauung gliedert sich in die drei Dimensionen Gestaltung, Programm und Kontext. Die Dimension Gestaltung umfasst dabei die Ziele „Energiebewusstsein“ (Ökologie) mit den Indikatoren passive und aktive Energienutzung und Graue Energie, „Kostenoptimierung“ (Ökonomie) mit den Indikatoren Lebens¬zykluskosten, Errichtungskosten und Wertstabilität und „Flexibilität“ (Soziales) mit den Indikatoren Aneignungspotential, Umbaufähigkeit und Nutzungsoffenheit der Struktur. Die Dimension Programm gliedert sich in die Ziele „positive Ökobilanz“ (Ökologie) mit den Indikatoren Nutzungssynergien, Flächen¬inan¬spruchnahme und Sicherung von Nachhaltigkeitsaspekten im Planungsprozess, „Produktivität“ (Ökonomie) mit den Indikatoren Digitalisierung, Innovationsfähigkeit und Aktivierung von lokalen Potentialen und „Kohäsion“ (Soziales) mit den Indikatoren Barrierefreiheit, Integration von Nutzerbedürfnissen und Mischnutzung. Die Dimension Kontext in „Mitigation“ (Ökologie) mit den Indikatoren Durchlüftung, Ver¬schattung und Wasserbewirtschaftung, „Zukunftsfähigkeit“ (Ökonomie) mit den Indikatoren Ausstrahlung auf das Quartier, Verkehrsanbindung und Verknüpfung mit städtebaulichen Leitbildern und „Kommunikative Orte“ (Soziales) mit den Indikatoren Aufenthaltsqualitäten, Kontextualität und Symbolische Offenheit.

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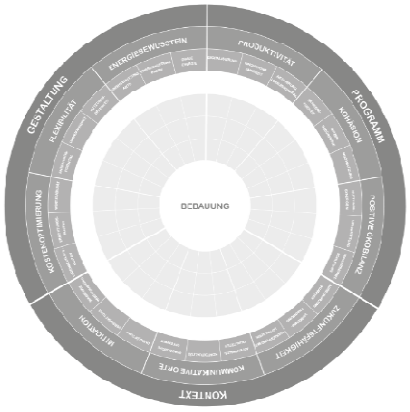
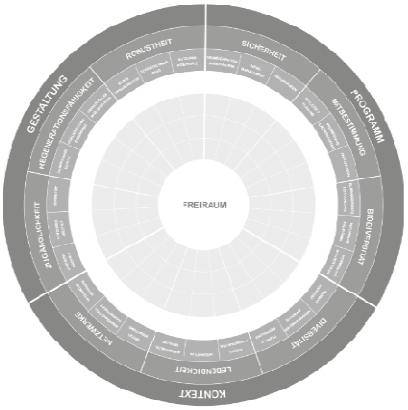


Dimensionen	Ziele	SDGs	Indikatoren	Leitfragen
Gestaltung				
	Energiebewusstsein	13,7	Energienutzung Aktiv	Werden lokale Energiepotentiale (Wind, Erdwärme, Sonne) durch die gebaute Struktur aktiv genutzt?
	ökologisch		Energienutzung Passiv	Berücksichtigen Kubatur, Lage der Fassadenöffnungen und Fassadengestaltung externe Energieeinträge?
			Graue Energie	Finden Materialien Verwendung, die geringe Energiebedarfe betrachtet auf ihren Lebenszyklus aufweisen?
	Kosteneptimierung	11	Lebenszykluskosten	Werden Strategien entwickelt, die zur Minimierung von Lebenszykluskosten und Energieverbrauche führen?
	ökonomisch		Errichtungskosten	Minimiert der Entwurf die Errichtungskosten, durch Materialwahl, Bestandselemente und Terrain?
			Wertstabilität	Gewährleisten Form, Materialität und Struktur zukünftig einen hohen Symbol-, und Gebrauchswert?
	Flexibilität	11	Aneignungspotential	Sind Elemente und Strukturen vorgesehen, die eine Aneignung durch zukünftige Nutzer unterstützen?
	sozikulturell		Umbaufähigkeit	Wird auf zukünftige Nutzungsänderungen flexibel und in der vorhandenen Struktur reagiert?
			Nutzungsoffenheit	Ermöglicht das Konzept programmatische Offenheit und damit vielfältige Nutzungen der Gebäudestruktur?
Programm				
	Positive Ökobilanz	3,13	Nutzungssynergien	Wird ein Miteinander von Nutzungen in ökologischer, energetischer und sozialer Hinsicht realisiert?
	ökologisch		Flächeninanspruchnahme	Ist die Minimierung des Flächenbedarfs durch kompakte Bauform auf Erdgeschossniveau vorgesehen?
			Sicherung von Nachhaltigkeitsaspekten	Integriert die Planung in Ausschreibung und Vergabe Nachhaltigkeitsaspekte?
	Produktivität	8,9,12	Digitalisierung	Reagiert die Architektur auf Anforderungen zunehmender Digitalisierung?
	ökonomisch		Innovationsfähigkeit	Finden innovative Strategien in sozialer, ökonomischer und ökologischer Hinsicht Berücksichtigung?
			Aktivierung von lokalen Potentialen	Stärkt die Programmwahl und die strukturelle Verzahnung mit der Umgebung die Wertschöpfung vor Ort?
	Kohäsion	11	Barrierefreiheit	Ermöglicht die Gebäudestruktur umfassende Zugänglichkeit für ein breites Nutzerspektrum?
	sozikulturell		Integration von Nutzerbedürfnissen	In welcher Weise integrieren die planerischen Entscheidungen die Interessen der zukünftigen Nutzer?
			Mischnutzung	Gewährleistet der Entwurf ein Nebeneinander von Nutzungen und dadurch ein robustes Betriebskonzept?
Kontext				
	Mitigation	3,13	Durchlüftung	Werden Aspekte der Durchlüftung auf Quartiers- und Gebäudeebene berücksichtigt?
	ökologisch		Verschattung	Reagiert die Kubatur auf die solare Einstrahlsituation vor Ort - für sich selbst und seine Umgebung?
			Wasserbewirtschaftung	Werden Strategien entwickelt, um Regen- und Brauchwasser im Gebäudekontext intelligent zu nutzen?
	Zukunftsfähigkeit	8,9	Ausstattung auf das Quartier	Trägt das Gebäudekonzept dazu bei, die stadträumliche Umgebung aufzuwerten?
	ökonomisch		Verkehrsanbindung	Leistet die Konzeption einen positiven Beitrag zur Anbindung der Nutzer an vorhandene Mobilitätsnetze?
			Verknepfung mit Leitbildern	Integriert das Konzept stadtebauliche Leitbilder und/oder schreibt es diese in die Zukunft fort?
	Kommunikative Orte	4,11	Aufenthaltsqualitäten	Stimuliert das Gebäude sein stadträumliches Umfeld und schafft es Orte mit hoher Aufenthaltsqualität?
	sozikulturell		Kontextualität	Findet im Entwurf die stadträumliche Umgebung historisch, sozial und strukturell ihre Entsprechung?
			Symbolische Offenheit	Ist eine symbolische Aneignung des Gebäudes durch unterschiedliche Akteursgruppen möglich?

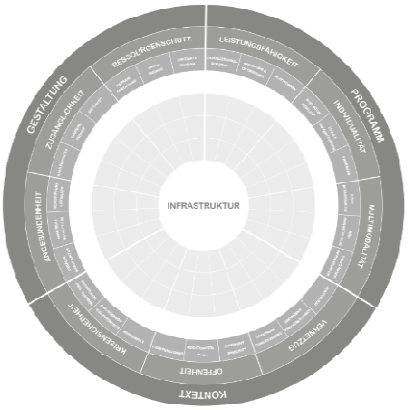
3.3.2 Freiraum

Die Dimension Gestaltung umfasst im Teilgebiet Freiraum die Ziele „Robustheit“ (Ökologie) mit den Indikatoren Blaue Infrastruktur, Versiegelungsgrad und Nutzungspotentiale, „Zugänglichkeit“ (Ökonomie) mit den Indikatoren Barrierefreiheit, Nutzungsvielfalt und Diversität in der Akteursstruktur und „Rege¬nerationsfähigkeit“ (Soziales) mit den Indikatoren Überhitzungsschutz, Resilienz bei Klimaereignissen und individuelles Wohlbefinden. Die Dimension Programm verfolgt die Ziele „Biodiversität“ (Ökologie) mit den Indikatoren Klimaangepasst Bepflanzung, Naturnahe Freiräume und Vermeidung invasiver Arten, „Sicher¬heit“ (Ökonomie) mit den Indikatoren Vermeidung von Angsträumen, Risikomanagement und Redundanzen und „Mitbestimmung“ (Soziales) mit den Indikatoren Begleitete Planungsprozesse, Angemes¬senheit der Flächennutzung und Partizipation. Die Dimension Kontext fokussiert sich auf die Ziele „Netz¬werke“ (Ökologisch) mit den Indikatoren Biotopvernetzung, Anbindung an das städtische Freiraumkonzept und die Etablierung eines Retentionsnetzwerks, Diversität (Ökonomisch) mit den Indikatoren Plurale Identität, Niedrigschwellige Angebote und Flexible Bespielung und „Lebendigkeit“ (Soziales) mit den Indikatoren Soziale Infrastruktur, Interaktion und Aufenthaltsqualität.



Dimensionen	Ziele	SDGs	Indikatoren	Leitfragen
Gestaltung				
	Robustheit	6,13,11	Blaue Infrastruktur	Integriert die Freiraumplanung Aspekte der Wasserbewirtschaftung, -speicherung und -retention?
	ökologisch		Versiegelungsgrad	Existieren Strategien einen möglichst geringen Versiegelungsgrad der Freiflächen zu realisieren?
			Nutzungspotentiale	Ist eine zukünftig Um- und Neunutzung der Flächen, ohne maßgebliche strukturelle Eingriffe gewährleistet?
	Zugänglichkeit	10	Barrierefreiheit	Wird Zugänglichkeit für Nutzerinnen mit eingeschränkter motorischen und geistigen Fähigkeiten ermöglicht?
	ökonomisch		Nutzungsvielfalt	Erfüllt das Freiraumkonzept die Ansprüche an einen möglichst vielfältiges Nutzungsspektrum?
		5	Diversität	Wird die Aneignung durch eine möglichst diverse Akteursstruktur ermöglicht?
	Regenerationsfähigkeit	3,9,11	Überhitzungsschutz	Sieht das Konzept gestalterische und funktionale Maßnahmen zum Überhitzungsschutz vor?
	sozikulturell		Resilienz bei Klimaereignissen	Wird die Widerstandsfähigkeit der Freiräume beim Eintritt selten auftretender Klimaereignisse garantiert?
			Individuelles Wohlbefinden	Gewährleisten die geplanten Strukturen Aufenthaltskomfort für ein breites Nutzerspektrum?
Programm				
	Biodiversität	3,12,13,15	Klimaangepasste Bepflanzung	Trägt die Pflanzenauswahl den sich in Zukunft anderner klimatischen Bedingungen Rechnung?
	ökologisch		Naturnahe Freiräume	Besteht der Anspruch möglichst naturnahe Angebote innerhalb urbaner Kontext zu etablieren?
			Vermeidung invasiver Arten	Legt die Pflanzenauswahl Wert auf die möglichst umfassende Verwendung heimischer Pflanzen?
	Sicherheit		Vermeidung von Angsträumen	Trägt die Gestaltung und Programmierung dem Sicherheitsbedürfnis möglichst vieler Nutzer Rechnung?
	ökonomisch		Risikomanagement	Findet eine Abwägung zur Frage von Risiken statt, dennoch öffentliche Freiräume ausgesetzt sind?
			Redundanzen	Integriert die Planung bewusst redundante Strukturen, um im Falle von Störungen leistungsfähig zu bleiben?
	Mitbestimmung	10,42	Begleitete Planungsprozesse	Verfolgt die Planungsstrategie über Elemente, die die Interaktion von Planern und Nutzern fordern?
	sozikulturell		Angemessene Flächennutzung	Berücksichtigt das Konzept eine möglichst behutsamen Umgang mit den existierenden Flächenpotentialen?
			Partizipation	Auf welchem Wege findet die Einbindung der Stakeholder/Nutzer statt?
Kontext				
	Netzwerke	3,6,13	Biotopvernetzung	Wird blaue und grüne Infrastruktur als Verbund betrachtet, der durch Vernetzung sein Potential entfaltet?
	ökologisch		Anbindung an Freiraumkonzept	Integrieren die Planungen projektbezogen mit den übergeordneten Freiraumkonzept?
			Retentionsnetzwerk	Wird Retention nicht als Einzelmaßnahme, sondern als Verbund verschiedener Elemente gedacht?
	Diversität		Plurale Identität	Ermöglicht die Gestaltung und Programmatik der Freiräume eine inklusive Identitätsbildung des Ortes?
	ökonomisch		Niedrigschwellige Angebote	Sind Freiraumangebote integriert, deren Nutzung an keine besonderen Voraussetzung gebunden ist?
			Flexible Bespielung	Welche Möglichkeiten zur temporären und langfristigen Neuprogrammierung sieht die Planung vor?
	Lebendigkeit	4,10,11	Soziale Infrastruktur	Wie werden Angebote in die Planung integriert, die den Zusammenhalt der Nutzen/Bewohner starken?
	sozikulturell		Interaktion	Welche Planungsentscheidungen tragen zur Erhöhung der Interaktion verschiedener Nutzergruppen bei?
			Aufenthaltsqualität	Bilden Maßnahmen zur Steigerung der Aufenthaltsqualität einen Bestandteil des Entwurfskonzepts?

3.3.3 Infrastruktur



Dimensionen	Ziele	SDGs	Indikatoren	Leitfragen
Gestaltung				
	Ressourcenschutz	12,15	Terraingestaltung	Werden möglichst geringe Terrainbewegungen realisiert?
	ökologisch		Graue Energie	Werden Materialien verwendet, die einen geringen Energiebedarf innerhalb ihres Lebenszyklus aufweisen?
			Effiziente Trassenführung	Wird eine möglichst effiziente und dadurch ressourcenschonende Trassenführung realisiert?
	Angebundenheit		Schnittstelle Gebäude-Infrastruktur	Existieren Konzepte, die Synergien an der Schnittstelle von Infrastrukturen und Gebäuden entfalten
	ökonomisch		Quartiersvernetzung	Auf welche Weise trägt die Infrastruktur zur Vernetzung von Mobilität und Stoffströmen bei?
			Verknüpfung mit Leitbildern	Finden nationale, regionale und lokale Leitbilder ihre räumliche Entsprechung in der Infrastrukturplanung?
	Zugänglichkeit		Shared-Spaces	Integriert die Planung flächen, die von verschiedenen Mobilitätsformen gleichberechtigt nutzen können?
	soziokulturell		Barrierefreiheit	Ermöglicht die Infrastruktur Zugänglichkeit für ein möglichst breites Nutzerspektrum?
			Offenheit	Bietet das Infrastruktursystem Adaptionsmöglichkeiten für zukünftige Technologien?
Programm				
	Multimodalität:	9,3,12,13	ÖPNV-Infrastruktur	Wird eine leistungsfähige und zukunftsfähige Integration von ÖPNV-Infrastruktur garantiert?
	ökologisch		Radinfrastruktur	Wird eine leistungsfähige und zukunftsfähige Integration von Radinfrastruktur garantiert?
			Fußgängerinfrastruktur	Wird eine leistungsfähige und zukunftsfähige Integration von Fußgängerinfrastruktur garantiert?
	Leistungsfähigkeit	9	Erschliessungseffizienz	Wie kann eine umfassende Erschließung mit einem minimalen Trassennetzwerk realisiert werden?
	ökonomisch		Steuerung und Optimierung	Integriert das Planungskonzept Möglichkeiten zur dezentralen Steuerung und potentieller Optimierung?
			Plattformen	Bieten sich Integrationsmöglichkeiten für zukünftige Nutzungen durch Energie- und Mobilitätsplattformen?
	Individualität		Innovative Mobilitätsangebote	Auf welche Weise finden innovative Mobilitätsformen und Angebote ihren Weg in die Planung?
	soziokulturell		Lokale Anforderungen	Reagiert das Konzept auf die spezifischen Anforderungen vor Ort?
			Freiräume	Können trotz Effizienzgebots Freiräume für Redundanzen und zukünftige Nutzungen integriert werden?
Kontext				
	Krisensicherheit	9,11,13	Starkregen	Sind Maßnahmen vorgesehen, die es ermöglichen Starkregenereignisse zu bewältigen?
	ökologisch		Redundanz der Verkehrssysteme	Gewährleisten redundante Strukturen während einer Störung ein Funktionieren des Betriebsablaufs?
			Robuste Trassenführung	Kann die Trassenstruktur auch unter Extrembedingungen ihre Funktion aufrecht erhalten?
	Vernetzung	9,8	Zentralität	Wird die Herausbildung eines Funktionsverbunds mit Ausstrahlung in die räumliche Umgebung gefördert?
	ökonomisch		lokale und regionale Anbindung	Wie ist die Infrastruktur an regionale und lokale Verkehrs- und Versorgungsinfrastruktur angeschlossen?
			überregionale Anbindung	Wie ist die Infrastruktur an die überregionale Verkehrs- und Versorgungsinfrastruktur angeschlossen?
	Offenheit	9,12	Leistbare Infrastrukturnetzwerke	Ermöglicht das Planungskonzept durch Kostenminimierung einen möglichst breiten Zugang?
	soziokulturell		Neue Technologien	Integriert das Konzept Potentiale zur Integration experimenteller Technologien?
			Erweiterbarkeit	Beinhalten die Planungen Möglichkeiten die Leistungskapazitäten des Netzwerks je Bedarf zu erweitern?

Der Index Infrastruktur verfolgt in der Dimension Gestaltung die Ziele „Ressourcenschutz“ (Ökologie) mit den Indikatoren Terraingestaltung, Graue Energie und Effiziente Trassenführung, „Angebundenheit“ (Ökonomie) mit den Indikatoren Schnittstelle Gebäude-Infrastruktur, Quartiersvernetzung und der Ver¬knüpfung mit übergeordneten städtebaulichen Leitbildern, „Zugänglichkeit“ (Soziales) mit den Indikatoren Shared-Spaces, Barrierefreiheit und Offenheit. Die Dimension Programm fokussiert sich auf die Ziele „Multi¬modalität“ (Ökologie) mit den Indikatoren Infrastruktur des öffentlichen Personennahverkehrs, Radinfra¬struktur und Fußgängerinfrastruktur, „Leistungsfähigkeit“ (Ökonomie) mit den Indikatoren Erschließungs¬effizienz, Steuerung und Optimierung und Plattformen und „Individualität“ (Soziales) mit den Indikatoren Innovative Mobilitätsangebote, Lokale Anforderungen und Freiräume. Die Dimension Kontext beinhaltet „Krisensicherheit“ (Ökologie) mit den Indikatoren Reaktion auf Starkregenereignisse, Redundanzen der Verkehrssysteme und Robuste Trassenführung, „Vernetzung“ (Ökonomie) mit den Indikatoren Zentralität, lokale und regionale Anbindung und überregionale Anbindung und „Offenheit“ (Soziales) mit den Indikatoren Leistbare Infrastrukturnetzwerke, Neue Technologien und Erweiterbarkeit.

4 FAZIT

Das hier skizzierte System ist primär als Methode zur Selbstkontrolle für Akteurinnen und Akteure in architektonisch-stadtplanerischen Gestaltungs- und Entscheidungsfindungsprozessen entwickelt worden. Es bietet die Möglichkeit zur Strukturierung von Entwurfsprozessen und individueller *design-control*, die verhindert, dass durch eine einseitige Fokussierung auf intuitive Entwurfsansätze die zur Etablierung von Nachhaltigkeit in Planungsprozessen notwendige ganzheitliche Arbeits- und Denkweise aus dem Fokus gerät. Der zentrale programmatische Aspekt des Ansatzes besteht in der Verschneidung von Analysetools der Makro- und Mikroebene im Quartiersmaßstab durch ein, in die Praxis des architektonisch-städtebaulichen Entwurfs selbst integriertes, *proaktiv nutzbares Planungswerkzeug*. Die Handhabbarkeit des Ansatzes in frühen Planungsphasen wird durch die Fokussierung auf die typologische Betrachtung als etablierte Methode architektonisch-stadtplanerischer Praxis erreicht, die durch eine programmatische Erweiterung ihrer tradierten Definition für die produktive Verwendung im Nachhaltigkeitskontext aktiviert wird. Die Struktur des Werkzeugs beruht auf der Annahme, dass ein Evaluierungssystem keinesfalls „hochkomplex“ sein muss, um eine effektive Bewertung von architektonischen Problemstellungen zu ermöglichen.[31]

In einem nächsten Schritt soll die *Methode erweiterter typologischen Betrachtung* zur Entwicklung beispielhafter Quartierstypologien beitragen, um die Praxistauglichkeit des Ansatzes theoretisch zu überprüfen. Ziel

[31] DRAEGER, Vergleich des Systems des Deutschen Gütesiegels Nachhaltiges Bauen mit internationalen Systemen. pp. 255.

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ist die Entwicklung eines Katalogs nachhaltiger Quartierstypologien, die weniger objekthaft, als im Sinne eines Sets von Programmen und Prozessen verstanden werden können.

Die *Methode erweiterter typologischer Betrachtung* bietet Ansatzpunkte für eine systematische Analyse und Weiterentwicklung der Begriffe Nachhaltigkeit in stadtplanerischen und architektonischen Kontext, Untersuchungen zur zukünftigen Rolle von Architektinnen, Archtikten, Stadtplanerinnen und Stadtplanern, die Weiterentwicklung einer methodenbasierten Entwurfsstrategie der Nachhaltigkeit, die Integration von Strategien aus anderen Disziplinen und die Entwicklung von Evaluationsmethoden zur Bewertung von Bewertungsmodellen selbst. Ebenso wirft die erweiterte typologische Betrachtung die Frage auf, ob die heute geltenden städtebaulichen und architektonischen Leitbilder auch weiterhin ihre Berechtigung haben werden oder ob sie durch Konzepte ersetzt werden müssen, die beispielsweise energetischen und soziokulturellen Entwurfsparametern eine wesentlich größere Bedeutung zumessen.

Die Forschung zeigt, dass der Einfluss früher architektonischer und struktureller Entscheidungen als wesentlich für die Realisierung nachhaltiger Gebäude gesehen werden kann.[32] Im Gegensatz zur Stadt der Moderne, die auf Entflechtung von Nutzungen setzte, wird die Stadt der Zukunft vermehrt aus Komponenten bestehen, die sich durch eine Überlagerung von Nutzungen und Synergieeffekte charakterisieren. Dieses Verständnis steht tradierten Planungsverfahren und Instrumenten entgegen und führt zu einer Komplexitätszunahme auf allen Maßstabsebenen. Produktiv mit dieser Situation umzugehen, muss künftig das Hauptkriterium von Architekturentwurf und -ausbildung sein. Letztlich kann sich hieraus eine Denkhaltung entwickeln, die Zielkonflikte in entwerferischen Prozessen bewusst nicht auflöst, sondern als komplementäre Bausteine eines Prozesses betrachtet, der Komplexität nutzbar macht. In diesem ganzheitlichen Denkansatz liegt eine Möglichkeit zur Beantwortung der von *Cedric Price* erhobenen Forderung nach einer hinreichenden Problemformulierung: ein der Nachhaltigkeit verpflichtet Verständnis architektonischen Entwerfens muss einer einseitigen Fokussierung von Entwurfsaufgaben durch Narrative, Sachzwänge und politische Einflussnahme entgegentreten und im Gegensatz dazu bewusst Möglichkeitsräume eröffnen und das eigene Handlungsfeld erweitern.

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🏆 *reviewed paper*

Estimating the HARA Land Use Model for Housing Planning based on Hedonic Price Analysis

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1 ABSTRACT

HARA is a land-use model that uses a search algorithm to find the optimal spatial allocation of new housing demands in an urban plan area. In the model, the plan area is represented as a grid of cells. A core element of the algorithm is a function that is used to evaluate the value of a cell for each possible land-use given its location. The value function is specified as the net value of a (housing) development given the land costs, the construction costs, and the market value of the development at a location. Specified in that way, the solution generated represents an optimum as well as a market equilibrium (maximum net value for developers). A critical prerequisite for this is, however, that the value-function is specified such that it accurately represents buyers' willingness-to-pay for dwelling and location characteristics in the housing market. In this paper, we show how the value function can be estimated using hedonic price analysis. The analysis is carried out based on a large housing transaction data set focusing on two medium-sized cities in The Netherlands combined with detailed land-use data of these areas. Although a full set of land-use types is taken into account, special attention is paid to the classification of urban green space, given the purpose to analyze scenarios for developing urban green space. The results indicate that land-use effects on housing prices differ considerably between housing types as well as city. We conclude therefore that it is important in the estimation of land-use models to take the specific local conditions of housing markets and housing segments into account.

Keywords: Land use allocation, Hedonic price method, Housing, Urban planning, decision making model

2 INTRODUCTION

Urban green space (UGS) attracts more and more attention as a means to release urban area climate problems given its variety of climate functions. Many studies have proved that UGS has great potential to deal with heat, hydrology, biodiversity and air quality problems. Also, UGS can improve the quality of the living environment for inhabitants by providing open space for relaxation, exercise and pleasant scenery. The value of UGS (e.g., as park or lake) for creating a pleasant living environment is also reflected in the value of real estate properties in the neighborhood. Purchasers of residential properties, for example, are willing to pay more for dwellings that have an attractive green neighborhood environment as shown by many studies (Engström & Gren, 2017; Huang & Yin, 2015; Jim, 2013; Kong, Yin, & Nakagoshi, 2007; Baranzini & Schaerer, 2011; Diewert, de Haan, & Hendriks, 2015). Given these advantages, urban planners generally seek proper ways to make current cities more climate adapted by using UGS as a tool. How to develop green space wisely in the city context is, however, not straight forward. Specifically, two main challenges need to be addressed. One is the costs of development and maintenance of UGS or, when retrofitted in buildings, of green vegetation on roofs or facades. Due to these costs a conflict may arise in the urban area development process between stakeholders who are seeking financial benefits and inhabitants or planners who care about living quality. The other is the scarcity of space to develop UGS especially in high-density urban area due to demands for other land-uses that must be met. The scarcity is reflected in land-prices and, therefore, also responsible for the high costs. These challenges may limit the amount and spatial flexibility of developing UGS.

Spatially, both the UGS climate (cooling effect) and (housing) property market value effects are strongly affected by their spatial allocation pattern (Li et al. 2018). Furthermore, the climate characteristics of urban green vary based on vegetation species. Spatial allocation of UGS therefore should be optimized considering their climate and land economic characteristics and effects. To support land-use decisions taking into account these objectives, in earlier work, we extended and refined the HARA[1] land-use allocation model system (Li et al. 2018). The model focuses on housing development. Using a function that determines the impact of locations on the net value of properties, the model generates allocation plans that have maximized housing

[1] HARA is an acronym for Housing-type Allocation in Residential Areas

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net value while meeting given demands for different housing types. In the process, the model considers a full range of urban and non-urban land-uses, including different green land-use types and mixing of green and built-up area (e.g., green building decorations). In Li et al. (2018) it is demonstrated how the model can be used in combination with a climate effect model to evaluate housing development strategies to release the climate pressure.

Land-use models have a long history in urban and spatial planning. A variety of modeling approaches has received attention including CA (cellular automata), regional economics (Lowry models and derivations) and optimization models. Invariably, the models use a classification of land-uses and a particular value function to evaluate the suitability of a location for a particular land-use taking into account interactions between land-uses and accessibility of locations. Obviously, for creating useful solutions the validity of the value function is of critical importance. Yet, the empirical estimation and validation of value functions have only received very little attention in land-use modeling. Usually, the models are manually calibrated based on face validity of the land-use plans generated. An exception is Ligmann-Zielinska, Church, & Jankowski (2008) who use an empirically estimated land–use allocation model to explore feasible land use possibilities. Hedonic price analysis offers a possibility to estimate the value function in a more rigorous way. A hedonic price model is able to predict the price level of a real-estate object based on characteristics of the object itself and location characteristics, and can be estimated based on transaction data.

In this paper, we consider the empirical estimation of the land value function used in the HARA model. We propose a specification of the value function that enables an empirical estimation of the parameters based on hedonic price analysis. To create a tool that is suitable for evaluating urban green scenarios, the sensitivity of the value function for urban green receives special attention. Next, we use a large transaction data set from the Netherlands to estimate the model for two cities in the Netherlands - Eindhoven and Almere. These two cities differ largely in terms of housing market and green land-use characteristics. They were chosen as cases to see whether parameter estimates show local differences between cities. Occurrence of such differences would indicate that local estimation (and application) of land-use models is needed.

The remainder of the paper is structured as follows. First, in the next section we explain the methodology used in terms of the land-use model and the hedonic price analysis. Next, in the third section, we describe the study area and data. Then, in the section that follows, we discuss the results of hedonic price analysis to estimate the value functions of the land-use allocation model. Finally, in the concluding section, we summarize the major conclusions and discuss remaining problems for future research.

3 METHODOLOGY

To provide a background for the empirical analysis that follows, in this section, we will briefly explain the HARA model, the value function that is to be estimated and hedonic price modeling as an estimation approach.

3.1 The HARA land-use model system

HARA implements an algorithm to generate optimal land-use plans, given demands for particular land-uses in a delineated plan area. The algorithm assumes that the plan area is represented as a regular grid of cells where each cell corresponds to a piece of land that has a particular land-use. Land-use allocation decisions concern decisions to develop current unbuilt-land (so-called Nature cells) for a particular urban land-use. Both the value function and allocation algorithm are focused on housing developments, so that the model can be used to generate housing development plans for a given plan area. The user specifies the size of (new) demand for each relevant housing type (e.g., stand alone, terraced houses, apartments, etc.) as well as the zones available for new housing development. Given the demands and zoning regulations, Hara determines which cells are to be developed for which housing type such that the best use for each location is realized, given the land-value function. Below we describe the function used to evaluate land developments and a method to estimate the parameters based on housing transaction data using well-known hedonic price analysis.

The value function used in Hara has the following form:

$$V_{ijk} = Vcon_{ijk} + Vnbh_{ijk} + Vacc_{ijk} \quad (1)$$

where V_{ijk} is the (market) value of housing of type *k* in cell *ij*, *Vcon* is a constant, *Vnbh* is a value component related to the direct neighborhood of the cell and *Vacc* is a value component related to accessibility of particular other land-uses from the cell. The neighborhood component is specified as:

$$Vnbh_{ijk} = \sum_{h \in H} \alpha_{kh} \cdot N_{ij0h} \quad (2)$$

where *H* is the set of all land-uses (nature, the housing land-uses and other land-uses), N_{ij0h} is the number of cells with land-use *h* in the neighborhood of cell *ij* and α_{kh} are parameters representing the marginal value of *h*-cells in the neighborhood for a housing land-use *k*. The neighborhood of a cell consists of the 8 adjacent cells. The accesibility component is specified as:

$$Vacc_{ijk} = \sum_{h \in H} \sum_{m} \beta_{khm} \cdot I_m(D_{ijh}^{min}) + \sum_{h \in H} \sum_{q} \gamma_{khq} \cdot N_{ijqh} \quad (3)$$

where *H* is defined as above, D_{ijh}^{min} is the distance to the nearest cell with land-use *h* from cell *ij*, I_m is a binary variable indicating whether the distance falls in the *m*-th distance band (= 1, if it does and 0 if it does not), β_{khm} is the value of having land-use *h* within distance band *m* for land-use *k*, N_{ijqh} is the number of *h*-cells within distance D_q from cell *ij* and γ_{khq} is a parameter representing the value of the accessibility of *h*-cells within that distance for a housing land-use *k*. Thus, accessibility is measured in two ways - availability of land-uses in distance ranges from the cell and distance to nearest cells with particular land-uses. Which of these two methods is most appropriate may depend on the land-use under concern.

The constants and coefficients $Vcon_{ijk}$, α_{kh}, β_{khm} and γ_{khq} are parameters that need to be estimated. We propose to use hedonic price analysis to estimate the parameters. The impact of urban green on value of residential property comes to expression in the alpha parameters (green land-uses in the direct neighborhood) and possibly also in beta and gamma parameters (accessibility to recreational green). As the subscripts indicate the values of all parameters are housing type (*k*) specific.

3.2 Hedonic price analysis

Hedonic price analysis uses multiple regression analysis to estimate the contributions of housing attributes on the total value (or price) of a dwelling (Rosen, 1974). When demand and supply of dwellings are in equilibrium, the estimated marginal values represent willingness-to-pay values of buyers for the specific attributes (Maslianskaïa-Pautrel & Baumont, 2016). Since the analysis of urban green scenarios is a special aim of the land-use model (HARA), the impact of UGS on housing values is of special interest in the hedonic price model we develop here. Therefore, in this section, we briefly review existing studies that have aimed to model UGS and measure its impact on housing values through hedonic price analysis.

Melichar & Kaprová (2013) investigate the distance ranges in which UGS have positive effects on housing prices. Tyrväinen & Miettinen (2000) finds that buyers have to pay more to obtain a dwelling with a green space view, which depends on the natural environment quality and amount. Conway, Li, Wolch, Kahle, & Jerrett (2010) show that each additional percentage of greenery coverage significantly increases the housing price. GIS has been used as a tool to determine a wide range of spatial factors in a hedonic pricing model to explore the urban green spatial configuration impacts on residential building prices (Asmawi, Norzailawati, & Tuminah, 2016). Diversity of urban green vegetation types and spatial landscape has also been shown to have added value on dwelling price (Panduro & Veie, 2013; Franco & Macdonald, 2016) . However, existing research has mostly focused on one single type of urban green (e.g., a park). In the present study, we extend existing literature by considering a broader range of urban green types that can be taken into account in land-use models. Furthermore, in our analysis, we make a comparison between two regions, in order to see whether local land-use configurations and housing market conditions have an influence on price relationships.

3.3 Estimation approach

A complication for hedonic price analysis is that structural, neighborhood and accessibility variables relate to different levels of scale - the plot and building, the direct neighborhood and the wider area of the dwelling, respectively. A robust and well-known way of estimating the parameters in such a multi-level case is to estimate fixed effects for locations in a first step regression analysis which are then used as dependent

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variable to estimate the effects of the location factors in a second-step regression (Helbich, Brunauer, Vaz, & Nijkamp, 2014). Formally, the regression models for the two steps are specified as follows. For the first-step regression analysis, the model is specified as:

$$\ln Y_{ij} = \beta_{01} + \beta_1 H_j + \beta_2 L_i + S_i + \varepsilon_{ij1} \quad (4)$$

where Y_{ij} is the transaction price of a dwelling j at location i, β_{01} is an intercept, H_j is a vector of value-relevant dwelling characteristics (volume, lot size, construction year, maintenance condition, etc.) and β_1 is a vector of related coefficients, L_i is a vector of neighborhood characteristics (urban green and other land-use types) and β_2 is vector of related coefficients, S_i represents the *fixed* effect of location i, and ε_{ij1} is random error term. By using the natural log of price as dependent variable, which is a commonly used approach, the coefficients represent effects as a percentage price increase. In this model, S_i captures the price effect of the location after having taken into account the dwelling and neighborhood characteristics.

In the second step, the fixed effects are regressed on accessibility factors to identify the marginal effects of location characteristics. The regression equation for the second step can be written as:

$$S_i = \beta_{02} + \beta_3 D_i + \varepsilon_{i2} \quad (5)$$

where β_{02} is an intercept, D_i a vector of location accessibility characteristcs, β_3 is a vector of related coefficients and ε_{i2} is a a random error term.

This two-step hedonic price model allows us to estimate the parameters of the HARA value function: the *Vcon* term (Eq. 1) corresponds to $\beta_{01} + \beta_1 H_j + \beta_{02}$, the alpha parameters (Eq. 2) to β_1 and the beta parameters (Eq. 3) to β_3 with proper handling of the log transformation of price. Since all parameters in the HARA model have housing type specific values, the regression models (Eqs 4 and 5) must be estimated housing type specific. Given limited space, we will only consider the first-step regression analysis in the application described in the next section.

4 STUDY AREA AND DATA

Figure 1 shows the location of the Eindhoven and Almere cities in the Netherlands. Almere is a planned city with 208,000 citizens (2019) in the province of Flevoland, Netherlands. Eindhoven is the fifth-largest city of the Netherlands with 231,000 citizens (2019) and located in the south of the country. Eindhoven is an industrial city in the center of a region that houses a lot of high-tech companies.

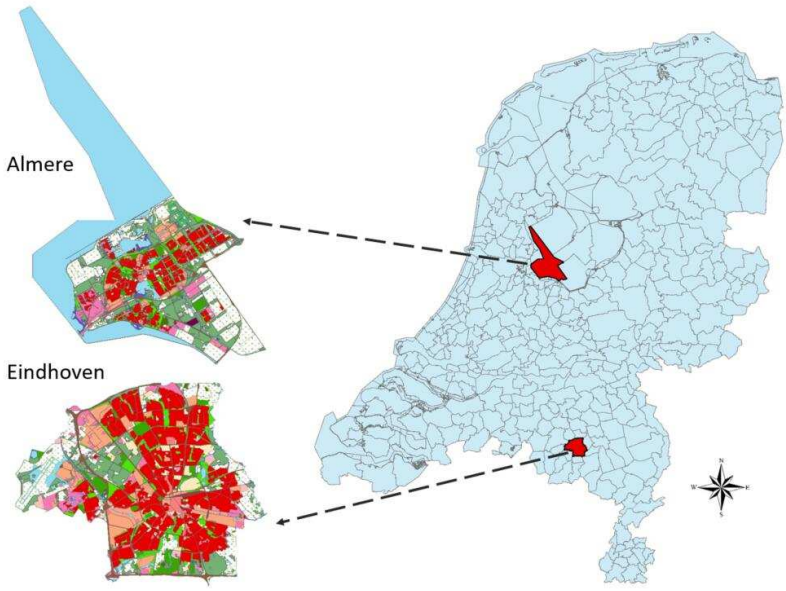

Figure 1: Research areas location (the cities Almere and Eindhoven)

The spatial land-use data used for the analysis are provided by the CBS (Central Bureau of Statistics) in the Netherlands. The transaction data used are provided by the NVM, the largest real estate market agency, in the Netherlands. For the present study NVM-data of transactions that took place in Eindhoven and Almere

from 2014 to 2018 were used. The data-set consists of 18813 geocoded housing transactions. Table 1 shows the dwelling characteristic variables Hj and neighborhood land use variables Li that entered the hedonic regression model. Of interest here is the estimation of location effects on housing price on the level of the neighborhood land-use variables. The land-use data include all land-use categories that are potentially relevant for housing value and land-use planning. The classification of UGS is extensive compared to earlier studies. This allows us to estimate housing value effects of UGS in a more detailed way than have been done so far. Also on the level of other land-uses, we are not aware of other hedonic price analysis studies that have modeled neighborhoods in this level of detail. The dwelling characteristics are included as control variables.

Dwelling characteristics			
Variable	Description	Measure	Expected sign
Log of transaction price		Number	DV[a]
Area		Number	+
Number of rooms		Number	+
Volume of the dwelling		Number	+
Construction year	Old to new (0-9)	Categorical	-
Lift	House has a lift (0/1)	Binary	+
Heating system	No; simple; advanced (0/1/2)	Categorical	+
Parking space	House has a parking space (0/1)	Binary	+
Facing direction	Good to normal (0-4)	Categorical	+
Maintenance inside	Excellent to bad (1-9)	Categorical	+

Neighborhood land use variables			
Variable	Description	Measure	Expected sign
Shopping area	Retail; restaurant; shopping mall, etc	%	+
Industry and office	Industry area; business offices	%	-
Public buildings	Museum; city hall; school; hospital	%	+
Road traffic area	Road traffic area	%	-
Park and sports field	Parks, sports field	%	+
Day recreational area	Day recreational area	%	+
Agricultural	Agricultural land use	%	+
Forest	Forest	%	+
Open wet natural terrain	Open wet natural land use	%	+
River and lake	River and lake	%	+
Other water body	Other inland water	%	+

[a] Dependent variable

Table 1: Definitions and descriptive of variables entering the hedonic model

The land-use variables related to each transacted dwelling are determined based on the HARA land use modeling framework. Each spatial observation is located by its postcode on a six-digit level and overlayed by a 100 by 100 meter cells grid. After this, the land-use characteristics of each cell's direct neighborhood (eight cells) are calculated as the percentage of cells covered by the land-use (Figure 2). The 4-digit postcode to which each transaction belongs are entered as dummies in the regression equations to estimate the fixed effects, Si. Eindhoven counts 47 4-digit postcode areas and Almere 52.

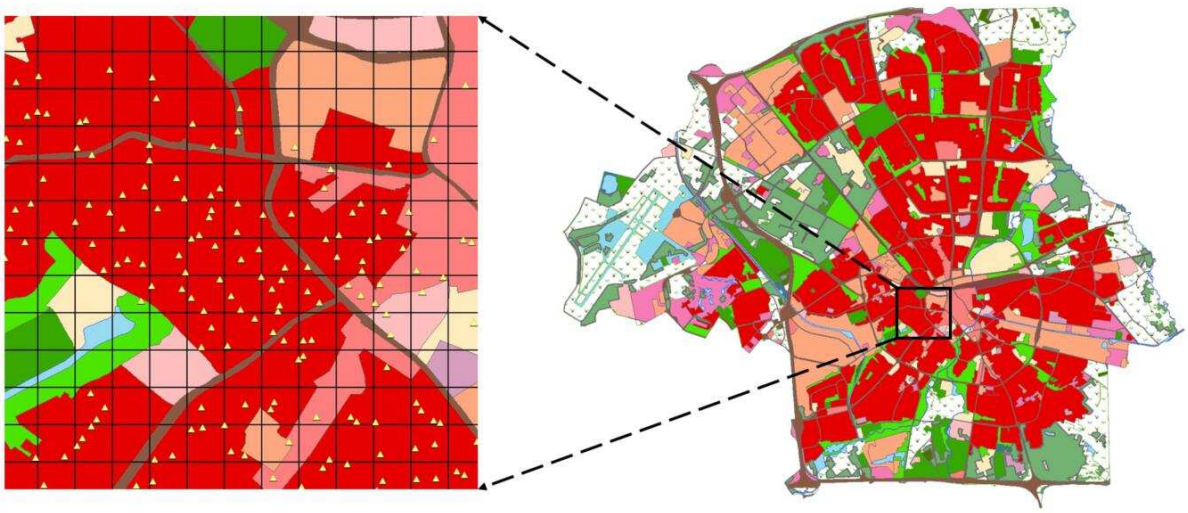

Figure 2: Transaction cases plotted on the grid map in Eindhoven

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5 RESULTS AND DISCUSSION

Housing types are classified into four categories: apartments, row house, semi-detached and detached. The hedonic regression model is estimated separately for the four major housing types and the two study areas Eindhoven and Almere. The Enter method was used and non-significant variables were removed to obtain a final model specification in each estimation using 5% alpha level. Table 2 shows summary statistics of the eight models.

Model	City	Adjusted R Square	N
All	Almere	.735	8115
Apartment	Almere	.582	1738
Row	Almere	.462	4804
Semi-detached	Almere	.583	1036
Detached	Almere	.603	491
All	Eindhoven	.784	10698
Apartment	Eindhoven	.718	3894
Row	Eindhoven	.638	4944
Semi-detached	Eindhoven	.718	1211
Detached	Eindhoven	.820	559

Table 2: Summary statistics of the eight models

Given the purpose of the present study, we will focus on the estimation results on the level of the land-use variables. For these variables, Table 3 shows the estimation results for Almere, and Table 4 for Eindhoven.

	Variable	Mean	Std. Deviation	Unstandardized Coefficients B	Standardized coefficients Beta	sig
All	Shopping area	2.523	11.322	.001	.040	.000
	Industry and office	2.188	7.162	.001	.020	.002
	Road traffic area	1.984	3.224	.002	.019	.002
	Park and sports field	11.129	12.572	.001	.035	.000
	Day recreational area	.218	2.373	.004	.026	.001
	Agricultural	.333	2.764	.003	.024	.000
	Forest	1.015	4.815	.001	.021	.001
	Open wet natural terrain	.0162	.730	.007	.016	.007
	River and lake	.226	2.440	.007	.049	.000
	Other water body	4.277	7.752	.003	.078	.000
Apart-ment	Shopping area	9.855	22.245	.003	.211	.000
	Industry and office	3.002	8.906	.005	.167	.000
	Park and sports field	11.586	15.121	.002	.105	.000
	Agricultural	.713	4.181	.003	.037	.037
	River and lake	.834	4.306	.009	.139	.000
	Other water body	8.020	12.840	.005	.203	.000
Row	Shopping area	.549	3.231	.003	.040	.000
	Industry and office	1.887	6.163	-.001	-.025	.029
	Road traffic area	1.780	3.049	.003	.044	.000
	Day recreational area	.096	1.737	.006	.050	.000
Semi-det.	Other water body	5.116	7.954	.003	.114	.000
Det.	Industry and office	1.605	7.525	-.003	-.105	.004
	Open wet natural terrain	.088	.685	.035	.102	.003

Table 3: Hedonic price regression results for the land-use variables in Almere

	Variable	Mean	Std. Deviation	Unstandardized Coefficients B	Standardized coefficients Beta	sig
All	Shopping area	4.647	12.371	.001	.029	.000
	Public buildings	3.771	9.617	-.002	-.043	.000
	Park and sports field	4.235	8.502	.001	.013	.008
	Day recreational area	.0258	.539	.007	.009	.047
	Other water body	.220	1.243	.005	.014	.004
Apart-ment	Shopping area	9.633	17.709	.002	.068	.000
	Industry and office	4.563	9.486	.001	.032	.002
	Public buildings	7.023	13.472	-.002	-.084	.000
	Road traffic area	8.009	7.122	.002	.040	.000
Row	Public buildings	2.004	6.026	.001	.029	.002
	Agricultural	.523	3.507	.002	.026	.006
	Forest	.572	3.264	-.003	-.029	.001
Semi-det.	Shopping area	1.708	6.855	.002	.053	.003
	Road traffic area	4.335	5.501	-.002	-.040	.017
	Park and sports field	4.244	8.628	.001	.039	.017
	Forest	1.241	4.895	-.004	-.060	.000
	Other water body	.223	1.467	.009	.042	.012
Det.	Park and sports field	6.305	10.442	.002	.056	.006

Table 4. Hedonic price regression results for the land-use variables in Eindhoven

We will discuss the results of Tables 3 and 4 with regard to the question whether there are differences between the two cities and within cities between housing types regarding the neighborhood land-use effects. First, for the question whether differences exist between cities, we consider the estimation results for all housing types together. In both cities, shopping area, park and sports field, day recreation area and water all have significant positive effects on housing price. For the other land-uses, however, there is no correspondence between the cities indicating that land-use neighborhood effects are dependent on the existing local landscape and housing pattern.

Second, regarding the question whether there are differences in the valuation of neighborhood land-uses between housing types we will consider Eindhoven as case. We consider the different land-uses in turn.

Shopping area has positive effects on housing price for apartments and semi-detached housing and no significant effect for row houses and detached houses. Since the pattern is different in Almere (shopping area only positive for apartment and row), the specific local pattern of housing facilities probably plays a role so that it is hard to generalize the finding.

Similarly, Park and sports field has positive effects on semi-detached housing and detached housing. There is no significant influence on the apartments and row houses. From the overall regression result, the park and sports field land use have positive effects. The possible explanation is that the low-density expensive housing buyers (high-income or family with children segment) are more concerned about the open urban green space for sports recreation compared to the market segment living in apartments and row houses.

Other water body has a low standard deviation in Eindhoven, reflecting the fact that relatively few transaction cases concern dwellings that possess water land-use in the direct neighborhood. In segments where the standard deviation is higher the effect is positive. Therefore, it is plausible that overall water land-use has positive impacts on the housing price. The same holds for day recreational area.

Public buildings have a positive effect on the price of row houses, but a negative effect on the price of apartments in Eindhoven. Since there is no common finding for both two cities, we didn't find significant effect of public buildings. This may be because the public buildings land use type includes so many different types, such as city hall, hospitals, museums, schools and so on. And we didn't specify the type of public facilites. Therefore, since mutiple funtional facilities may affects housing value differently, it is difficult to find a common effect regarding public buildings as a single land use type.

Industry and office has a positive effect on the price of apartments. This land-use mainly refers to business and commercial land-use, including creative business offices and small-scale industry, which are typically located near the city center. Given the nature of this industry negative externalities such as noise and pollution is not in play. That may explain the positive influence on the housing price. The positive influence does not have significant influence on other housing types (based on the overall results in Eindhoven). So the explanation could be that for owners of apartments on average the creative business activities add to the quality of the environment in or around the city center locations.

Road traffic land use has a positive impact on apartment prices and a negative impact on price of semi-detached houses in Eindhoven. In Almere, road traffic has a positive effect on price of row houses. Based on the results of both cities, we can conclude that, to some extent, from row house to semi-detached house, there is a negative effect. This indicates that the balance between convenience and quietness may differ between housing types.

Agricultural and forest are mostly located at the edge of a city. Only the neighborhoods located near the border of the city have agriculture and forest land-use in the direct neighborhood. Agricultural land-use has a positive effect on the price of row houses. This may be an edge-of-the-city effect. Unexpectedly, forest has a negative effect on row and semidetached housing types. However in Almere, all the natural environment land use, including open wet natural terrain, agricultural and forest all have a positive effect. In Almere the allocation pattern of these nature elements is much more evenly distributed compared to Eindhoven. Hence, the negative effect of forest in Eindhoven may not be a generalizable effect.

In conclusion, shopping area and park and sports field are two types of land-use environment that have a positive impact on house purchasers' preferences. Housing buyers' evaluations of industry and office, public buildings, and traffic land use depend on housing type, which may be related to differences in family situations between housing types. Apartment owners prefer industry and office and road traffic area in the

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neighborhood possibly due to convenience and a city like atmosphere, while house owners of lower density housing assign more value to public buildings in the neighborhood such as schools and hospitals. Agriculture and forest are located at the edge of the city and may reflect how isolated the housing locations are.

6 CONCLUSIONS

In this paper we have proposed and illustrated the use of hedonic price modeling to estimate parameters of a land-use allocation model. The model focuses on housing. Although all land-uses are taken into account, UGS receives special attention given the intended use of the model to analyze urban green scenarios. We showed how a hedonic price model can be specified to fit the framework of the land-use model. A large housing transaction dataset was used and the analysis was conducted for two medium-sized cities in the Netherlands. Hedonic price models were estimated separately for different housing types and a full range of land-uses was taken into account.

The results indicate that UGS indeed has a positive influence on residential real estate prices to some extent. Different UGS types have different impacts on dwelling prices. Comparing the two cities - Eindhoven and Almere - the results indicate that local differences exist that are related to specific characteristics of the spatial land-use arrangement in the two areas. Especially, some UGS types do not occur in both municipalities. We also found structural differences in the way land-use affects housing prices between different housing types that may be related to differences in socio-demographic and socio-economic characteristics. Therefore, the findings indicate that land-use models should be estimated locally and housing market segment specific. The parameter estimates can be transferred to the HARA model system. In a follow-up we plan to develop an application of the estimated model to analyze UGS scenarios to support the development of urban greening strategies.

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🏆 *reviewed paper*

Evaluating the Impact of Innovative Public Transport Systems: a Case of South Africa

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1 ABSTRACT

The Fourth industrial revolution has created new realities on the spatial growth of urban areas. One interesting phenomenon is the innovative public transportation systems that have emerged in the developing world. Developing countries such as South Africa have seen a rapid improvement in mobility systems, with the introduction of innovative public transport systems such as bike sharing services, bus rapid transport and high speed trains. Building on these innovations is the concept of big data, which has enhance the development of information dissemination systems. The objective of this paper was to review innovative public transportation systems and develop an index to determine the sustainability of these systems. Using an explorative approach the innovative public transportation systems were assessed in relation to the spatial development of land parcels within their proximity. Preliminary results reveal locations within close proximity to the high speed train stations are highly accessible, as there are connected to more one or two other traditional mobility systems which has increased the rate of multi-modal trips in these zones. Although bike sharing services are present in major metropolitan cities, few commuters utilise these services for commuting trips. In conclusion the innovative public transportation systems have improved mobility in the city, however, currently interchange zones between these modes are still limited which has adversely affected the rate of multi-modal commuting. Also economic opportunities over time for citizens have increased in location within close proximity to routes of these innovative mobility systems.

Keywords: Innovative public transportation, Connectivity, Multi-modal, Sustainability, South Africa.

2 INTRODUCTION

Public transportation has over the past decade evolved. Notable examples inlude the introduction of high speed trains, bus rapid transportation and ride sharing servies. In developing world there has been a growth of interest in the concerpt of innovative urban public transport systems. Innovative public transportation uses optimal efficiency to improve the communting experience as a whole. Within the innovation sector of transportation planning, literature focuses on implementation and dissemination of transportation infrastructure and service delivery. However, there is a large gap in the literature related to empirically evaluating the outcomes associated with public transport innovation (Novak, 2015). Whilst there is literature on how innovation can guide policy development, there is still a need for more research that evaluates the impact of innovation on mobility trends. To address this city authorise have developed models to ensure sustainability within the transportation sector (Geurs & van Wee, 2013; Yatskiv & Budilovich, 2017).

With the urban population growing at such a rapid rate, transportation planning is consequently faced with challenges of optimisation of services and infrastructure. Improving the commuting experience is essential in bridging the inequality gap in most developing countries. Developing countries have set a sustainable urban public transport (PT) trend, through the adoption of improved urban PT standards which facilitates transformation through initiatives such as using non-motorised transport, improved urban PT and mobility systems and providing pedestrian walking zones in cities previously dominated by automobiles (Veeneman, 2016; Pojani & Stead, 2015).

3 LITERATURE REVIEW

PT is an essential means of mobility for any city and it‘s dwellers (Potter & Skinner, 2000). Public transport provision provides for the needs of the urban dwellers while providing functionality to a city and it‘s economy (Cardinale et al., 2014; Ryser, 2014; Schwaberger, 2014). Central to urban public transport is the ability to be accessible, reliable, convenient and affordable to the commuters, making movement from one location to another possible (Scoppetta, 2014; Szczech, 2014; Tan et al., 2008; Zhou, 2014). In this regard,

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urban public transport paves a way for economic, social, health and environment aspects of a city and its dwellers to thrive providing better livelihoods. Significantly, urban public transport plays a crucial role in reducing private motor vehicle use, traffic congestion and environmental pollution in cities across the world. (Tanahashi et al., 2012; GMA, 2013; Tillner, 2014).

Urban PT has vastly evolved into a concept of better possibilities. Moreover, it has become the theatre of innovative ideas, opportunities as well as a platform to collaborate with different sectors in development. Although there is no common definition for innovative, there are still many concepts surrounding the term (Cobbinah et al, 2015). The concept needs to be unpacked as it has elements lined to being smart and the Fourth industrial revolution (4iR). Countless authors have exhausted meaningful means to epitomize the concept of innovative public transportation systems and many cities in the global north and south are in the process of implementing the concept as thorough and best as they can (Zhukova & Smirnova, 2014).

Emerging research studies on mobility have focused on factors which have historically reflected the various levels of accessibility such as distance or time between points of origin to destinations (Castillo & Benitez, 2012; Nil & Naciye 2004). In this interplay of public transportation provision, innovation is not limited to creating new services and improving existing ones. Innovation is also required to reduce transactions costs, enabling commuters to reach their target destinations. Improved travel time, connectivity and information dissemination are a few of the innovations that have been introducted to improve the commuting experience (Legara et al, 2014; Novak et al, 2015; Perl & Goetz, 2015).

In an international context, different methods have been created to obtain new knowledge to develop innovative urban PT, with some researchers focusing on smart cities (Giffinger et al., 2007), transport economics and urban geography (Miller, 2013; Gao et al, 2013). Agostino et al., (2014) have articulated in developing urban public transportation for an agglomeration, technology can be instrument for improving mobility. Currently, the state of urban public transport in most developing countries is gradually improving as evident in South Africa and Ethiopia that have implemented innovative public transport systems namely high speed railway systems and bus rapid transporation sytems in their metropolitan cities (Wilkinson, 2009; Yatskiv & Budilovich, 2017).

Building on such innovations over the years have been new phenomena such as the concept of big data, which has enhance the development of information dissemination systems. Big data has also been described as “datasets whose size is beyond the ability of commonly used software tools to capture, manage and process the data within a tolerable elapsed time. The integration of urban public transport and big data has significantly enhanced the manner in which authorizes manage and monitor spatial interests. Nonetheless, though the potential merits of implementing urban public transport are vast, most African cities are still to integrate them into their daily practice, as most do not have the required mechanisms to do so (Ambrosin et al, 2014; Cardinale et al, 2014).

Given such a background, the physical structures of PT systems encompass the road networks, railways, routes and stops represented by a multifaceted network of spatial and temporal data (Ceder, 2007; Hadasa et al, 2014). Kittelson & Associates et al., (2003), hence have expressed that in order to measure or analyse the connectivity of PT systems, one needs to focus on three key factors: Firstly, the geographic location, that is area where the service is offered. Secondly, the temporal aspects, that is the time factor associated with the service and lastly focus must be given on information that is how accessible is information regarding the service.

Contemporary, information and communication technologies (ICTs) allow public transportation providers to tap into previously inaccessible sources of demand by establishing an instantaneous connection with the city (Geurs et al, 2013; Małeckia et al, 2014). This opens up new possibilities in origin and destination (O-D) analysis as people move around with various mobile devices which are constantly sending information to the internet, such as cell phones, tablets and smart watches. This will allow for more accurate location of trip distribution and also trace the various movement networks. As internet of things (IoT) has led to nearly every device and human being locatable and interlinked (Farooq, et al., 2015). This has greatly made man’s life simpler and transformed how decision making is done, as information is now shared almost instantaneously and at times automatically. However with this interconnectivity concerns of information security have arisen and a call for new means to ensure data is secure arises (Farooq, et al., 2015). With the right capabilities, technology-driven structural change in public transportation systems, greatly reduced trave-times for

commuter. Notable examples have been the high-speed trains, ride-sharing services, and bus rapid transportation.

4 STUDY AREA

Recognising that developing cities are different, we assess the metropolitan cities namely Johanesburg, Pretoria, Ekurhluleni and Cape Town in South Africa (see figure 1). All the four cities are run by an elected executive mayor from a political party. The Gauteng economic hub is made up of three metropolitan cities namely Johannesburg, Tshwane and Ekurhuleni. The innovative public transportation connecting the Gauteng economic hub is the Gautrain, a high speed train (figure 2). Johannesburg is the commercial capital of South Africa with a population of 957 441 people and a surface area of 1,645km2 (Stats S.A, 2011). The Rea Vaya is a rapid bus transporation which connects commuters from the south of the city to the central business district of Johannesburg (Figure 3). Pretoria is located to the north of Johannesburg as is known as the administrative capital of South Africa with a surface area of 687,5 km2 and a population of 741 651 people (Stats S.A, 2011). A Re Yeng is a rapid bus transporation, which connects commuters within central Pretoria (figure 2). Ekurhuleni lies to the east of Johannesburg and is known as South Africa's manufacturing hub with a population nearly 3.2 million and a surface area of 1,975 km² (City of Ekurhuleni, 2013). Harambe is a bus rapid transporation currently being implemented in Ekurhuleni, which is still at the initial stages of operations. Cape Town, located in the Western Cape province of South Africa has a population of 433 688 people and a surface area of 400,3 km2 (Stats S.A, 2011). MyCiti is a rapid bus transporation which connects commuters in central Cape Town (figure 3).

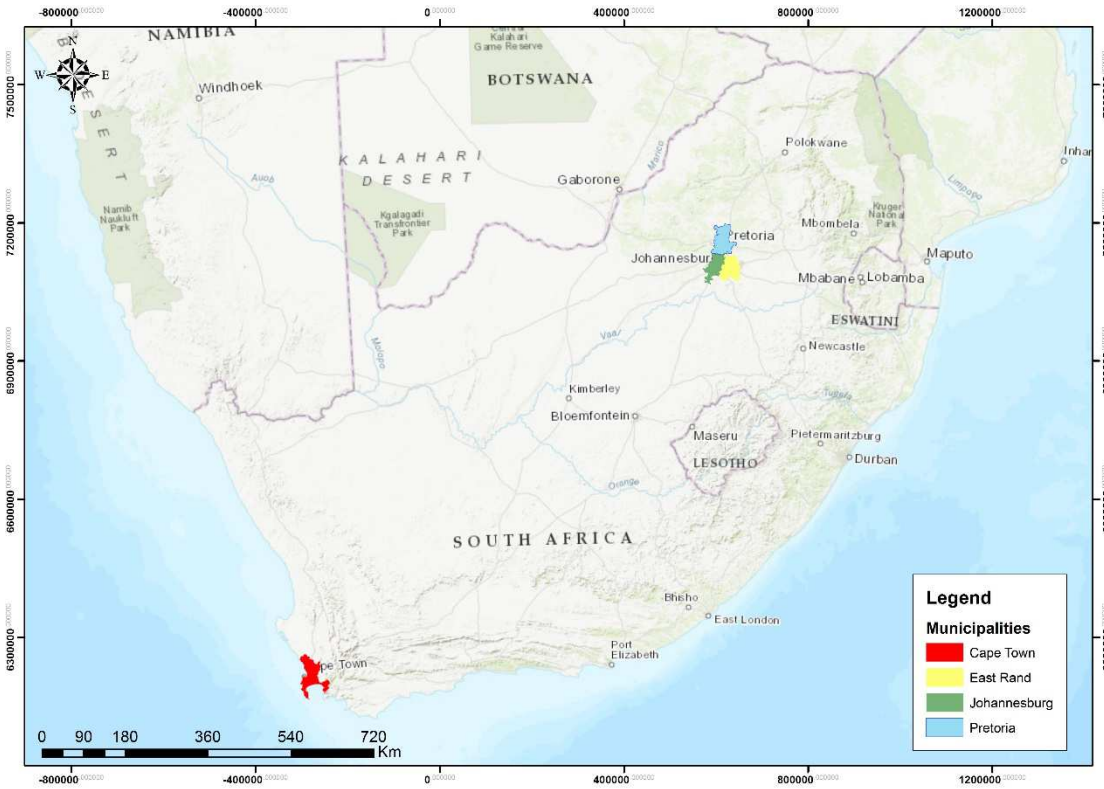

Figure 1: Study Area

5 METHODOLOGY

Using an explorative approach the innovative public transportation systems in the metropolitan cities were assessed in relation to the spatial development of land parcels within their proximity. Key informant interviews were also used to unpack the status quo of urban public transport systems; while spatial data (GIS Shapefiles) are used to visualize rail and road route networks of the urban public transport systems. Consequently a workshop was conducted with a group consisting of four spatial planners (i.e., urban and transport planners) from the four metropolitan cities and 16 masters students from the University of Johannesburg. An index was developed that ranked the public transportation in the cities (see figure 4). For

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the various mobility systems each was ranked using the developed Index factors and was given a score from 0 to 100.

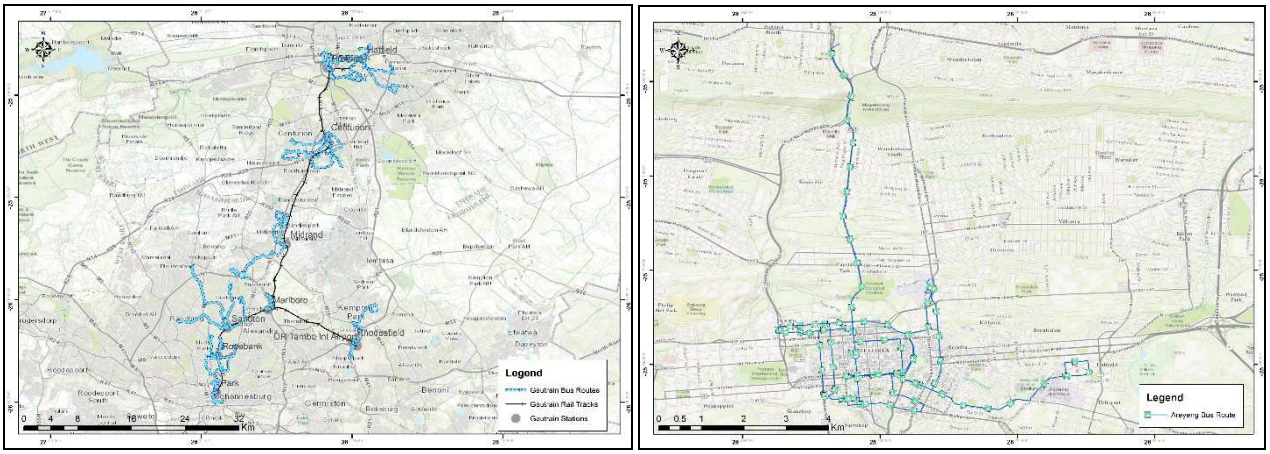


Figure 2: Gautrain (Johannesburg, Pretoria and Ekurhluleni) and A Re Yeng (Pretoria)

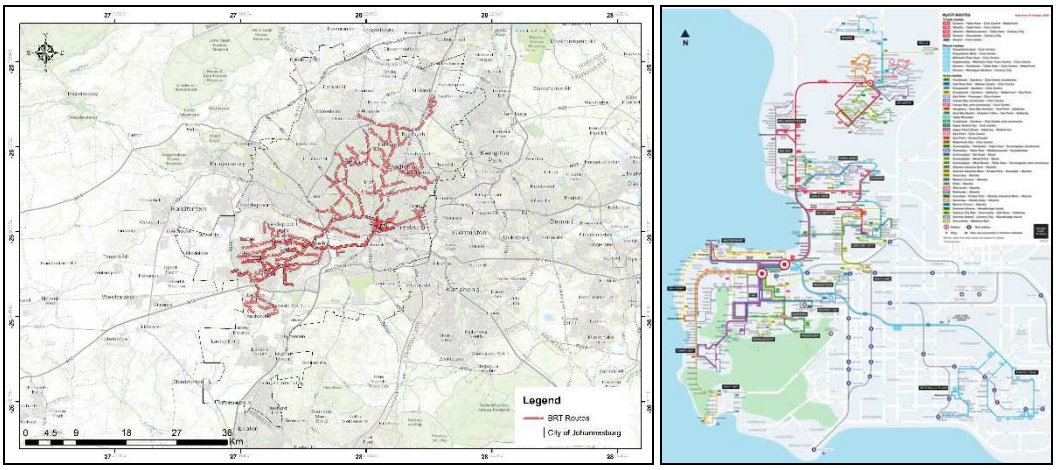


Figure 3: Rea Vaya (Johannesburg) and MyCiti (Cape Town)

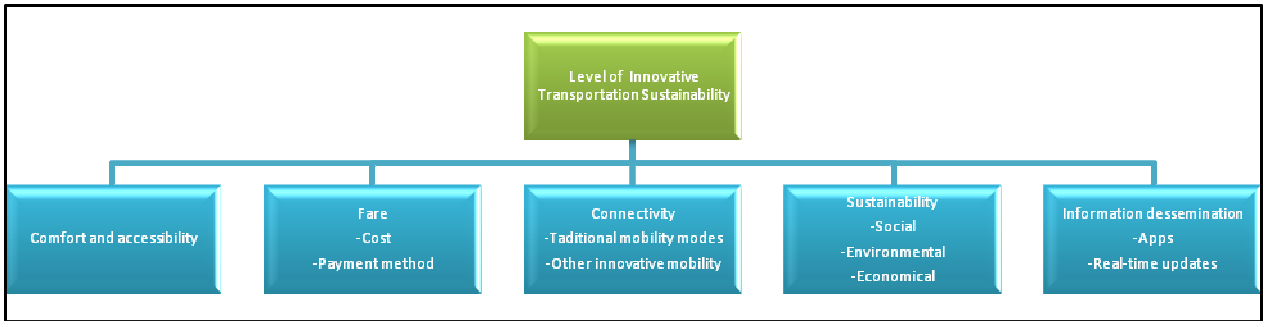


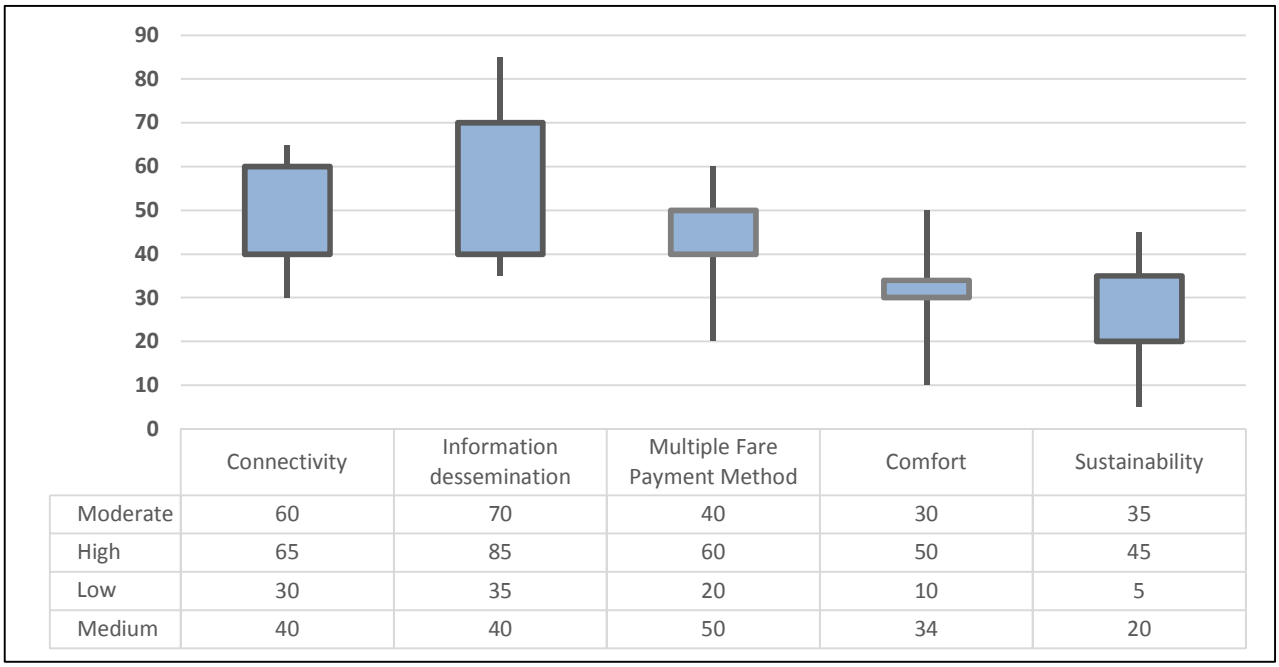
Figure 4: Index factors

6 RESULTS AND DISCUSSION

The results from the inital discussion concerning spatial connectivity of within the metropolitain cities (see figure 5) reveal certain locations along the innovative public transportation routes namely Braamfontein, Rosebank CBD, Sandton CBD in Johannebsurg, Pretoria CBD and Kempton Park in Ekurhuleni are highly accessible, as there are connected to more than two or three traditional mobility systems (mini-bus taxi and other bus services) this which has increased the rate of multi-modal trips in these locations. Regarding connectivity to alternative mobility modes bike sharing services are present in major metropolitan cities, few commuters utilise these services for commuting trips. This has led to most commuting trips in these cities being undertaken either using road or railway based public transportation systems. The innovative mobility modes were then assessed using the index factors as shown in figure 5. The results reveal variations on the utilisation of technology by the varies public transportation providers such as the payment method, with A

Re Yeng and Rea Vaya yet to develop a mobile payment method. Also there are variations in the target groups with the Gautrain targeting commuters within the middle to upper class, whilst all the three rapid transportation targeting all income groups, however with jey focus on the middle income group.

Figure 5 : Innovative mobility modes in relation to Index factors



	Connectivity	Information dessemination	Multiple Fare Payment Method	Comfort	Sustainability
Moderate	60	70	40	30	35
High	65	85	60	50	45
Low	30	35	20	10	5
Medium	40	40	50	34	20

Figure 6: Gautrain

In Gauteng the initial intention for investment in innovative mobility was to improve the economic efficiency of the rail system and consequently enhance the market share of the rail public transportation system compared to road public transportation services. A second goal was to reduce travel time between and within the metropoliatn cities. The creation of high speed train was the innovation introduced. The ineffectiveness of the existing rail public transportation required an introduction of a new railway line, in the form of the Gautrain. Using the index (figure 6), the Gauteng has a high connectivity level to numerous public transportation networks. Investment into social media applications has greatly enhanced information dessemination, which has led to many commuters utilising the Gautrain app, to obtain fare rates, timetables and also to plan their commuting trips. Commuters have also welcomed the tag-in and tag-out system, which can be done with either the train card or bank card. With regards to comfort, the train is reasonable comfort however commuters have expressed the need for more comfortable seats at the train station. Lastly with regards to sustainability over-time, the high speed train has the potential to be the backbone to introduce more innovation into the existing public transportation system.

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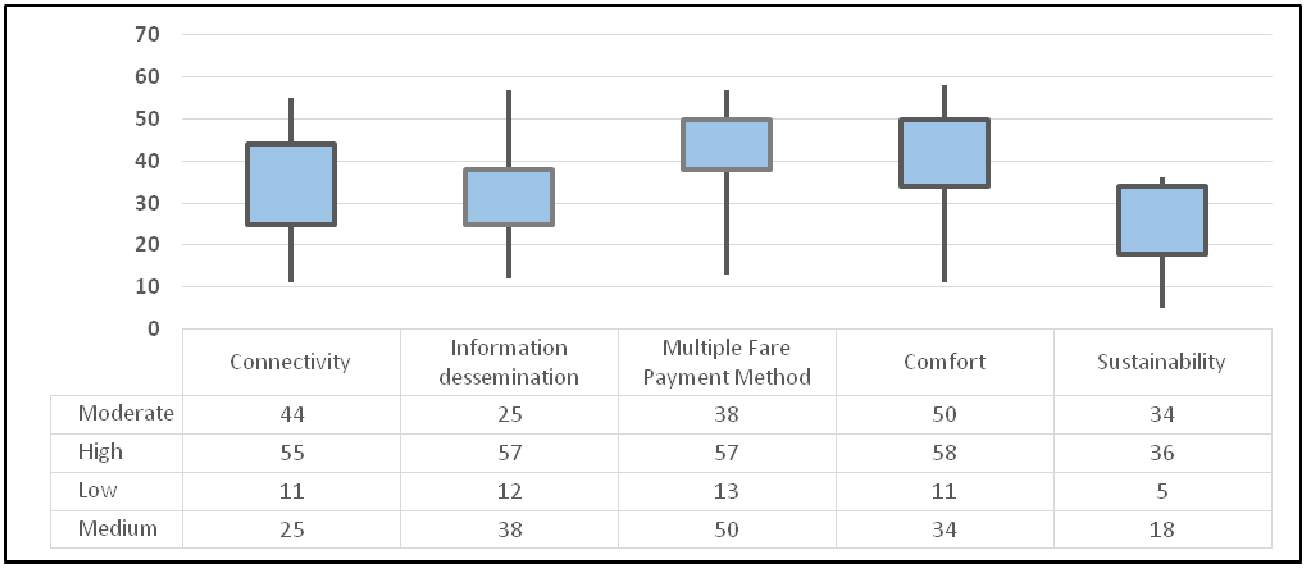
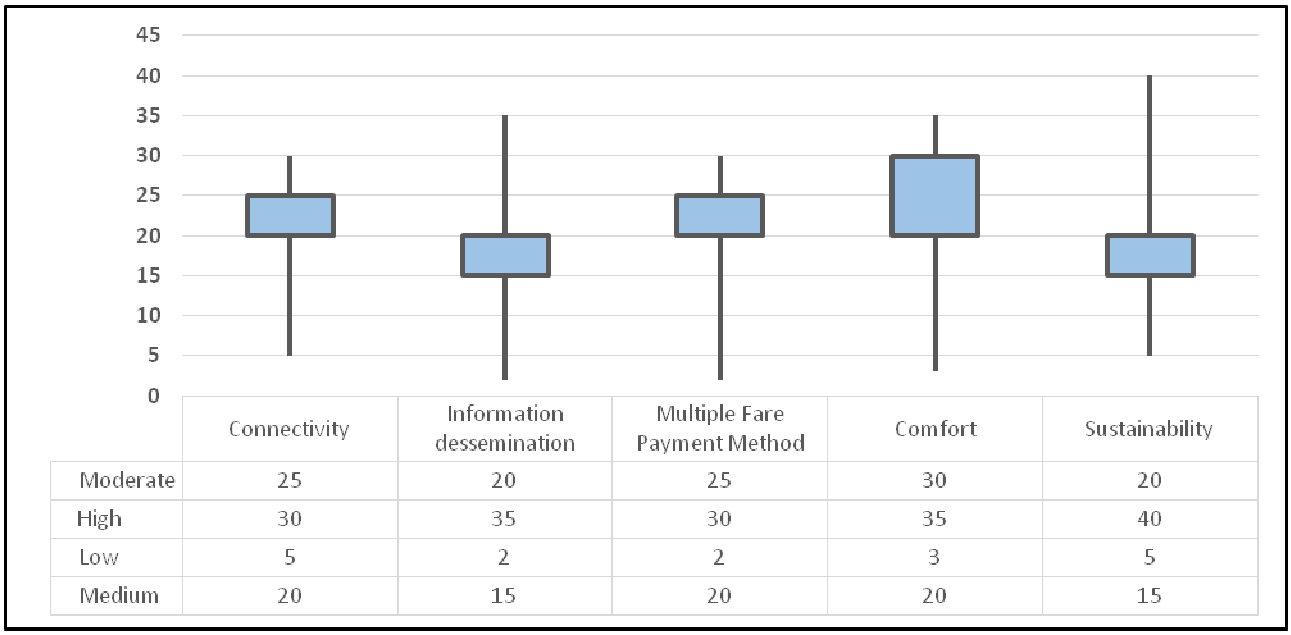


	Connectivity	Information dessemination	Multiple Fare Payment Method	Comfort	Sustainability
Moderate	44	25	38	50	34
High	55	57	57	58	36
Low	11	12	13	11	5
Medium	25	38	50	34	18

Figure 7: Rea Vaya

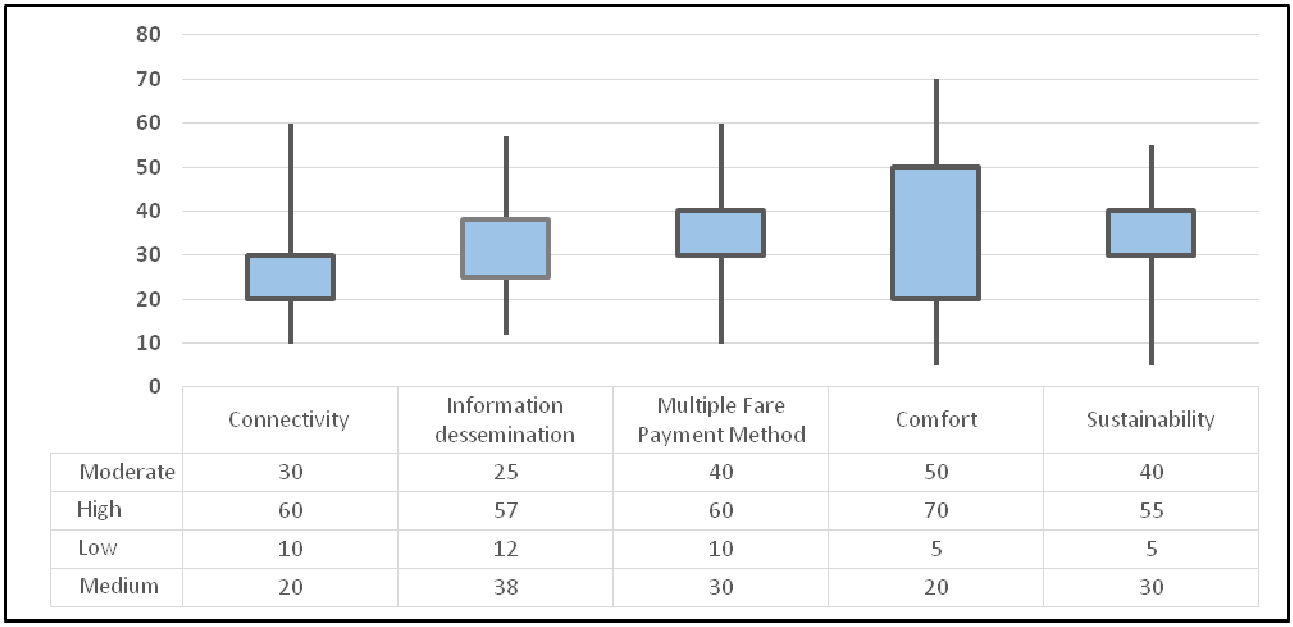
In the city of Johannesburg, the Rea Vaya (bus rapid transportation) connects commuters from the south of the city to places of economic interest, namely the Central business district in Braamfoentin, Rosebank and parts of Sandton. The route network connects commuters from Soweto (which has a population of over 1,2 million) to their work places. With such a high demand, this has led to the municipality investing on infrastructural upgrades to support the system. Commuters can either use cash or bank cards to load money on a smart card, which allows them to pay for commuting trips and tag-in and out of the bus stations (see figure 7). Regarding comfort and sustainability, commuters have highlighted concerns with the payment system as the online payment network is unrealiable which has led to commuters seeking alternative commuting modes. However given the high demand for connecting from Soweto to the CBD, the continued investment into the Rea Vaya would greatly improving the commuting experience in the region.



	Connectivity	Information dessemination	Multiple Fare Payment Method	Comfort	Sustainability
Moderate	25	20	25	30	20
High	30	35	30	35	40
Low	5	2	2	3	5
Medium	20	15	20	20	15

Figure 8: A Re yeng

In Pretoria the A Re yeng was recently introduced to improve mobility within the city's CBD. The bus rapid transportation, is within close proximity to tranditional public transportation networks, however more A Re yeng bus routes are still required (figure 8). Information dessemination is currently based on traditional means, namely signage at bus stops and little socia media useage. Fares can be made at disgnated stations, however commuters cannot tag-in with other means. There is still a need to expand the route network to ensure sustainability of the system.



	Connectivity	Information dessemination	Multiple Fare Payment Method	Comfort	Sustainability
Moderate	30	25	40	50	40
High	60	57	60	70	55
Low	10	12	10	5	5
Medium	20	38	30	20	30

Figure 9: MyCiti

Technology utilization in current public transporation systems, promises to increase commuter ridership. In the city of Cape Town, MyCiti (bus rapid transportation) is a notable example of innovative public transportation. The route network is well connected to other existing public transportation systems, namely train, ships and road based public transportation systems (figure 9). The smart card used for boarding the bus can be utilised to make purchases at select shopping centres. Regarding comfort and sustainability, commuters have outlined the seats are funtional and comfortable. The smart-card has over the years been praised for the multi-useability, this which has lead to an increase in commuting trips undertaken using MyCiti.

7 CONCLUSION

In this paper from a spatial prespective, we observe that transportation routes are along commuter points of interest which as some advantages but is not always the best solution to ensure decentralitation of development. Moreover, the preferred solution for one operator does not necessarily coincides with the national public transportation system's best solution. In conclusion the innovative public transportation systems have improved mobility in the city, however, currently interchange zones between these modes are still limited which has adversely affected the rate of multi-modal commuting. Also economic opportunities over time for citizens have increased in location within close proximity to routes of these innovative mobility systems.

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🏆 *reviewed paper*

Experiences and Future of Using VR in the Construction Sector

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1 ABSTRACT

Living in the era of digitalization shapes more or less all the aspects of one's life. The multitude of available technologies extends the range of tools, established processes, and available affordances in many spheres. Cities of the future will not only impact the living patterns of their inhabitants but also require special conditions and requirements for their planning and design. Virtual reality as an interactive tool for visualization and urban planning is no more tomorrow's technology, as it can be seen from the appearance of cheaper and portable virtual reality devices. However, we still lack established routine and multidisciplinary best practices for designing VR educational applications. There are also not enough "visionary approaches" attempting to cross-sectoral exploitation of technologies. In this paper we will try to extrapolate and extend learning use cases of construction and mechatronics to the broader areas of construction and planning sector. We will discuss our experiences and use-cases of integrating innovative visualizations tools in the learning context of construction and planning related fields. Based on this, we will discuss potential applications and links to other disciplines and their integration into the construction and planning sector.

Keywords: Digitisation, Digital Reality, Construction, Education, Virtual Reality

2 INTRODUCTION

Virtual reality as a special type of digital reality attracts steady interest from both the general public and scientific community. People have long been drawn to alternative realities (e.g., storytelling), but physically and technically it has become possible to plunge into another world relatively recently. Though the term "Virtual reality" was coined about 30 years ago, the technology itself has not reached its technical peak yet; neither has been it widely accepted by the community and unleashed its full potential.

Challenges arise starting from the definition of the basics. The majority of definitions given to VR are rather descriptive: digitally generated 3D environment (see e.g., KAVANAGH, LUXTON-REILLY, WUENSCHE, & PLIMMER 2017), as the terminology around the technology also still young and being used inconsistently. A common definition being used in urban planning sciences is the one highlighting the essence of VR as a visualization and simulation technique (PORTMAN, NATAPOV, FISHER-GEWIRTZMAN 2015). Sherman & Craig (2018), the authors of one of the most seminal and comprehensive works about virtual reality, gave their definition of VR emphasizing its integral characteristics as an interactive immersive (both mentally and physically) medium of communication providing synthetic sensory stimulation. We would also delineate our understanding of VR in a narrower and broader sense: the former includes completely immersive (and interactive) instances of VR (frequently referred as those being used with a head-mounted display), whereas the latter brings together under its wing all the other forms of VR (as, e.g., less immersive screen-based ones; MAKHKAMOVA, EXNER, GREFF, & WERTH 2020).

Virtual reality research (as any other research) can be outlined as two general approaches: fundamental, focusing on the VR as it is - as the end target of research and on the understanding on how it works, especially which effect it has on living creatures (e.g., cognitive and behavioural changes when being exposed to VR), including usability concerns, sense of presence, technology advancements etc.; or as a tool - as a utilitarian approach of its application to various domains in form of proof of concept (e.g., what are the effects of using VR as a marketing tool).

Some of the virtual reality features have determined a certain interest in it as a learning tool and medium, and because it is believed to be improving the quality of learning. Scenarios of its application to education has a

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very wide range, and vary from surgery skills training (GURUSAMY et al. 2009) to basketball tactics (TSAI et al. 2017), from ecosystem science (DEDE et al. 2017) to robotics and kinematics (FLANDERS & KAVANAGH 2015). Among some of the positive results of using VR for learning, researchers reported learners' enjoyment, increased motivation, and long-term retention. However, some systematic studies showed that the results are less obvious and optimistic (e.g., SITZMANN 2011) indicating that the use of VR is rather favourable in terms of enjoyment than in terms of learning.

E.g., one of the advantages of integrating VR into curriculum is commonly discussed in the literature (e.g., WOLFARTSBERGER 2017) is that it enables reality-like natural interaction with 3-dimensional objects and intuitive in operation. Putting aside the question of how intuitive the typical VR input devices really are, let us focus on VR as a medium that delivers decent 3D-output. That is why VR is being used in such domains as construction and adjacent fields, providing great potential for planning, design, and construction management.

3 VR AND CONSTRUCTION

Virtual reality has been recognized as a promising tool to use in the construction and planning industry. Possible implementation are seen especially in the conceptual phase and also in the light of vizualizations for participation purposes, but also for education and training, as well as for adopting it for just widely connected further purposes. This could include, for example, vehicle and utility communications simulation, urban design and planning, as well as digitization and model making of virtual twin-cities.

Thomson, Horne, and Fleming (2006) provided an overview of using VR for urban modeling. Based on the interests of various stakeholders of urban models (e.g., city authorities) and their motives (e.g., attract more tourists), they presented an extensive list of use cases where VR city modeling can be beneficial. Besides, they discuss some important reasons for the practical adoption of VR modeling and some obstacles when doing so. Particularly interesting is the voiced concern about the ownership of the city model.

Wang et al. (2018) conducted a systematic review of 347/66 journal articles published between 1997 and 2017 on the use of VR in construction engineering education and training (CEET). They found that the most adopted approach to VR systems was Building Information Modeling (BIM)-enabled VR. They point out that the possibility to reflect real-time changes in a model may be the biggest advantage of that, but at the same time also the challenge needs to be overcome due to compatibility and connection issues (also discussed in XIE, SHI, & ISSA 2011).

Portman, Natapov, and Fisher-Gewirtzman (2015) focused on the showcasing VR because of the inaccessibility reason (e.g., yet not existent places) in the context of learning architecture, landscape architecture, and environmental planning. They also raised the question of how realistic visualization should be for these purposes (as always: context matters).

Regarding educational purposes, the most common scenario at first glance seems to be safety training. E.g., Sacks, Perlman & Barak (2013) compared construction site safety training in a traditional classroom settings with visual aids and VR training, and found positive effects of VR over baseline for the courses of stone cladding work and for cast-in-situ concrete work, but not for general site safety training, in terms of recall and attention. Rüppel & Schatz (2011) describe the process of the creation of an environment to practice fire emergency evacuation based on a serious game approach. Discussing the capabilities of BIM for data-driven design, they also propose to increase the realism of simulation in a way that affects the human senses, such as binaural and 5.1 surround sound, olfactory exposure (smell of smoke), and feelings of heat and movement. By doing so, it is expected to make the simulation from only "visually satisfying" to more "real", immerse the users to evoke a greater sense of presence - which, in turn, critical to performance in case of emergency.

Nonetheless, the amount of critical papers addressing VR specifically in application for construction and planning purposes in the urban context, seems not to be great. E.g., a cursory search (as of January 2020) conducted in REALCORP database resulted just in 7 papers total with term "Virtual Reality" in their names. In the following sections we will present 2 use-cases from adjacent areas of construction and mechatronics which results could inspire and provide an impulse for further discussion of VR use for broader urban-scale planning context.

4 USE CASE 1: D-MASTERGUIDE - DEVELOPMENT AND TESTING OF DIGITAL LEARNING STATIONS FOR THE ACQUISITION OF MEDIA COMPETENCE IN THE FINISHING TRADE

The research project D-MasterGuide aims to prepare apprentices of crafting professions for the world of future work, where many processes are digitized. Digital visualization tools will influence the planning and construction process more in the future and hence also non.-research-related branches are using these methodologies more frequent in the project work and especially in the training for ongoing experts. Based on Germany-located vocational training centers of the building and renovation trade, it focuses on the encouragement of the apprentices not only to gain required expert knowledge but also methods expertise, media literacy, and self-competence when working with new digital technologies. In order to achieve that, eight domain-specific digital learning stations (DLSs), based on the essence of processes of plastering trade, were created and integrated into master preparatory course framework, with help of a learning management system. DLSs contain anchored instructions, work orders or exercises in order to augment blended learning lessons with a situated learning experience. Apprentices and trainers switch between digital learning sequences and activities in the workshop to review and discuss their results afterward in meetings. This scenario enables new learning dynamics and competence development of the participants. Moreover, lessons are enriched with virtual reality experiences, video animations of the working area, role-playings, open exercises and a self-organized learning environment. Finally, self- and external assessments are the basis for deeper discussions as well as for an increase of self-reflection.

Technical basis of the approach is the Smart Guided Learning System (SGLS) which combines a learning management system with a process guidance component. The architecture is enhanced by various devices, applications and services providing optimal tools depending on task and place of action. Apprentices and trainers are involved in a participatory development process to give direct feedback and derive improvements for the next implementation stage.

Theoretical basis of the approach is Anchored instructions (AI) representing a situated learning content in the form that “anchors” a problem-solving task into a short story or adventure. Every DLS starts with a narrative describing an authentic problem behind the learning content, which was supposed to familiarize the prospective masters with the content of DLS and motivate them by providing also contextualized essence of their future work (e.g., client consultation, agreeing upon the end result of plasterworks). VR experience pieces of training here were conceived as a special type of AI aimed to provide the utmost “reality-like” grounding. That would allow the apprentices to solve real-world problems actively and independently. The relation of those narratives with further knowledge acquisition helps to apply new knowledge in practise. Assuming the apprentices to be novices to that technology, the experience were designed to tailor lack of experience with peripherals etc.

The VR experience is grounded in the story of a house on-site inspection. The learners make a virtual walkthrough around a house that was filmed with help of a 360° camera. The end goal is to identify scope of further work and plan necessary repairs and finishing. In order to achieve that, the apprentices start by outlining all the problem spots on the exterior of the house. Every correctly identified spot was gamified as an question-answer sequences in order solidify the obtained knowledge and also reduce the chance of false positives answers. Figure 1 gives a glance of the VR user interface and snapshot of its use. This used methodologies enables a transferability in related use cases, such as education of architects or also on the job training for building inspectors.

Fig.1: VR experience of a house inspection

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4.1 Results of evaluation

During continuous evaluation of the approach, we were focused on the user experience and acceptance of the apprentices, as well as their motivation (SCHMIDT et al. in press; SPILSKI et al. 2019). The Proof-of-Concept results indicate that the scenario has a potential of integrating that form of learning into curriculum. The evaluations involving more than 60 prospective masters mostly did not reveal discomfort, motion sickness, low motivation or low acceptance in the target group.

An additional thesis study compared the learning outcomes of on-site house inspection with that one in virtual environment. The apprentices who learned within the VR environment overperformed the control condition in terms of correctly identified problem spots (d = 1.15) and correctly answered questions (d = 0.85). All in all, the usability of the VR environment can be considered as above average (M = 72.85, SD = 10.79).

4.2 Implications for practitioners regarding learners acceptance and integration VR into class

It is specifically important to note that the didactic setting depicts specific work processes. To this end, a virtual learning environment was implemented in such a way that it enables action-oriented learning in a vocational training institution, including for planning tasks. This includes, for example, recording the building structure of an existing old building facade and planning the necessary next steps.

So far, we have focused on the learners perspective: However, during our studies we found that the actual gatekeepers for the acceptance and integration it into the practice are the teachers and lecturers. If they do not translate the value of accepting the technological innovations even when using them and propagating their use in the class, the use of the technology and the acceptance of those by their students will be rare. The problem is that teachers often do not get the time resources to develop expertise with these new methods, or has not developed self-competence, i.e., confidence in use and believe that it can be beneficial.

We also noticed during our evaluations that when using VR application instructors seem to feel a break in regular dynamics between instructors and apprentices. The common routine instructing method in the craftsmanship environment is obviously the three-step-method: Demonstrating – Imitating – Exercising. Therefore instructors tend to adopt the same frontal presentation method in a typical classroom setting where they reinforce their subjectively self-experienced learning from their own learning history. This scenario is one that traditional handcraft instructors would intuitively choose. Nevertheless the VR-application under consideration encourages learners to experience the VR-application on their own, individually. This kind of individualized learning results in a massive loss of control at the instructors side on the one hand and with the chance of compensating looking at the learners as unique persons following their specific learning challenges and having the patience to answer their numerous feedbacks in the learning process being on a par with young people on the other hand. Whereas learners obviously enjoy the kind of new experience an educational institution is saving time-consuming excursions by the VR-application as a substitute a comparable learning sequence would exist in the analog world. Presumably repeated use of VR-glasses will lower this existing motivational effect but strengthen the demand of effectiveness of learning. Consequently, the instructors would have the need as in other typical autonomy fostering environments to improve their own 4C-competencies (4C-didactical model) - communication, collaboration, creativity and critical thinking – in order to cope with the unfamiliar accompanying of the learning process. Nevertheless if the VR-interactions at the frontage seem from the professional point of view to be incomplete the building expert would judge it´s not more than a play and could lose his interest. That is why for sustainable implementation in a VET-course realistic and complete work through by the authoring editors for VR environment is necessary in advance enabling in this case VR-interaction to replace traditional visuals-aided way of teaching.

Although the trainers are very experienced in training small groups of about 15-20 apprentices, they focus mainly on improving manual skills. Therefore, mainly facade construction techniques are taught. In contrast, little or no consideration is given to preparatory and follow-up cognitive work processes (e.g., planning).

Furthermore, vocational training institutions are currently still investing predominantly in analogue, "tangible" technologies. Even for relatively small 4-digit amounts, it is often not greatly affordable. However, current funding policy trends could bring about a change in the investment culture.

5 USE CASE 2: INKRAFT – INCLUSION IN VOCATIONAL TRAINING IN THE CONCRETE CASE OF AUTOMOTIVE MECHATRONICS USING VIRTUAL REALITY TECHNOLOGY

In the project InKraFT, a VR application was developed and used for the training of prospective automotive mechatronics engineers. The virtual environment enables students to learn practical skills as a part of the official training course. Prior to integration, the practical activities and sequence of processes and actions were recorded and documented in detail by an experienced mechanic. Then, the sequence of the individual steps was transferred to the VR environment and embedded in an overarching didactic concept. Specifically, that includes processes of dismantling and assembling an engine and a brake system, measuring and testing the cylinders and performing a compression pressure test. First evaluation results show a strongly increased motivation of the users as well as an increased knowledge transfer into practice. A distinguishing feature of the project is the barrier-free design and the development of alternative input methods and assistance systems in order to match special needs the target learning audience has. Thus, the additional focus of the project is inclusion of people with disabilities into vocational learning. Though this tailor-made solution is designed for the automotive context, the theoretical concept could be transferred also to the planning context because an disassemble engine model could be a disassemble architectural model in another context and the shown principles as well as partly the study results could be transferred in another domain.

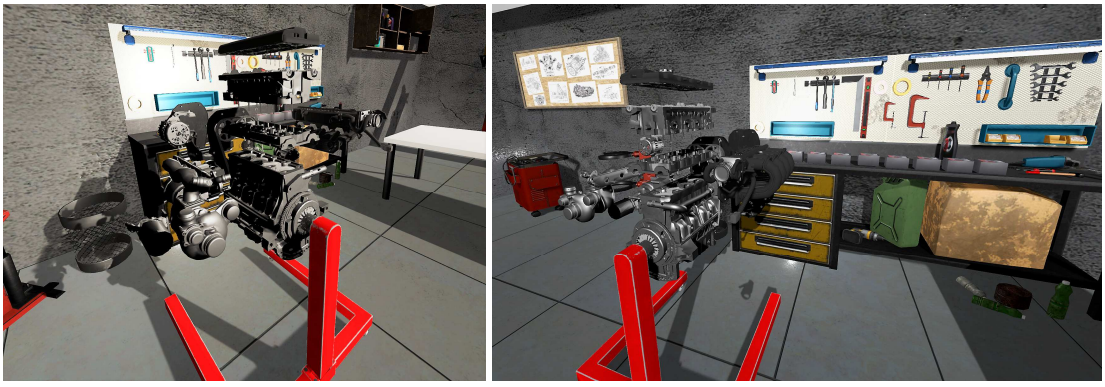

Fig.2: VR experience of an engine dismantling

In addition to the virtual work environment where students can train their practical skills, the VR application is also equipped with a learning room where 360-grad videos with theoretical content can be watched. The videos have been created by other students and provide small learning nuggets on various topics related to the basic course as well as content that builds on this with more advanced topics. The combination of a theoretical, immersive environment and the practical workshop showcases how digital technologies can be used in order to enhance the learning and motivation and at the same time give people with special needs access to the job market, as e.g., as prospective masters with strong diagnostic or teaching orientation.

Fig.3: Use of the VR app and a snapshot of explanatory 360-grad video

5.1 Results of evaluation

A total of 20 subjects (1 female, 19 male) were tested an interim version of the VR environment between March and April 2019. The participants' age ranged between 16 and 56 (M = 29.10; SD = 14.55), with 14 (70%) of participants either working as car mechanics or currently training to become one. Education had a

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similarly broad range with 8 participants not having a certified vocational education yet, 8 participants with a finished vocational education and 4 participants with either a Bachelor or higher university degree. Participants reported no major visual, auditive or physical 5 impairments, 7 wore prescription glasses due to hyperopia or myopia and one participant reported Tinnitus. Therefore, no participant had to be excluded from participation. All twenty subjects volunteered to participate in this study and either received work time compensation for their participation or participated on their own accord as part of a roadshow, where the VR environment was showcased to the public.

In the pre-questionnaire participants reported some experience with VR (M = 2.40, SD = 0.99; on a scale from 1-4) with 5 people reporting no previous experience with VR systems at all and two participants reporting having their own VR headset at home. No participant reported experiencing major feelings of dizziness during or after interacting with the VR environment with one participant feeling "everything was spinning" during their interaction in VR, possibly due to a technical problem, which was resolved quickly. We used an adapted German version of the igroup presence questionnaire (IPQ) where items were changed to be tailored towards our specific VR use case (exemplary item: "How real did the virtual mechanic workshop seem to you?"). As these are preliminary results without a comparison group, participant scores for the IPQ were taken as single factor and a mean was calculated from all 13 items without the use of the standard three factor structure. Participants overall reported a tendency towards a sense of presence (M = 4.14, SD = 0.65; on a scale from 1-6). We added an open space for feedback and comments on the VR environment at the end in which participants particularly noted the realistic engine and that they had fun while doing the task, while some wished more detailed visualisation for the future. One participant with several years of expertise as mechanic noted "A large step into the right direction. Needs more time & refinement" (translated from German by the authors).

5.2 Implications for design of VR

Virtual Reality applications pose a great challenge for developers when concerned barrier-free design as a priority, because the use of the hardware often requires a strong physical effort. Experience has shown that there are no perfect settings that fits everyone, and the most important thing is to offer alternatives that the user can use to individually adapt the 3D application to his needs. Two essential features of every VR environment are movement and interaction. A barrier-free implementation of these features depends also on the question on which target system the software should run on, since the hardware can be very different. The tasks in a virtual learning environment are versatile and often very complex. For this reason, the tasks should be divided into small steps and always be presented in a way that the user can perceive them with at least two of his senses. In InKraFT all sub-steps are read out aloud by the system, so that people with reading disabilities still have a chance to understand the next necessary steps. All text content and audio instructions are implemented in several languages , so that language barriers can also be avoided. If the user completes a partial step, this is confirmed with a positive sound feedback. If he completes a whole task, he receives an achievement to increase the motivation and the perseverance of the learners. The removal and fitting of crucial screws usually also requires some physical effort, which mechanics with more work experience get a "feeling" for (SPILSKI et al., 2019), which might be difficult to replicate in a virtual space. Since our environment was designed as an out-of-the-box solution for usage in the field of vocational education, we did not include specific forms of haptic feedback and will rely on the HTC Controller or Knuckles as available. For possible solutions to this problem, see e.g. the work of Choi and colleagues (2017) as well as Lee and colleagues (2019) for manual manipulation and haptic controllers. In addition to a solid theoretical foundation it is important to get feedback from the population which the environment is designed for.

This approach towards more participatory and compensatory designing processes is crucial to guide action to meet the needs and preferences of various groups of people. This particular use-case can be extrapolated to the sphere of public participation in planning. The well-known in the software development user-centered approach can be particularly applicable here. Individuals from various stakeholder types should be involved into the planning, designing and decision making processes from the very beginning, not only when the model is ready and needed to be validated on the final steps with finishing touches. Only that can ascertain the hearing real-human concerns and needs.

An important highlight here to takeaway is also possibility of transferring regular processes and procedures in the digital world, as well as replication of "feeling" the place and object in the virtual world.

Though spatial representation of information and certain special abilities was not primarily considered during our approaches when designing and evaluating both VR applications for D-MasterGuide and InKraFT, we could not help but notice that users need additional contextual information for orientation in space. This was especially noticeable in D-MasterGuide, when subjects could not immediately understand that they were moving around just one object in space. For them, it was difficult to combine many mosaic projections from different perspectives into one full-fledged cognitive model.

6 SO HOW TO DESIGN & USE VR FOR URBAN PLANNING AND CONSTRUCTION?

Based on the lessons learned, in this section we will outline our vision when designing and integrating VR experience into practice. We chose the mentioned projects because they represent from a technological point of perspective two different settings with different technological solutions which concepts could be transferred in respective use case in the construction and planning sector. This studies tries to assess the potential fields of application with an evaluation of the potential use. Advocating the “problem first” approach, it would be ideal to start the development of VR application with the questions "Do we actually need VR here?" and "What goals we want to achieve with it?" to gauge whether VR is appropriate medium for that. In the context of such disciplines relying heavily on spatial representation of information as design, construction and urban planning sciences, the utmost reason to integrate VR is to improve ability to examine and explore 3D data.

The main reason for using VR in the first project D-MasterGuide was essentially to have positive effect on the motivation of apprentices but also to bring more authentical practice to the learning without necessity to leave the class. The relevant in that regard is also the emphasis of planning activities, starting with the inspection and determination of weak spots for identification of scope of work. The added value in the long term is the better acceptance and self-competence when using the technologies of such type. As we can imagine, the today’s apprentices will be the practicing professionals in the future, and their ability to be confident with the technologies will determine the ease of which they would integrate them to their daily working routine, e.g., to plan and communicate the vision of project with clients.

Another feature of the project is use of 360-grad VR. We can extend this use-case to the 360-grad construction documentation and also for “digitizing” entities bigger in scale than regular buildings, as in our case. Google Panoramas actually has done a vast amount of work capturing virtual tours of incredible amount of places on Earth (and even further). However, this does present challenges such as problems with wayfinding/navigation and constructing a mental map of the area/object. Although it involves more computational power, using this type of virtual reality to reflect the fourth dimension (i.e., time) in a virtual model is potentially of a big interest, as this could bring up capturing “real” development of the entity. This, obviously, would be more appropriate for the domains where this “reality-likeness” has significant importance. Especially the use for collaborative Virtual Environments (CVEs) is very promising in this field, because they support the non-local communication between planners and public (HÖHL, BROSCHART 2015). This can be used for either greater urban master plans as well as detailed architectural questions with respective level of detail. Especially if planners is personally affected by a project, the visualization techniques can make use of their potential during communication with the general public. In this way, citizens can be sensitized to thoroughly serious urban planning issues in a playful way and form their own opinion, which they can then express in further planning phases.

The focus of the second project InKraFT was, on the other hand, on the acquisition of procedural knowledge with bringing potentials created by the VR application to a very special category of users. Though the latter is not the main focus of this use case in that context and that work, it is still can be reasonable to consider that when applying VR to other areas. Designing with inclusiveness in mind however is not that easy even nowadays, especially for those use to leave without special needs. We can imagine including VR into curricula of urbanists in order to, e.g., familiarize them with daily challenges individuals with special needs face living in various environments. Specifically, some studies have shown that “walking in someone else's shoes” (i.e., perspective-taking induced by means of VR) can lead to a boost in empathy towards special ones (VAN LOON et al. 2018,), especially on the long-term scale (HERRERA et al. 2018).

Turning back to the question of procedural knowledge, the potentials of VR-technology can be supported in a application to such highly complex modelling and problem-solving oriented areas as urban planning,

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especially what concerns the possibilities to interact with the virtual world in the way it is not possible in real, e.g., scaling up and down, implementing various perspectives, even at once. Virtual reality, as any other technologies, for sure will not substitute all the processes and routines - architects still use 2D blueprints to convey the necessary details without over cluttering the things, but the it can help to go where no one else has gone, to add and to reduce details to the visualization as we wish, experiment in the safe environment and play "what if scenarios".

The main lesson that we learned from the D-MasterGuide is basically the importance of transportation of theoretical knowledge and skills into virtual word, making them testable in real practice, aside from open-mind attitude toward technologies. InKraFT raised some further questions regarding interactive conceptual participatory design. The results from both ongoing projects show that practice and integration them into real-world for sustainable use surely raises subsequent problems that could not be foreseen from the theoretical positions. Here that can be mitigated by involving expertise from other disciplines, e.g., psychologists and pedagogues in order to observe behavioural and cognitive challenges and phenomena going deeper than mere acceptance and enjoyability of the experience. This is especially important to reflect that from the stances of environmental psychology. Churchman (2002) voices those issues and convincingly discusses that such important things as concepts and perceptions of places, territoriality, people in these places, their feelings are not always intuitively or obviously relevant to urbanists. This interdependences and dualism posits indeed demanding and sophisticated mission to solve when we adding into the equation the Unknown "X" in the form of digital technologies.

7 CONCLUSION

Even though the use of VR seems promising for learning purposes and usually receives positive feedback from participants, it is uncontroversial that the research on VR in education and its further integration into practice is still limited. There range of possible applications in the sector of construction and urban planning is considerably wide and can embrace the stages from early planning and concepting to the construction itself, as well as showcasing and validation on later levels. Though, what can be said for sure is, that the variety of fields in these sectors will grow and together with it, the requirements for training and further education. In this paper we argued that exploratory dip in adjacent areas can enrich and revive the veins of VR for UP research. We tried to give a brief overview of state-of-art research focusing on the use of virtual reality in construction and urban planning context, and discussing some of the interesting use-cases as e.g., integration of human senses other than vision for better sense of presence. Based on our experience of two projects that are adjacent to the areas discussed, we broadly outlined some implications that we consider to be fruitful to deepen further, i.e., more interdisciplinary focus involving pedagogical and psychological perspectives; more critical view considering which added value the use of such technologies can bring and what actual ultimate goal is to achieve (and not just integration of those for integration's sake); once more voiced necessity of the user-centered iterative design; bridging the gap between research and actual incorporation of its results into the practice and curriculum, where the main driver in acceptance and digital transformation is still the person who translates them as valuable as a teacher and tutor. Besides, we outlined some problematic areas which are worth further investigation: i.e., question of wayfinding and construction of cognitive models when using the complex VR models; and potentials of VR not only for inclusion but also for empathy and perspective-taking reasons. The given results indicates, that a deep practical integration of the mentioned approaches will always bring up new obstacles for implementation, which cannot be foreseen in the theoretical frameworks. Though, using the visualization methods not only helps for the respective project (public participation of 3D-city models, BIM-analysis etc), but it also could help to improve the willingness of people to be open to new technologies. To achieve this mindset will be crucial for urban planners in the coming decades.

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🏆 *reviewed paper*

Feeling Safe in Urban Estates: Learning from Riverwood, Sydney

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1 ABSTRACT

Feeling safe is a necessity for quality of life. Conversely, feeling unsafe has a substantial impact on residents' quality of life. How does design impact on the perception of safety, and moreover, how can design reduce incidences of crime? Safety is influenced by many social, economic, and wellbeing factors that affect residents' experiences of their built environments. Neighbourhood and urban design – which are liable to be affected by the perceived quality of local spaces – are likely to be significant factors influencing broader residents' feelings of safety.

To these ends, this paper reviews recent literature on how design processes have influenced perceived and actual safety in public spaces. This paper focuses on different aspects of urban safety, including planning, management, and design in a mix-tenure neighbourhood. The paper selected Riverwood, a social housing renewal neighbourhood located in southwest Sydney, as the study area. Data collection methods used by the author for this paper include direct-observation and a cross-sectional survey of 62 households, aimed at shedding light on what are residents' preferences to improve safety perception in public spaces.

The paper finds that, for greater safety of neighbourhoods in urban estates, design approaches need to consider both physical and social-cultural factors; and that to achieve this, practical and realistic mechanisms are required to improve existing estates and to design future estates better. The findings of the study reveal that, addressing the concerns revolving around the trust-deficit in the community, will be the cornerstone to promote residents feeling of safety.

Keywords: Feeling of safety, urban estates, safety perceptions, Riverwood, Social housing renewal.

2 INTRODUCTION

Cities are the places where people with various backgrounds mingle with each other, and it is also the place where we can witness a higher intensity and complexity of social life, culture creation, palpable economic development and also strides in science. Globalisation has brought, along with all its virtues, certain negative impacts on the society – which we cannot deny. The apprehensions about safety, the increase in crimes and an ever-increasing feeling of insecurity among the residents were the ultimate downsides of all the development sagas. Due to the constant growth of cities, provision of urban safety, thus become one of the most important pre-requisite to achieve a sustainable development of an urban system; which is reflected in the renewed interest towards urban safety in recent literature (Kudryavzev et al., 2011; Rastyapina and Korosteleva, 2016).

One of the prominent factors, which contribute towards achieving sustainable urban safety, is to experience a feeling of safety in residential areas (Chandola, 2001; Jesus et al., 2010; Whitley and Prince, 2005; Ziersch, 2005). Various studies and observations have indicated that, when citizens are asking for higher safety, they will refer not only to criminal behaviours of the fellow citizens but also to planning and design issues that make a sense of insecurity. Safety perception about a neighbourhood depends on various aspects, such as the location of the neighbourhood, the social, cultural and religious composition of the community which reside in it, the economic disparity among the neighbourhood, as well as the physical design. Therefore, incorporating the residents' idea into the adaptive planning, design and management strategies pertaining to the neighbourhood can lead to increased satisfaction among its residents. Thus, the policymakers at local levels should address urban safety by considering these novel ideas and local governments should make provisions to implement these in existing neighbourhoods and the planning of future establishments.

3 URBAN SAFETY: URBAN PLANNING, URBAN DESIGN AND URBAN MANAGEMENT

Urban planning, urban design and urban management are three crucial attributes for achieving urban safety (Abbott, 2013). Urban planning strategies for creating a safe city should consider factors such as typology of urban spaces, the function of the desired city, its density, its inhabitants and their day to day activities. Thus, urban planning contributes to the improvement of urban safety via managing the distribution of function and

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activity, the layout of infra-structures, location, and characters of commercial sectors. These strategies play a role in urban safety as well as the quality and liveliness of the cities.

Structures and design of spaces highly affect the actual safety, as well as the perception of safety among its inhabitants. Some places are enjoyable and energetic and convey a sense of well-being, while certain others create anxiety and fear. The urban design addresses the structure of spaces, location of the buildings, the use of the building, layout of green areas and public spaces, street patterns, location of transit stops, and parking areas. Good designs result in a neighbourhood with higher vitality, whereas, bad urban designs may lead to empty spaces, uninteresting environments, fearfulness, unsociable behaviour and higher incidence of crimes.

Good management provides opportunities for neighbours to be familiar with each other and generate Neighborhood Watch programs. Neighbourhood Watch programs are intended to educate the people in these neighbourhoods regarding the security and safety aspects of the neighbourhood, and also it teaches them how to achieve this (Fennelly, L. and Perry, M., 2018). A good space management in the neighbourhood will send a clear message of care and safety, which reassures the residents and discourage the offenders. It also advocates community participation which is an effective solution to improve urban safety (Abbott, 2013). Moreover, managing a place in terms of safety includes maintenance, surveillance, regulation of its use, communication with users, and provision of suitable standards for vulnerable groups (Fennelly, L. and Perry, M., 2018; Fennelly, L. J. and Perry, M. A., 2018). Each of the above activity requires a complicated interaction between the various providers and the beneficiaries in the community. The owners and contracting authorities of a project have to engage these stakeholders in their decisions for considering their jobs and requirements. Similarly, As Carmona (2008) suggests: “in order to manage public space more efficiently, there has been a tendency to carve up the field into smaller units of responsibility, sometimes contracted out to a multitude of private contractors”

Thus, it is necessary to consider these safety strategies in various aspects of urban settlement, right from the initial phases of planning like decision-making, master plans, and urban renewal plans. The following figure shows a blueprint of the possible urban safety strategy that can be achieved by urban management, design and planning.

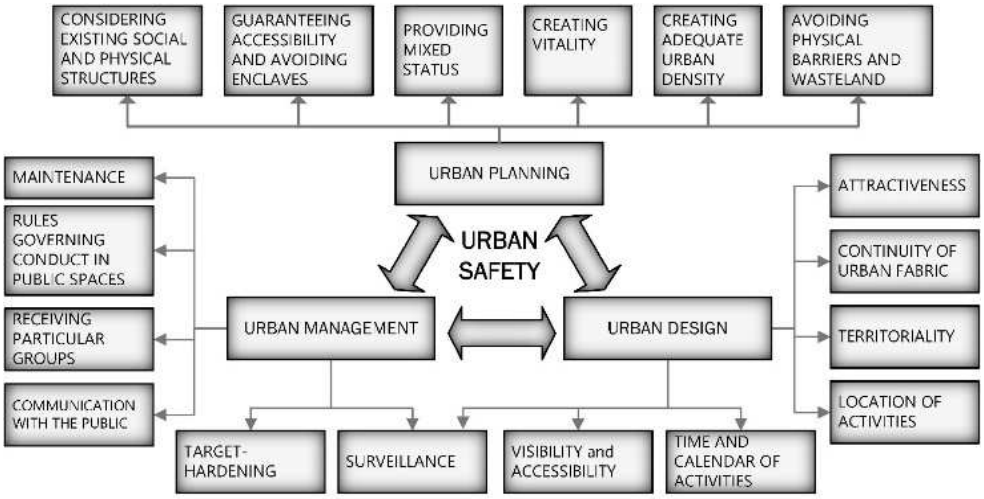


Fig. 1: possible urban safety strategies by urban management, design and planning

4 SAFETY PERCEPTION

One of the prominent factors, which contributes to the sense of health and wellbeing, is to experience a feeling of security and safety in residential areas (Chandola, 2001; Jesus et al., 2010; Whitley and Prince, 2005; Ziersch, 2005). Safety perception can be influenced by environmental and design components, including poor lighting, presence of graffiti, absence of sightlines, other individuals and seating or recreational spaces. It also depends on various factors such as the age and gender, the social position, economic status, personal characteristics, health and political views of the members in the community (Koskela, 1997; Koskela and Pain, 2000; LINDGREN and NILSEN, 2012; Madge, 1997; Pain, 2001; Valentine, 1989). For instance, the above-mentioned factors cause variable perception about safety and security in the neighbourhood among the residents during situations like the re-location strategies in urban

renewal programmes by the government. Research conducted on U.S. tenant relocation plans constantly demonstrated that some residents from public housing, who moved out of their congested neighbourhoods with poverty, feel a higher sense of personal safety in their new settlements (Goetz and Chapple, 2010; Popkin et al., 2009). On the contrary, certain people who were relocated from public housing districts to new neighbourhoods, experienced a higher degree of insecurity in their new establishments (Brooks et al., 2005; Popkin et al., 2009). A meta-analysis conducted by Goetz and Chapple (2010) between 1995 and 2010 revealed that there is no statistical relationship between these individual perceptions and the actual benefits of the migration like mental or physical health. On the contrary, interviews with the participants of large-scale Scottish research among the tenants re-housed in a novel social rental neighbourhood showed less anxiety among the participants while getting out of their house in the new neighbourhood. These feelings of safety and security in their newer neighbourhoods can lead to better social behaviours among the residents (Forrest and Kearns, 2001).

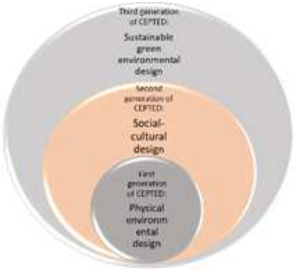
5 URBAN SAFETY AND CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED)

Crime prevention through environmental design (CPTED) is one of the branches of spatial practices that address interventions by focusing on the place-based approaches to reduce crime, and enhancing spatial cognition, as there is a relationship between a place and perception of being safe and secure at that particular place (Fennelly, L. and Perry, M., 2018). Brantingham and Brantingham (1981) mentioned that four dimensions should be considered for any approach towards crime prevention; which are locations, targets, offenders and the prevailing laws in that region. Similarly, Erdoğan (2010) asserted that place-based approaches to reduce crimes and fear of crimes are based on the theory that there is a relationship between spatial features of a particular place, which can support or encourage criminal activities. Thus, crime location is one of the most prominent dimensions of a crime, as crimes are not randomly dispersed in modern urbanised regions.

Particular areas are found in cities, which are identified by the public and administrations as 'hot spots' of crime which are not safe (Eck et al., 2005). In these scenarios, suitable designing and efficient application of the fabricated environments may result in the decline of fear and the occurrence of crime and thus improves the safety and quality of life among its residents (Crowe, 2000). Various studies have proved the efficacy of design options in the reduction of crime and emphasised the role of CPTED (Jacobs, 1961; Lynch, 1984; Stiles, 2009).

The CPTED theory has evolved over time and we can broadly categorise them into three generations (Fig. 2 and Table 1):

- First-generation: Physical Environmental design
- Second-generation: Social- Cultural design
- Third-generation: Sustainable Green Environmental design



Physical environmental design	Natural surveillance Natural access control Territorial Reinforcement	Image management Target hardening
Social-cultural design	Social cohesion Connectivity	Community culture Threshold capacity
Sustainable green environmental design	Energy crisis Natural energy	Recycling and minimizing waste

Fig. 2: A dynamic integrated model for CPTED (Adapted from Cozens and Love (2015)), Table. 1: The principles of Crime Prevention Through (CPTED) (Adapted from Cozens and Love (2015)

Each generation is a guideline to create a mixed-use and walkable communities that have numerous benefits from a crime prevention point of view; which can be created by proper urban design, management and planning (see Fig. 2). The 1st generation of CPTED was a set of approaches to prevent crimes which are related to urban design. The 2nd generation of CPTED concentrates on the approaches for eliminating the root causes of criminal behaviours through sustainable and rich environments which are related to urban planning and management. Similarly, urban planning and management play a major role in the 3rd

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generation of CPTED, which concentrates mainly on the security and consider it as a universal problem. The 3rd generation CPTED attempts in providing a guideline that can be applied in social, political, and geopolitical divisions (Fennelly, L. and Perry, M., 2018).

6 METHODOLOGY

The research started with a review of literature and direct-observation (by using drawings, note-taking, photography, and mapping), followed by a field study. The data collection in the field was using household survey questionnaire (Table 2). The questionnaire sample included 62 adolescents, both genders and aged 18 or over.

Data collection methods	Target area or population	Purpose
Direct-observation	Social housing renewal projects	Finding criteria to measure safety in public spaces. Selecting a case study area
household Survey questionnaire	Residents	Residents' perception of safety Residents' expectations for safe public spaces. Residents' needs Residents' experience about safety What are the existing safety problems in the area?

Table 2: Stages of data collection.

A case-study approach was chosen to gain a detailed understanding of the context. Table 3 shows the criteria to determine Riverwood as a case study area.

Criterion	Reason
Social housing neighbourhoods with different socio-economic level	To enable safety development to be investigated in different socio-economic contexts.
Social housing renewal projects	To explore safety issues before and after renewal.
Medium to high-density estates	Potential for future urban model
Crime rate	Potential for safety improvement

Table 3: Case study selection criteria.

6.1 Case study area

The neighbourhood chosen as the study area is part of the Local Government Area (LGA) of Bankstown and state suburb of Riverwood (Fig. 3). Riverwood today is an established residential suburb with its commercial centre focused around the intersection of Belmore Road and the East Hills railway line. The suburb is located approximately 18 kilometres (km) south-west of the Sydney CBD and is situated within the municipalities of Canterbury and Hurstville.

The study area consists of two urban renewal projects undertaken by the NSW state government and has been held up as a model for the future; where one site has already been re-developed and the other one is under re-development. The former is the Washington Park Development which was renewed by Payce developer and the latter one is currently being redeveloped by the Communities Plus (Fig. 3). Riverwood is an integrated housing neighbourhood consisting of social housing, affordable housing and private housing. These dwellings comprise a range of housing types from single cottages to high rise residential apartments. The age of the housing stock ranges from buildings built in the mid-1950s through to relatively recent projects from the mid-2000s. The Riverwood estate is within a 1100m radius of Riverwood Station and the Riverwood shopping centre is located to the south (NSW Government, 2018). Figure 4 shows a pictorial overview of Riverwood study area.

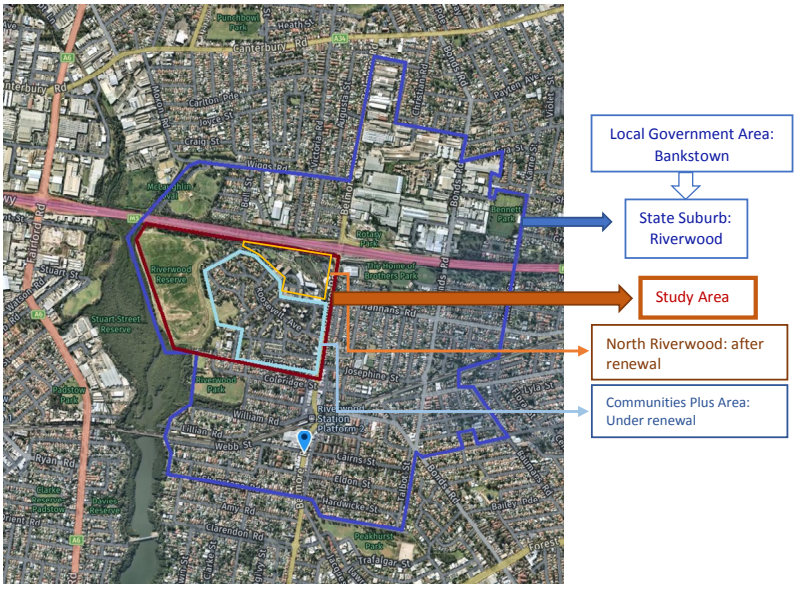

Fig. 3: Map of Riverwood study area (Nearmap, 2019)

Fig. 4 Pictorial overview of Riverwood study area (Researcher, September 2018)

According to the Australian Bureau of Statistics (ABS) household and family projections, between 2006 to 2016, the Riverwood estate residents came from a diverse set of countries and had various racial backgrounds. Many of its residents born in China, Taiwan and Lebanon has declined, and those from other countries such as Australia, Philippine and Sudan showed a sharp increase. The population of listed races in Riverwood in 2006, 2011 and 2016 were 1620, 1484 and 2356 respectively. The largest number of people immigrating to Riverwood from 2006 to 2016 were from the south and southeast Asia and New Zealand. The immigrants from India grew at 833.3%, followed by those from Sudan at 683% and those from New Zealand at 104.1%.

Statistics relevant to the understanding of crimes at Riverwood were obtained from the NSW Bureau of Crime Statistics and Research (BOCSAR). The hotspot map depicts the density of incidents of non-domestic assault and domestic assault crimes in Riverwood estate (see Fig. 5: a and b). The five most common offences reported in the estate in 2006, 2011 and 2016 were theft, malicious damage to property, transport regulatory offences, assaults and the offence of 'Against Justice Procedure'. 'Theft' was the major crime in Riverwood in 2006 and 2011 and the second major crime after 'transport regulatory offences' in 2016. Four offences with the highest incidents were the same in 2006, 2011 and 2016 but with different varying incidence (see Fig. 5: c). Except for malicious damage to property, which was reduced from fifth to the sixth place in the most reported offence's list in 2016, the other four stated offences held their positions as the top crimes. Drug offence was placed in the fifth place in the list of the first five offences in 2016, which has linearly increased from 31 incidents in the year 2006 offences to 101 incidents in 2016.

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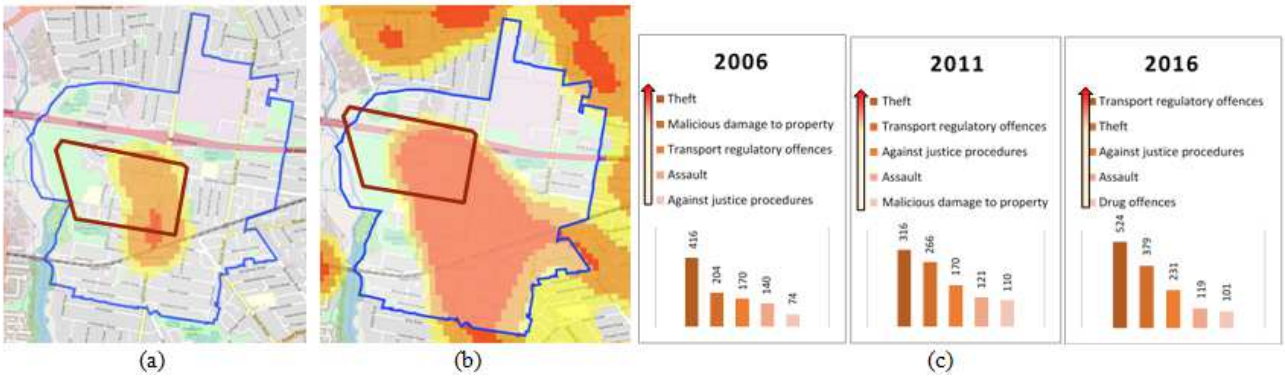

Fig. 5: (a) Incidents of Assault (Non-domestic assault) from April 2018 to March 2019 (NSW Bureau of Crime Statistics and Research, 2019), (b) Incidents of Assault (Domestic assault) from April 2018 to March 2019 (NSW Bureau of Crime Statistics and Research, 2019), (c) Five common offences on the estate in 2006, 2011 and 2016 (NSW Bureau of Crime Statistics and Research, 2019)

6.2 Data Collection

Household surveys were conducted in the study area using the questionnaire method. The residents were provided with a questionnaire having five closed questions (with 10-13 sub-questions) about the relationship between the quality of the neighbourhood and public spaces, and the perceptions of safety in public spaces. The scale or measures of public spaces quality and safety perception were selected based on the first and second generation of CPTED (See table 1).

The household surveys were conducted on random days between 10:00-17:00 from February 2019 to June 2019. The inclusion criteria to choose participants were their age (age should be more than 18 years) and their residential area (the participants should be from the study area).

7 RESULTS

7.1 The Perceived Safety of the Residents

The response by the participants about the perception of safety was categorized into three groups:-

(1) Safe (includes Very Safe and Fairly Safe)

(2) Unsafe (includes Very Unsafe and Fairly Unsafe)

(3) No opinion (Neutral)

The public areas considered for the study included the immediate area around the individual house/ apartment, playgrounds, public gathering spaces, shopping areas, resting areas and community gardens.

Out of the 62 participants, 87.09% of the respondents said that the public spaces in these neighbourhoods were safe during the day time, whereas during the night time only 46.77% felt these areas are safe (either Very safe or Fairly safe). 6.45% among the respondents had no opinion about the safety of public spaces during daytime and 4.83% during nighttime safety. 54.83% of the participants were females. The gender variation regarding the perception of safety is shown in Table 4. Among night-time safety, 82.14% of the males felt the public spaces in the neighbourhood safe, whereas it was only 17.64 % for the females.

Participants	Daytime			Nighttime		
	Safe	Unsafe	No opinion	Safe	Unsafe	No opinion
Female (34)	28 (82.35%)	3 (8.82%)	3 (8.82%)	6 (17.64%)	26 (76.47%)	2 (5.88%)
Male (28)	26 (92.85%)	1 (3.57%)	1 (3.57%)	23 (82.14%)	4 (14.28%)	1 (3.57%)
Total (62)	54 (87.09%)	4 (6.45%)	4 (6.45%)	29 (46.77%)	30 (48.38%)	3 (4.83%)

Table 4: Gender-wise comparison of the perception of safety in public spaces during the daytime with that of nighttime.

Among the public spaces, the immediate surroundings near to each one's house or apartment was found to be the most unsafe area among the respondents (58.06%), followed by playgrounds (50%) and community gardens (35.48%). None of the respondents felt shopping areas to be unsafe. The opinion of the residents towards safety in various public spaces in the neighbourhood is depicted in Figure 6.

Fig. 6: Perceived Safety of specific locations inside the neighbourhood.

The next group of questions in the questionnaire were related to the general factors in the neighbourhood, which made the residents feel safe or unsafe. The factors considered for the study were:

(1) Impact of criminal offences in the surrounding neighbourhoods

(2) Impact of lack of activities in their neighbourhood, especially in the evenings.

(3) Effect of trees and vegetations that might create blind spots or hiding places

(4) Presence of high-density residential areas in the neighbourhood.

(5) Presence of Wastelands in the neighbourhood

(6) The effect of unattractive public spaces in the neighbourhood

(7) The impact that can be caused by the presence of Police in the neighbourhood.

(8) Winter weather.

Figure 7 clearly shows the residents reaction towards each of the above factors and their impact on their feelings of safety in the neighbourhood. 30% of the participants felt that criminal offences in the surrounding neighbourhoods negatively affect safety in their neighbourhood. The large majority of the participants indicated that the presence of police force in the neighbourhood would help in controlling the crimes. An interesting fact was that, for a small proportion among the participants (20%), feelings of unsafety tend to have seasonal variation, with winter weather increasing their fear and making them feel insecure.

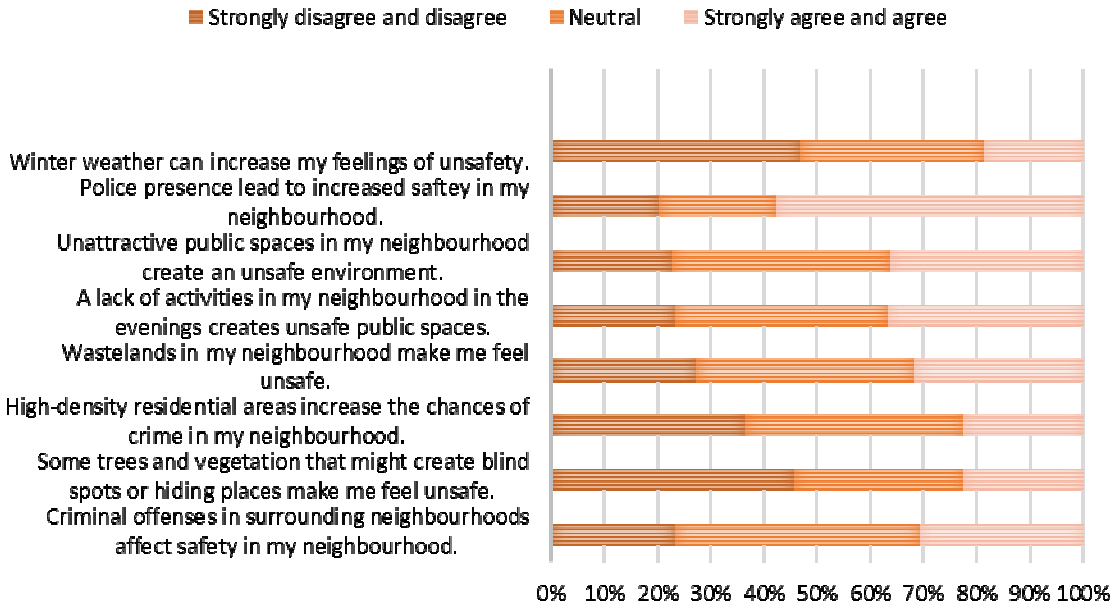

Fig. 7: Residents opinion regarding various factors and their effect on the perceived safety in the neighbourhood

Within the respondent group, drug abuse or dealing with drugs was the most important factor which made the participants feel unsafe in their neighbourhood (100%), followed by alcohol-related issues (90%), anti-social and nuisance behaviour (85%), robbery (85%), and Graffiti and vandalism (47%) (Fig. 8).

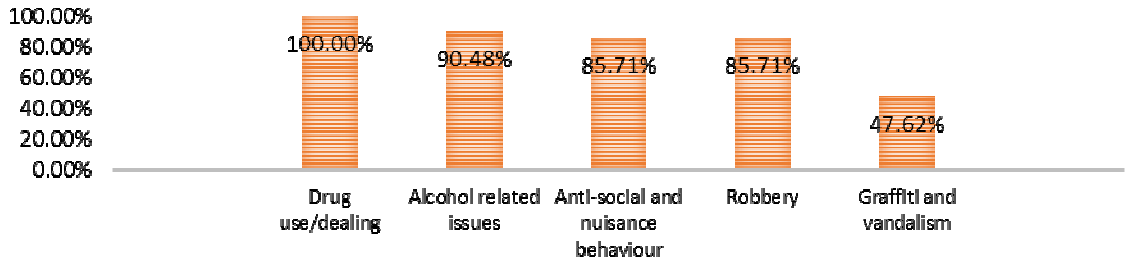

Fig. 8: Residents outlook on common offences in the estate which affect their feeling of safety in the neighbourhood

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7.2 Residents' suggestions for improving safety conditions

This part of the survey was designed to understand the importance of physical, social and cultural factors for feeling safe in the neighbourhood according to residents' suggestions. The scale or measures of these questions were defined based on the first and second generation of CPTED principles. All the questions in the questionnaire were close-ended.

This part had 2 sections:

PART 1: Suggestions for improving the neighbourhood using the Physical Environmental Principles, and

PART 2: Suggestions for improving the neighbourhood utilising the Social- Cultural Principles.

Table 5 shows the suggestions by the residents for improving the safety perception in their neighbourhood by physical environmental factors.

Table 5: Residents' suggestions for improving the perception of safety in their neighbourhood by modifying the Physical Environmental factors

A summary of the main social-cultural principle to improve safety, indicated by the respondents are presented in Table 6.

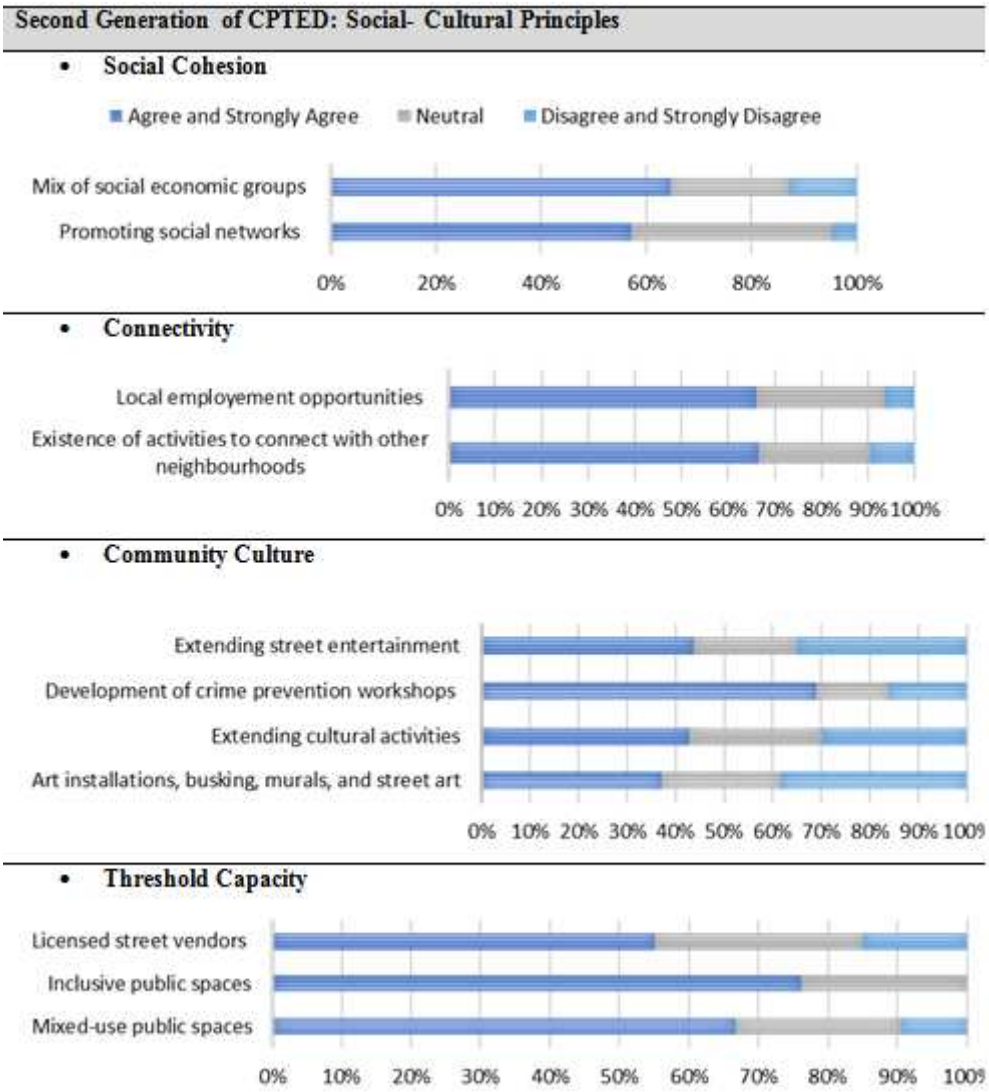

Table 6: Residents' suggestions for improving the perception of safety in their neighbourhood by modifying the Social Cultural factors

8 DISCUSSION OF THE RESULTS

Perception of safety is one of the most significant factors in livable public spaces, which is influenced by various social, cultural, and environmental factors. Residents' perception of safety is a subjective measurement and it is influenced by their preferences.

Safety feelings can impact people's quality of life as well as the social and economic wellbeing of a community (Cai and Wang, 2009, pp. 221–222; Klima et al., 2016; Michalos and Zumbo, 2000; Sugiyama et al., 2009). The social and economic wellbeing of a community is a vital element for the success of a city because these principles help build a sense of community among its residents (Cai and Wang, 2009; City of Sydney, 2018; Fennelly, L. and Perry, M., 2018)

According to the aspiration model proposed by Campbell et al. (1976), there is a relationship between residential preference, perception, and satisfaction. His model shows that residents assess their neighbourhood characteristics, and they compare their expectations to what they really have. Lang (2010) has opined that - "Fundamental to any understanding of human activities within the built environment and feelings about it is an understanding of the processes of perception". In his study, very often residents would declare feeling generally safe in public spaces located in their neighbourhood (87.09%) but still would point out that some public places during the night trigger unsafe feelings. The high rate of safety feeling among the residents can be due to the fact that, they sometimes adopt their preferences with their actual life situations.

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By comparing the incident records and residents' perceived safety, it can be noted that there is a discrepancy between the types of commonly perceived crimes and that of actually recorded ones; which can be attributed to individual experiences. For example, if a particular person had a bad experience of drug abuse within themselves or in their family, then they tend to implicate drug abuse as the most important crime which makes them insecure. Jackson (2004) has pointed out that the gap between the perception of crime and the actual crime rate can be because of the different cultural meaning of crime prevalent in different communities. The perception of the public towards crime has an important effect in making policy decisions addressing crimes (Cohen, 2000). The results of this study are in accord with the recent studies, indicating that, policymakers should consider the perception of crime as well as actual criminal records when they make decisions related to law enforcement.

Overall, the residents' perception of safety is important to understand which factors are more effective in terms of providing a feeling of safety. They have different suggestions in terms of both physical and social principles, to improve the safety environment in the public spaces located within their neighbourhood. A possible explanation for this might be that, in a neighbourhood environment that is well planned, well designed and well managed; residents will feel comfortable and have a sense of belonging. This sense can be achieved not only by improving the physical environmental design but also by implementing a favourable social-cultural design. The recommendations for the estate of Riverwood is certainly to engage residents in the Neighbourhood Renewal Process in all the different stages - design, planning and management; in order to create a sustainable development.

9 CONCLUSION

The present research reveals that the feeling of insecurity increased at night for the female residents in a significant amount, in comparison with day-time, but this pattern could not be observed with similar strength in males. To improve the feeling of safety in their neighbourhood using physical environmental principles, close accessibility to public transportation, developing pedestrian-friendly streets and installing physical security devices were the suggestions which were supported overwhelmingly by the residents; whereas the distribution of parking areas and the ownership of the residence could not gather much support. With regard to utilisation of socio-cultural principles in improving the feeling of safety, development of crime prevention workshops, inclusive public spaces and connectivity were the most supported ideas, but there were few takers for the suggestion of installing artworks to improve safety. The findings of the study reveal also brings out that, addressing the concerns revolving around the trust-deficit in the community, will be the cornerstone to promote residents feeling of safety.

To summarise, the paper finds that, for greater safety of neighbourhoods in urban estates, design approaches need to consider both physical and social-cultural factors; and to achieve this, practical and realistic mechanisms are required to improve existing estates and to design better estates in the future.

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🏆 *reviewed paper*

Flächenkonflikte urbaner Mobilität – mit Flexibilisierung zu mehr Raumpotenzial?

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1 ABSTRACT

Dieser Artikel ist eine literaturbasierte Analyse des Konzeptes der Flexibilisierung in der Planung von Verkehrsflächen zur Schaffung von mehr Raumpotenzial. Bei der Aufteilung des öffentlichen Raumes mit seinen dominierenden Verkehrsflächen wurden jahrzehntelang nicht die Verkehrsmittel des Umweltverbundes bevorzugt, sondern vor allem flächenintensive Verkehrsarten wie den privaten Pkw: Das ist das Ergebnis der einseitigen Orientierung am autogerechten Paradigma der 1960er und 70er Jahre. Um Räumen in der Stadt im Sinne der aktuellen Debatte um ‚Flächengerechtigkeit' neue Nutzungen zuzusprechen, braucht es zeitgemäße Ansätze unter Zuhilfenahme neuer Planungsphilosophien. Dabei müssen innovative Wege der infrastrukturellen und regulativen Gestaltung gefunden werden.

Vor diesem Hintergrund soll in dieser Publikation der Fokus auf die Flexibilisierung von Verkehrsinfrastrukturen gelegt werden. Flexibler Städtebau zeichnet sich durch seine Fehlertoleranz aus. Es wird eine Basis bereitgestellt, die den Aus-, Rück- und Umbau zulässt. Sowohl für aktuell bestehenden Flächenkonkurrenzen als auch für die sich stark wandelnden und noch schwer kalkulierbaren Entwicklungen urbaner Mobilität können flexible Verkehrsinfrastrukturen ein Lösungsweg sein. Daher lautet die Forschungsfrage dieser Arbeit: „Ist der Ansatz von Flexibilisierung der Verkehrsflächen ein Lösungsweg, um im Kontext städtischer Mobilität aktuellen Herausforderungen der Flächenkonkurrenz zu begegnen?" Mit Hilfe einer Literatur- und Dokumentenanalyse soll die Fragestellung beantwortet und diskutiert werden.

Im Rahmen der Publikation werden zunächst die aktuellen Herausforderungen städtischer Flächenkonkurrenz im Kontext der urbanen Verkehrswende dargelegt. Darauffolgend wird der städtebauliche Ansatz der Flexibilisierung definiert und abschließend auf die Gestaltung städtischer Verkehrsflächen angewandt. Als Untersuchungsbeispiel dient die Seestadt Aspern, welche in ihren Planungsdokumenten Flexibilität berücksichtigt. Die Publikation wird literaturbasiert eine Übersicht über die Möglichkeiten und Chancen sowie die Schwächen des Konzepts gegenüberstellen. Abschließend folgt die Diskussion der Frage, inwiefern sich Ansätze der flexiblen Raumplanung im Sinne der Herausforderungen der Verkehrsinfrastrukturplanung als zielführend erweisen können.

Keywords: Flexible Verkehrsflächen, Urbane Mobilität, Flexibilisierung, Verkehrsplanung, Nachhaltigkeit

2 FLÄCHENKONFLIKTE URBANER MOBILITÄT: HERAUSFORDERUNGEN AN URBANE VERKEHRSINFRASTRUKTUREN

Die Vielfalt der Nutzungen des urbanen Raums in seiner Funktion als Verbindungs-, Erschließungs- und Aufenthaltsraum (vgl. Brilon 2005) nimmt stetig zu. Die Diversifizierung des Nutzerinnen- und Nutzerverhaltens stellt dabei vielfältige (versorgungstechnische, wirtschaftliche, ökologische, verkehrliche, soziale, kulturelle und gestalterische) Anforderungen an die Straßenräume einer Stadt (Notz 2016). Angesichts des immensen Bedeutungszuwachses, den die Verkehrsplanung im Laufe der Zeit gegenüber der Stadtplanung erlangt hat, geraten nicht-verkehrlichen Nutzungsformen allerdings zunehmend in Vergessenheit (vgl. Bendiks/ Degros 2019: 14). Denn, bedingt durch starre Infastrukturen, etablierte Verkehrsträger und einflussreiche Akteurinnen und Akteure, wie Automobilunternehmen, zeichnen sich Verkehrsräume durch ein hohes Maß an Pfadabhängigkeiten aus (Butzin/Rabadjieva 2018: 9). Dabei zeigt sich die Infrastruktur gerade in wachsenden Städten und Städteregionen mit steigenden Einwohnerinnen- und Einwohnerzahlen sowie Pendlerinnen- und Pendlerzahlen tendenziell als überlastet. Im Zuge dessen verschärfen sich auch die Flächenkonflikte im und um den endlichen urbanen Raum (vgl. Agora Verkehrswende 2019). Die wachsenden Ansprüche an räumliche Qualitäten, starre Nutzungsrechte und die mangelnde Kompatibilität einiger Nutzungsformen können dabei verkehrssektorintern und -extern zu Zielkonflikten und Flächenkonkurrenzen führen (vgl. BMUB 2015). Im von einer unsicheren sowie unberechenbaren Entwicklung geprägten urbanen Raum, gilt es daher neuartige Ansätze in der Verkehrsplanung zu fokussieren. Darüber könnten neue Raumpotenziale generiert werden, die sowohl den

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Verkehrsträgern des Umweltverbundes als auch vielfältigen nicht-verkehrlichen Nutzungsansprüchen Rechnung tragen.

Vor dem Hintergrund seiner gesamtgesellschaftlichen Relevanz, ist die Qualität des Straßenraums von essentieller Bedeutung für urbane Lebensqualität. Gleichzeitig ist eine leistungsfähige, bedarfsgerechte und moderne Verkehrsinfrastruktur eine wesentliche Grundvoraussetzung für Wettbewerbsfähigkeit, Wachstum und Wohlstand der Städte. Neben öffentlichen Gebäuden und Freiflächen besteht der öffentliche Raum einer Stadt anteilsmäßig zu großen Teilen aus Straßenraum. Zumeist wird dieser Straßenraum allerdings „gemeinhin eher als technisches Artefakt oder als Verkehrsfläche für zumeist motorisierte Fahrzeuge wahrgenommen und weniger als Freiraum für Menschen." (Notz 2016: 4) In seiner Rolle als Allmendegut, das allen Nutzerinnen und Nutzern und ihren Ansprüchen gleichermaßen zur Verfüng steht, wird er oftmals vernachlässigt. Das Straßenrecht, das die Nutzungsrechte für öffentliche Straßen im Allgemeinen regelt, unterstützt diesen Effekt: Der Auffassung einer ‚Konzeption des Gemeingebrauchs' wird prinzipiell nicht widersprochen. Allerdings spiegelt sich die historisch gewachsene Auffassung, nach der „der öffentliche Raum in erster Linie ein verkehrlicher Transitraum ist" (Ruhrort 2019: 203). Dieses Postulat, das sowohl in der öffentlichen Wahrnehmung als auch im Recht reproduziert wird, und das dem Verkehr eine Vorrangstellung in der Nutzung des Straßenraums einräumt, führt in autogerechten Strukturen dazu, dass urbane Flächen faktisch vom motorisierten Individualverkehr dominiert wird, da er mit Abstand die meisten Flächen und Nutzungsprivilegien beansprucht und zugesprochen bekommt (ebd.). Demzufolge wird je nach absoluter Flächenverfügbarkeit, sowohl die Nutzung alternativer, flächen-, raum- und energieeffizienter Formen der Mobilität als auch die Befriedigung anderer Nutzungsbedürfnisse durch die Dominanz des motorisierten Individualverkehrs konterkariert und Flächenkonkurrenzen produziert.

Trotz erheblich geringeren Flächenanforderungen werden die Verkehrsmittel des Umweltverbundes faktisch benachteiligt, indem gesamtgesellschaftliche Ressourcen (Parkraum) für bestimmte Nutzerinnen und Nutzer reserviert oder sogar privatisiert werden, wobei gleichzeitig die Kosten für die Bereitstellung eben jener Flächen der Allgemeinheit angelastet werden (vgl. Kühne 2018). So konstatiert Notz (2016), dass endliche „Kapazitäten, Nicht-Ausschließbarkeit der Nutzung und Rivalität im Konsum" dazu führen, dass Flächenkonkurrenzen entstehen, da „Allmendegüter in der Praxis oftmals übernutzt werden, gerade wenn ihr Verbrauch ungehemmt möglich ist" (vgl. Brezina et al. 2008: 293).

Für eine langfristige Neubewertung urbaner Straßenräume im Rahmen von Stadtentwicklungsperspektiven braucht es daher zeitgemäße Ansätze unter Zuhilfenahme prozessorientierter Planungsphilosophien, die in ihren Bestandteilen flexibel agieren können (BMVBS 2013). Neue Planungen dürfen dabei nicht zu neuen Flächenkonflikten und Rebound-Effekten führen (Stadtentwicklung Wien 2014).

3 DER ANSATZ VON FLEXIBILISIERUNG

Ein innovativer Ansatz in der infrastrukturellen Planung und regulativen Gestaltung von Verkehrsflächen ist daher Flexibilisierung. Flexibilität beschreibt ein Bindeglied zwischen dem Raum und den in Konkurrenz stehenden Funktionen, Aufgaben, Akteurinnen, Akteuren, Nutzerinnen und Nutzern (Ardeshiria et al. 2016). Vermehrt ist der Ansatz von Flexibilität bei der Planung und Gestaltung unserer Städte aufgetaucht. Grund dafür sind die sich wandelnden Bedürfnisse der Gesellschaft, der politische und soziale Druck auf Klimaanpassungstrategien in Zeiten von Unsicherheiten und unvorhersehbaren Naturereignissen. Und zu diesen Herausforderungen des 21. Jahrhunderts zählt Flexibilität und neue Anforderungen an die Erschließungsqualität (Wien 3420 aspern development AG 2009).

Die Untersuchung, die der vorliegenden Publikation zugrunde liegt, erfolgte methodisch durch eine qualitative Literaturrecherche. Mit Hilfe von zentralen Begriffen, wie Flexibilisierung und Infrastrukturplanung, flexibler Städtebau, Raumpotenziale durch Flexibilität, wurden Literaturdatenbanken durchsucht. Die Recherche wurde dabei induktiv vorgenommen, die zu gewinnenden Erkentnisse sollen theorieentwickelnd sein. Zwar ist das Messniveau der qualitativen Literaturrecherche niedrig, jedoch ist der Planungsansatz von Flexibilisierung in der Literatur noch nicht ausreichend repräsentiert, um quantitativ vorgehen zu können. In einem ersten Schritt wurde zunächst ein Überblick von nationalen und internationalen Literaturen generiert. Anschließend sind die Erkenntnisse zusammengefasst auf die Potenziale der Flexibilisierung für urbane Verkehrsinfrastrukturen bezogen worden. Zuletzt wurden die gewonnenen Erkenntnisse zur Frage, ob Flexibilisierung ein Ansatz zur Lösung von Flächenkonkurrenzen ist, auf die aktuellen Herausforderungen der Schaffung von Raumpotenzialen für urbane

Verkehrsinfrastrukturen übertragen. Mit Hilfe einer explikativen Datenanalyse wird der Forschungsfrage „Ist der Ansatz von Flexibilisierung der Verkehrsflächen ein Lösungsweg, um im Kontext städtischer Mobilität aktuellen Herausforderungen der Flächenkonkurrenz zu begegenen?“ nachgegangen.

In der Literatur sind bereits Planungsansätze von Flexibilisierung der Verkehrsinfrastruktur zu finden, jedoch sind diese noch nicht bezüglich ihrer Wirkung auf Raumpotenziale untersucht worden. Aus diesem Grund werden nachfolgend Erkenntnisse aus wissenschaftlichen Dokumenten zum Ansatz von Flexibilisierung in der Infrastrukturplanung beleuchtet und anschließend auf die zu gewinnenden Raumpotenziale übertragen.

3.1 Was ist Flexibilisierung?

Starre, permanente zeitlich und im Kontext unveränderbare Lösungen sind nicht mehr Konsens und es wird nach innovativen Strategien gesucht: auch für vermeintlich starre Verkehrsinfrastrukturen. Flexibilität muss aber nicht als rein physisch, gebautes Werkzeug verstanden werden. Neben physischen Handlungsmöglichkeiten sollten auch weiche Faktoren, wie beispielsweise digitale Infrastrukturen, Berücksichtigung finden (Moroni et al. 2018).

Flexibilität kann verstanden werden als ein dynamisches, prozessbasiertes Planungsinstrument, welches sich zeitlich und räumlich auf die gegebenen Umstände anpassen lässt. Definieren lässt sich Flexibilität als „ein Gestaltungsmittel, um eine ressourcenschonende Raumplanung zu erreichen. Flexibilitätsmaßnahmen sind: reversibel, abnehmbar, anpassungsfähig, verstellbar und/oder ausbaufähig.“ (Stratmann 2019: 1) Dabei gibt es Kriterien, welche den Grad der Flexibilität bestimmen und beeinflussen. Dazu zählt der Grad der Veränderungs- und Umbaumöglichkeiten, das Potenzial der Erweiterungsmöglichkeiten und der Grad der Wiederverwendung (ebd.). Ziel von Flexibilität ist es für neue Nutzungen und Funktionen Räume zu schaffen mit niederschwelligen Eingriffen und strukturellen Veränderungen (Sanei et al. 2018). Auch Infrastrukturen sind städtische Strukturen und bedüfen durch die sich ändernden Anforderungen einer näheren Betrachtung, denn Flexibilität kann wesentliche Zielqualitäten in der Planung erfüllen.

3.2 Flexibilisierung von Verkehrsflächen: Von Flächenkonflikten zu Raumpotenzialen?

In den Städten nehmen Verkehrsinfrastrukturen einen wesentlichen Flächenanteil im öffentlichen Raum ein (vgl. Agentur für clevere Städte 2014). Mit einer flexiblen und dynamischen Planung können diese Flächen einen wesentlichen Beitrag zur Nachhaltigkeit eines Quartiers, einer Stadt, einer Region, eines Landes und über die Landesgrenzen hinaus leisten. Neben ökonomischen und sozialen Vorteilen ist dabei insbesondere der ökologische Nutzen einer flexiblen Infrastrukturplanung, in Bezug auf ihre Wirkung auf die Nachhaltigkeit urbaner Verkehrsinfrastrukturen, zu betonen.

3.2.1 Der Ansatz von Flexibilisierung in der Literatur

In der Literatur sind bis dato nur wenige Ansätze von Flexibilisierung der Verkehrsflächen zu finden und diese sind nach Meinung der Autorinnen bislang unzureichend zusammengetragen worden. Aus diesem Grund wird nachfolgend beleuchtet, was Flexibilisierung der Verkehrsflächen bedeutet, welche Elemente und Umsetzungsmaßnahmen notwendig sind und welche Kriterien es in Bezug auf die Planung flexibler Verkehrsflächen zu beachten gilt.

Moroni et al. (2018) betonen, dass es bei dem Ansatz von Flexibilisierung der Verkehrsinfrastruktur nicht allein um das physisch Gebaute geht. Auch die rechtliche Ebene, digitale Strukturen und der Prozess an sich Bedürfen einer Einbindung. Auf dieser übergeordneten Ebene stellten Moroni et al. (2018) heraus, dass bevor neue Infrastruktur gebaut wird zwei Optionen geprüft werden sollten: zum einen soll nichts getan werden, die Verkehrsinfrastruktur soll bestehen bleiben wie sie bis dato ist, und zum zweiten sollte die bestehende Infrastruktur effizienter gemacht werden (ebd.). Wie schon vormals erwähnt bekräftigt Kötter (2005) dieses Argument, laut dem insbesondere die bauliche (Neu-) Gestaltung der Flächen einen Interessensausgleich zwischen Nutzerinnen Nutzern, Aktuerinnen, Akteuren und Funktionen schafft (ebd.). Um Raumpotenziale schaffen zu können ist es wichtig, dass jene Infrastrukturen priorisiert werden, welche nicht nur für eine Nutzung bestimmt sind (Moroni et al. 2018). Monostrukturen müssen vermieden und polyzentrische bevorzugt werden (ebd.). Damit der Ansatz von Flexibilität in der Infrastrukturplanung greifen kann, sollte dieser im kleinen Maßstab Anwendung finden. Begründet ist der kleinräumige Eingriff durch weniger Kostenschätzungsfehler, weniger finanzielle und technische Risiken, es kann in kürzeren

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Phasen und zeitlichen Abschnitten gedacht und umgesetzt werden und einer der Hauptgründe: Der Eingriff ist anpassungfähiger an den Raum (ebd.).

Neben der Mobilität können Straßenräume auch als Spiel- und Aufenthaltsorte programmiert werden (Lewis/Schwindeller 2014). Eine Bevorzugung von Funktionen kann durch viele Kombinationen von Strategien angepasst werden, um eine vielfältigere Nutzung zu erreichen (ebd.). Lewis/Schwindeller (2014) fassen dementsprechend zusammen, welche Elemente Vekehrsflächen flexibel und anpassungsfähig machen. Ein oft genanntes Element ist das städtische Mobiliar. Die Ausweisung von Flächen durch Schilder für oder gegen bestimmte Nutzungen lassen Räume flexibel werden. So können beispielsweise Straßen für Feste temporär abgesperrt und anderen Nutzungen zugesprochen werden. Sanei et al. (2018) bekräftigen, dass multifunktionalen Stadtmöbel die Flexibilität der Verkehrsflächen positiv beeinflussen.

Da Verkehrsflächen öffentliche Räume sind, betonen Ardeshiri et al. (2016) die Wichtigkeit diese Flächen unterschiedlich nutzbar zu machen. Flexible Stadträume sind demnach multimodale Räume (ebd.). Ziel der flexiblen Räume ist es, auf die Bedürfnisse der Nutzerinnen und Nutzer reagieren zu können. Es wird herausgestellt, dass sich durch flexible Straßenräume unterschiedliche Nutzerinnen und Nutzer und Funktionen gleichzeitig derselben Fläche bedienen können. Somit stellen flexible Räume eine optimale Raumnutzung dar (ebd.).

3.2.2 Einfluss von Flexibilisierung: Vortheoretischer Ansatz zu Raumpotenzialen

Zusammengefasst kann der Ansatz von Flexibilisierung dann zu einer Minderung von Flächenkonflikten auf Verkehrsflächen führen, wenn Flexibilisierung als ein Planungsinstrument verstanden und angewandt wird, das statt einem ‚Nebeneinander' der unterschiedlichen Verkehrsträger und Nutzungen zu einem ‚Miteinander' beiträgt (Stadtentwicklung Wien 2014). Durch die Offenheit für diverse Flächennutzungen im Raum werden Resistenzen gemildert, sodass Konflikte nicht entstehen müssen. Dabei ist ein Hauptargument für Flexibilisierung, dass bei ihrer Umsetzung Ressourcen eingespart werden können. Dieser Vorteil greift vor allem in urbanen Gebieten, wo der Boden hart umkämpft ist und Flächenkonkurrenzen bestehen. Diese Konkurrenzen werden durch Flächen, die sich durch multiple Nutzungsmöglichkeiten auszeichnen, gemildert. Im Zuge dessen kann Flexibilisierung in Kontext urbaner Verkehrsflächen neue Raumpotenziale aufdecken.

Flächenkonfikte im urbanen Mobilitätskontext können durch den Ansatz von Flexibilisierung reduziert werden. Grund dafür ist, dass prinzipiell die Offenheit der Gesellschaft für anderweitige Nutzungen auf öffentlichen Flächen gefördert wird. Der Ansatz, Flächen mehrfach und zeitgleich zu bespielen und offen für (temporäre) diverse Nutzungen zu machen, ermöglicht, dass der Flächenverbrauch sinkt. Durch multifunktionale Räume können daher neue Raumpotenziale ausgeschöpft werden (vgl. Ardeshiri et al. 2016). So können Verkehrsmittel dieselben Flächen nutzen. Wie herausgestellt werden konnte, bedarf es nicht nur der phyischen Gestalt des Raumes zur Schaffung von Raumpotenzialen (vgl. Moroni et al. 2018), sondern ebenso der Wechselwirkung von dem Gebauten und den wahrgenommenen Optionen (vgl. Deffner et al. 2014). So können durch Veränderungen der Nutzungen, Anforderungen und Umstände (steigende Pendlerinnen- und Pendlerzahlen, neue Mobilitätsmuster und Verkehrsmittel) neue Zielkonflikte entstehen (vgl. Zandvoort et al. 2019; Carr/Dionisio 2017) die zu einer weiteren Überlastung der Verkehrsräume führen. Ein Beispiel hierfür sind neue Verkehrsmittel, wie E-Scooter, die zuvor nicht dagewesene Flächenkonflikte auf urbanen Verkehrsflächen verursachen. Hier kann Flexibilisierung eingreifen und beispielsweise durch das Aufstellen von Schildern das Fahren mit neuen Verkehrsmitteln auf bestimmten Flächen freigeben oder untersagen (vgl. Lewis/Schwindeller 2014). Für die Planung urbaner Verkehrsräume ist es daher ebenso relevant, dass die „… sie durchfließendenVerkehrsströme eine gewisse Flexibilität aufweisen …" (Bendiks/Degros 2019: 26). Das flexible Freigeben von öffentlichen Flächen für Nutzungen, beispielwesie auch nur in bestimmten Zeiträumen, kann dabei eine Entlastung der Verkehrsflächen addressieren. Laut Bendiks/ Degros sollte daher trotz spezifischer Gestaltung die Anpassung der gemeinschaftlichen Nutzung des Raums auch an den „Rhythmus des Quartiers" erfolgen. „Ein Parkplatz wird (Jahr)markt, Stellplätze vor Schulen werden tagsüber für Räder von Eltern und Schülerinnen und nachts für die Autos der Anrainer (Flexparking) genutztsowie variable Höchstgeschwindigkeiten vor Schulen" (ebd.: 88). Technologische Hilfsmittel, wie bspw. in Form von Verkehrsleitsystemen, können dabei entscheidend zu einer flexibleren Teilung des Raums beitragen (ebd.).

Der Herausforderung, den gesellschaftlichen Ansprüchen an die Qualität der Straßenräume generell gerecht zu werden, kann ebenfalls durch eine Form der Flexibilisierung begegnet werden, die mit städtischem Mobiliar und Inventar qualitätvolle Aufenthaltsräume schafft und so zu neuen Raumpotenzialen beiträgt (vgl. Lewis/Schwindeller 2014; Sanei et al. 2018; Ardeshiri et al. 2016). Neben dem Potenzial Qualitäten zu sichern, begegnen Mobiliar und Inventar auch der Herausforderung Zielkonflikte in den Nutzungen zu lösen: Durch das verschieben, aufstellen und abnehmen von Mobiliar werden städtische Flächen nutzbar. Beispielsweise können durch Fahrradabstellanlagen an neuralgischen Punkten neue Räume erschlossen werden, Sitzmöglichkeiten können zum Aufenthalt einladen oder Beschilderung zum Spielen einladen.

Für solche unvorhersehbaren Nutzungen plant Flexibilisierung und ist damit fähig auf akute Bedarfe zu reagieren. Da nicht in jeder Stadt und jedem Quartier die gleichen Flächenkonflikte herrschen, ist der kleinräumige Ansatz zur Schaffung von Raumpotenzialen essentiell. Eine optimale Raumnutzung kann im kleinen Maßstab erfolgen (vgl. Moroni et al. 2018). Die Nutzungen und die daraus resultierenden Konflikte ändern sich mit der Zeit. Flexibilisierung kann durch eine kurzfristige Reaktion auf Ereignisse Potenziale schaffen. Gleichzeitig können Zielqualitäten eine langfristige Planung sichern. Neben der Generierung von Raumpotenzialen, begegnet der Ansatz allerdings auch Herausforderungen. Ein wichtiger Punkt ist, dass Flexibilisierung auch politisch gewollt sein muss (vgl. BMVBS 2013). Dafür ist ein adäquater und flexibler Rechtsrahmen unabdingbar. Die mangelnde rechtliche Verankerung könnte einer der Gründe sein, wegen derer es noch kaum Umsetzungsbeispiele gibt.

In der Literatur finden sich Ansätze, die Flexibilisierung und ihre Umsetzung in der Planung fossieren. Jedoch mangelt es an Beispielen, die das theoretische Konzept in der Praxis verwirklichen. Daraus ergibt sich die Frage, ob Flexibilisierung in der Realität umsetzbar ist oder welche Faktoren einer Umsetzung entgegenstehen (Ardeshiri et al. 2016). Über die Gründe lässt sich bis dato nur spekulieren, da die Literatur hierüber bisweilen nur wenig Aufschluss liefert. Mögliche Ansatzpunkte für die mangelnde theoretische und praktische Auseinandersetzung mit Flexibilisierung könnten sein, dass das Konzept bislang zu abstrakt scheint, die bisherigen wissenschaftlichen Beiträge nicht ausreichend gebündelt und fundiert dargestellt sind, die Schwelle zwischen Forschung und Praxis zu groß ist oder die Strukturen in den jeweiligen Planungseinheiten der Länder und Städte in ihrem System zu starr erscheinen.

4 ENTWICKLUNGSKONZEPTE SEESTADT ASPERN: EINBINDUNG VON FLEXIBILITÄT IN DIE VERKEHRSPLANUNG

Die Seestadt Aspern ist eines der wenigen Beispiele, welche in einer städtebaulichen Entwicklung den Ansatz von Flexibilisierung sowohl in der Planung (in den Entwicklungskonzepten) fest verankert als auch praktisch umgesetzt haben. Die Seestadt Aspern ist ein Stadtteil im Außenbezirk der Millionenstadt Wien in Österreich. Aufgrund der hohen Nachfrage nach Wohnraum in der Hauptstadt Österreichs wurde auf dem ehemaligen Militärflughafen außerhalb der Kernstadt ein neuer Stadtteil ‚auf der grünen Wiese' entwickelt. Diese räumlichen Gegebenheiten bietet bei der Planung und Entwicklung das Potenzial traditionelle Stadtstrukturen zu überdenken und bezüglich der Verkehrsinfrastrukturen losgelöst vom Autogerechten Paradigma zu bewerten. Für ein qualitativ hochwertiges städtebauliches Konzept hat die Stadt einen Wettbewerb ausgelobt.

Anhand der in Kapitel 2 dargestellten Methodik, sind im Rahmen der vorliegenden Publikation die städtebaulichen und planungsrelevanten Konzepte und Entwürfe der Seestadt Aspern auf den Ansatz von Flexibilisierung untersucht und hinsichtlich der daraus resultierenden Raumpotenziale beleuchtet worden.

Nachstehend werden zunächst die relevanten Planungskonzepte vorgestellt und die Passagen mit Aussagen und Festsetzungen zur Planung flexibler Verkehrsflächen erläutert. Darauffolgend werden die in den Planungsdokumenten gefundenen Elemente mit den zuvor dargestellten Raumpotenzialen verschnitten. So kann ein erster Eindruck generiert werden, wie und in welcher Form es möglich ist, in Planungsdokumenten Flexibilisierung festzusetzten, sodass diese in der Realwelt Anwendung finden und Potenziale im Raum freisetzen können.

4.1 Die Planungskonzepte

Das theoretische Fundament für den Bau der Seestadt besteht aus mehreren (Teil-)Konzepten. Diese bauen aufeinander auf oder stehen nebeneinander. Nachstehend werden die zentralen Planungsdokumente zur Schaffung von Flexibilität der Verkehrsflächen vorgestellt. Der Masterplan ist dabei als das übergeordnete

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Konzept zu verstehen, dem alle Fachkonzepte untergeordnet sind - Der Masterplan gibt den Rahmen vor. Des Weiteren wird die Partitur des öffentlichen Raums beleuchtet. Die Partitur ist eines der wesentlichen Planungsdokumente, das insbesondere international Aufmerksamkeit erlangt hat und zehn Jahre nach seiner Aufstellung evaluiert wurde. Diese Evaluierung (lessons learned), wird im Rahmen des vorliegenden Artikels ebenfalls analysiert. Auch das Fachkonzept Mobilität sowie der City Lab Report werden hinsichtlich ihrer Bezugnahme auf Flexibilität in der Verkehrsinfrstrukturplanung näher betrachtet. Begründet ist die Auswahl der vormals beschriebenen Planungsdokumente darin, dass diese insbesondere die Planung von Verkehrsflächen fokussieren. Die hier aufgeführten Konzepte der Seestadt Aspern sind allerdings als nicht abschließende Planungsgrundlagen zu begreifen, sondern evaluieren das theoretische Konzept der Flexibilisierung in Bezug auf Möglichkeiten seiner Umsetzung. Zudem soll die Analyse keine Wertung darüber abgeben, ob die Seestadt Aspern eine Flexibilität von Verkehrsinfrastrukturen erreicht hat. Der Umfang der zugrunde liegenden Analysen reicht hierfür nicht aus.

4.1.1 Masterplan

Der Slogan des Masterplans ist: “Grundlage für die intelligente Stadt bildet eine gründliche und flexible Planung“ (wien 3420 aspern development AG 2017: 1). Die räumliche Planung zu Flexibilisieren ist somit ein Leitziel der Stadt. Der Masterplan soll kein starres Planwerk sein und sich auf Veränderungsprozesse während der jahrelangen Entwicklungslaufzeit anpassen können. Aus diesem Grund ist Flexibilität im Planungswerk verankert. Dies soll auch dazu führen, dass Qualitäten vorgegeben und gesichert werden können (ebd.). Die Planung der Verkehrsinfrastruktur soll sich demzufolgen ebenfalls an den Grundsätzen flexibler Planung orientieren. Flexibilität bietet das Potenzial auf Bedarfe zeitlich angemessen zu reagieren. Dieser Vorteil kann beispielsweise beim Bau von Parkmöglichkeiten zum Tragen kommen. Dazu heißt es: „Hochgaragen sollen so gestaltet sein, dass sowohl Erweiterungen und Rückbau als auch Umnutzungen möglich sind, um auf den zukünftigen Bedarf flexibel reagieren zu können“ (ebd.: 30). Zudem sollen Straßen einen hohen Grad an Nutzungsflexibilität und Weiterentwicklungsmöglichkeiten aufweisen (ebd.). Damit bietet das übergeordnete Konzept des Masterplans erste Richtlinien, welche Flexibilisierung in der Verkehrsinfrastrukturplanung beinhalten. Beispielhaft aufgegriffen werden soll an dieser Stelle das Konzept der Quartierswege. Wie Abbildung 1 zeigt, können diese Wege mehrere Funktionen gleichzeitig miteinander verknüpfen. Sie sind zugleich Verkehrs-, Aufenthalts- und Parkraum (ebd.).

Abb. 1: Quartiersweg, Mischprinzip (eigene Darstellung nach Wien 3420 aspern development AG 2017: 24)

4.1.2 Partitur des öffentlichen Raums

Die ‚Partitur des öffentlichen Raums‘ wurde 2009 vom Planungsbüro gehl architects aufgestellt. Ebenso wie der Masterplan gilt die Partitur als ein „prozessbasiertes dynamisches Planungswerkzeug“ (Wien 3420 aspern development AG 2009: 18). Dieses dient als Planungsgrundlage für die Seestadt. Die Partitur bündelt mehrere Konzepte mit Fokusbereichen, wie beispielsweise den Mobilitäts- und Bebauungsleitfaden (entwickelt in Zusammenarbeit mit Wien3420 AG) und der Strassenplanung und -gestaltung (entwickelt in Zusammenarbeit mit MA28). Die Themen um die Entwicklung und Gestaltung der Verkehrsinfrastrukturflächen sind vielseitig. Bedacht worden sind u.a. Räume wie die „Savanne“, ein flexibler und multifunktioneller Ort mit interaktivem Charakter (Wien 3420 aspern development AG 2009). Berücksichtigung fand auch das Stadtmobiliar, welches flexibel und situationsbedingt anpassungsfähig ist

(ebd.). Zu diesem Inventar zählen u.a. Fahrradabstellanlagen, Pöller und auch Lichtsignalanlagen, die dem öffentlichen Straßenraum zuzuordenen sind. Jedoch ist auch festzustellen, dass der motorisierte Individualverkehr auch in diesem Konzept weiterhin priorisiert wird. Nichtsdestotrotz hat sich die Partitur den zeitlich anpassbaren Charakter von Flexibiliserung in der Festsetzung von temporären Nutzungen und Infrastrukturen zu Nutze gemacht. So ist während der Entwicklung und des Baus der Seestadt u.a. ein temporäres Wegenetz zum Einsatz gekommen. Dieses Wegenetz passt sich den Bedürfnissen der Bewohnerinnen und Bewohner an und reagiert flexibel auf die Entwicklungen im Raum (ebd.: 104). Die „Savanne“ soll zu einem multifunktionellen und flexiblen Ort werden, d. h., dass der Ort in längeren zeitlichen Perioden interaktiven Charakter erhält. Ähnlich ist mit unbefestigten Wegen umgegangen worden, welche sich zu einer Straße entwickeln konnten (ebd.). Diese Wege dienten temporär in den Bauphasen der Seestadt zum Verbinden von neuralgischen Punkten und Schaffung von kurzen Wegen, in der zeitlichen Entwicklung haben sich die Wege etabliert und sind zu Straßen ausgebaut worden. Neben dem Verkehrsinfrastrukturbereich ist der Ansatz der Flexibilisierung auch im Bereich Wohnen verankert worden (ebd.). Hier liegt der Fokus vor allem auf flexiblen Nutzungen der Gebäude.

4.1.3 Lessons learned

Das Dokument ‚Lessons learned‘ entstand aus der Evaluierung der Entwicklungsziele der Partitur. Dass sowohl die Partitur als auch ihre Evaluierung vom Planungsbüro gehl architects durchgeführt wurde, hat in der Vergangenheit vermehrt zur Kritik geführt, da eine Evaluierung der eigenen Planung nie objektiv erfolgen kann und demzufolge vermieden werden sollte. Aus diesem Grund muss kritisch hinterfragt werden, inwieiweit die folgenden Ergebnisse valide sind.

Die Relevanz von Flexibilisierung kommt in den ‚Lessons learned‘ (Gehl 2019) besonders zum Vorschein. Im Gegensatz zur Partitur ergeben sich hier einige Änderungen in den Entwürfen: Aus der Partitur folgte die Straßengestaltung respektive die Verteilung der Straßenräume an die unterschiedlichen Nutzungen anders: „im endgültigen Design wird Fußgängerinnen großzügig Raum gegeben. Dies spricht für die verantwortlichen Verkehrsplanerinnen und Verkehrsplaner, die den gesamten Planungsprozess im Sinne einer Vision von Straßen“ (Gehl 2019: 5). Besonders hervorzuheben ist, dass die Partitur Überschneidungen von Nutzungen vorgesehen hat. Die Analyse hat gezeigt, dass dies in der Realität gut funktioniert (siehe Abbildung 2; ebd.: 8). Sowohl der Masterplan als auch die Partitur sehen Überschneidungen von öffentlichen Räumen und Funktionen vor, um eine lebedige Stadt zu schaffen (ebd.). Die Evaluierung hat jedoch auch gezeigt, dass die multifunktionellen Flächen bis dato nicht genutzt werden. Als Grund wird neben einer Überdimensionierung der Flächen auch die bislang zu geringe Anzahl an Nutzerinnen und Nutzern genannt. Wie diese ungenutzen Flächen sich in den nächsten Jahren entwickeln werden, bleibt abzuwarten.

Abb. 2: Lebendige Freiräume durch Überschneidung von Aktivitäten (eigene Darstellung nach Gehl 2019: 8)

4.1.4 Citylab Report

Wie bereits zuvor beleuchtet, greift auch der Citylab Report (Wien 3420 Aspern Development AG 2011) die Potenziale des Ansatzes von Flexibilisierung auf. „Die Schaffung einer neuen Gemeinschaft muss die Veränderungen über kurze und lange Zeiträume reflektieren und berücksichtigen, sie muss einerseits die Ziele und Bestrebungen präzise formulieren, andererseits aber auch flexibel und offen bleiben“ (Wien 3420 Aspern Development AG 2011). Im Report wird hervorgehoben, dass das Zusammenspiel von Identität und

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Flexibilität konzeptionell verankert sein muss, damit eine Entwicklung gelingt (ebd.). In dem aufgestellten Katalog zu Kriterien einer nachhaltigen Entwicklung wird das Thema Flexibilität aufgeführt (ebd.). Flexibilität ist Teil des Plans, so der Report (ebd.). Freiräume müssen bereitsgestellt werden, in welchen flexible Nutzungen zugelassen werden. Dafür bedarf es an flexiblen Rahmenvorgaben, welche trotz Anpassungsfähigkeit ihre Zielqualitäten nicht verfehlen (ebd.).

4.1.5 STEP 2025 Fachkonzept Mobilität

Das Fachkonzept STEP 2025 Mobilität fokussiert ein neues Element von Verkehrsflächen, die insbesondere durch ihre Möglichkeiten der flexiblen Nutzung auffallen: die Multifunktionsstreifen. Dieses Element weist deshalb einen hohen Grad an Flexibilität auf, weil es so angelegt ist, dass es auf sich rasch ändernde Nutzungen und neue Verkehrsträger reagieren kann. Dazu heißt es: „Die Flexibilität ergibt sich aus einer entsprechenden baulichen Gestaltung des Raumes zwischen Gehsteig und Fahrstreifen. Diese erfolgt so, dass Multifunktionsstreifen als eigenes Element im Straßenraum wahrgenommen werden. Sie sind Teil des Gehweges, und nicht Teil der Fahrbahn. Die Befahrbarkeit, beispielsweise um Fahrzeuge abzustellen, wird durch sanfte Niveauübergänge gewährleistet. Keinesfalls dienen Multifunktionsstreifen dem fließenden Fahrzeugverkehr“ (Stadtentwicklung Wien 2015: 78). Mit Hilfe dieses Entwurfselementes möchte das Konzept mehr Flexibilität in der Planung und Durchführung umsetzen. Der Multifunktionsstreifen lässt, wie der Name schon sagt, verschiedene Funktionen zu und ist damit anpassbar.

Geminderte Flächenkonflikte und mehr Raumpotenziale durch Flexibilisierung

Die vormals besprochenen Konzepte zur Entwicklung der Seestadt Aspern greifen den Ansatz von Flexibilisierung von Verkehrsflächen auf. Das Beispiel Aspern zeigt dabei auch, dass Flexibilität eine konzeptionelle und rechtliche Verankerung braucht, um Umsetzungsfähig zu sein: Der Masterplan als übergeordnetes informelles Planungsinstrument hat Flexibilität zum Leitziel, sodass die darauffolgenden Konzepte, wie die ‚Partitur des öffentlichen Raums‘, der ‚Citylab Report‘ und das ‚Fachkonzept STEP 2025‘ sich daran orientieren und die Planungsziele weiterführen konnten. Dem Kritikpunkt einer mangelnden rechtlichen Grundlage von Flexibilisierung in Planungsdokumenten, konnte in Aspern von Beginn an begegnet werden. Sowohl der Masterplan als auch der Citylab Report betonen, dass ein flexibles Planwerk Grundvoraussetzung ist, um Flexibilität in die Praxis zu transferieren. Ohne Rahmenvorgaben und Zielqualitäten ist der Ansatz von Flexibilisierung nicht möglich. Mit diesen Festsetzungen kann das Potenzial der Umsetzung von Flexibilisierung geschaffen werden. Die Literaturrecherche hat zwar ergeben, dass direkte räumliche Potenziale bis dato nicht erreicht werden, jedoch hat die konzeptionelle Verankerung hohe indirekte Auswirkungen auf die Schaffung von Raumpotenzialen.

Durch eine zeitlich versetzte Abfolge der Erstellung und Ausführung der Konzepte ist das Festsetzen von Flexibilität im Prozess ein weiterer wichtiger Baustein. Der Masterplan und die ‚Partitur des öffentlichen Raums‘ verstehen sich als ein dynamisches Planungswerkzeug. Das hat zum Vorteil, dass ein flexibler Prozess generiert wird. Dieses Potenzial hat die ‚Lessons learned‘ (vgl. Gehl 2019) herausgestellt.

Wie in der Literatur zusammengetragen worden ist, spielt das städtische Mobiliar eine zentrale Rolle zur Schaffung von Raumpotenzialen. In den Planungsgrundlagen und der anschließenden Umsetzung sind flexibles Inventar und Stadtmobiliar zu finden. Dadurch sind unterschiedliche Nutzungen im Raum möglich. Ebenso ist der kleinräumige Maßstab der Umsetzung von Flexibilisierung, wie es in der ebenso in der zugrunde liegenden Literatur dargestellt wurde, beachtet worden. Der flexible Ansatz ist auf kleinem Maßstab umgesetzt worden und erreicht somit einen hohen Grad der Anpassungsfähigkeit.

Neben übergeordneten Zielen zur Flexibilisierung sind auch bauliche Umsetzungen festgehalten. So wird beispielsweise im Masterplan der Rückbau, Umnutzung und die Erweiterung von Hochgaragen festgesetzt, damit auf Bedarfe flexibel reagiert werden kann und das Potenzial der begrenzt zur Verfügung stehenden Flächen genutzt wird. Diese Nutzungsneutralität von städtebaulichen Strukturen kann Konflikte lösen und Raumpotenziale für anderweitige Nutzungen generieren. In der ‚Partitur des öffentlichen Raums‘ werden Raumpotenziale durch das temporäre Wegenetz eröffnet. Durch das Bereitstellen von temporären Wegen, können Konflikte auf bestehenden Verkehrsflächen vermieden werden; gleichzeitig können diese Flächen zu einem späteren Zeitpunkt für andere Nutzungen bereitgestellt werden. Damit nicht jede Nutzung eine eigene Fläche braucht sieht das ‚Fachkonzept STEP 2025‘ eine flexible Fläche im Sinne des Masterplans vor. Mit der Etablierung von Multifunktionsstreifen sollen mehrere Nutzungen gleichzeitig ermöglicht werden. Neben baulich-räumlichen Aspekten werden den Nutzerinnen und Nutzern die Möglichkeiten des flexiblen

Bespielens der Flächen zugesprochen. Die ‚Partitur des öffentlichen Raums' hat gezeigt, dass durch mehr Flexibilität im Planungswerk letzendlich in späteren zeitlichen Abschnitten flexibler auf die sich wandelnden Bedürfnisse der Gesellschaft reagiert werden kann. Es bleibt nicht aus, diesen Prozess weiterhin zu evaluieren und ein stetiges Monitoring zu betreiben, um zu prüfen, inwieweit das theoretische Konzept um Flexibilisierung, Auswirkungen auf den Raum und den Mensch in der Stadt hat.

Trotz der dargestellten positiven Aspekte müssen sich die Konzepte und ihre Umsetzung auch einiger Kritiken stellen. So lässt sich feststellen, dass es noch keine ausreichende wissenschaftliche Datengrundlage zu vielen der in den Konzepten genannten Ansätze gibt. Dazu zählt beispielsweise der Multifunktionsstreifen, zu welchem es bis dato sowohl an wissenschaftlicher Evaluation als auch erfolgreichen Umsetzungsbeispielen mangelt. Eine Evaluation wäre unter anderem deswegen von großer Bedeutung, da erst auf dieser Grundlage erörtert werden kann, welche Raumpotenziale im Vergleich zur herkömmlichen Planung freigesetzt werden. Dasselbe gilt für eine Evaluierung sinkender Flächenkonflikte. Dennoch lässt sich sagen, dass die Seestadt Aspern als ein gutes Beispiel voraus geht, einen innovativen Ansatz praktisch umzusetzten, um flexibel auf sich ändernde Ansprüche einzugehen.

Abb. 3: Seestadt Aspern. Straßenraum mit Mischprinzip (eigene Darstellung).

5 MIT FLEXIBILISIERUNG ZU MEHR RAUMPOTENZIAL?

Im Rahmen der vorliegenden Publikation wurde der Frage nachgegangen, inwiefern sich Ansätze der flexiblen Raumplanung im Sinne der Herausforderungen der Verkehrsinfrastrukturplanung als zielführend erweisen können. Die in diesem Kontext vorgenommene Literaturanlyse hat gezeigt, dass über die Flexibilisierung von Verkehrsflächen einer Transformation urbaner Mobilität positive räumliche Effekte und dementsprechende Raumpotenziale geschaffen werden können. Flexibilisierung kann einen Beitrag leisten, Unsicherheiten in der städtebaulichen Entwicklung aufzuheben und Konflikten durch flexible Lösungen zu begegnen. Flexibilisierung bietet zudem das Potenzial, die Aufenthaltsqualität durch die städtebauliche Aufwertung der Straßenräume immens zu steigern. Das Konzept muss allerdings auch dahingehend gedacht werden, dass derartige flexible Gestaltungen nicht in jedem städtischen Raum Sinn ergeben oder angewandt werden können. Das Beispiel Aspern zeigt, dass ein Konzept mit dem Ansatz von Flexibilisierung die Bedürfnisse der Gesellschaft in Entwicklungszeiten gerecht werden kann. Obwohl in der Literatur bislang nur wenige theoretische Ansätze der Flexibilisierung von Verkehrsflächen bestehen und trotz Mangel an Umsetzungsbeispielen hat sich die Stadt Wien hier dem Ansatz von Flexibilisierung angenommen und von Grund auf während der Entwicklung mitgedacht. Dabei wurde berücksichtigt, dass die unterschiedlichsten Elemente, vor während und nach der Planung maßgeblich die Flexibilität von Infrastrukturen und Planungsabläufen beeinflussen. Dieses Beispiel zeigt, wie wichtig es ist, Flexibilität nicht nur aus einer infrastrukturellen Perspektive heraus zu denken, sondern in den Konzepten und Rahmenbedingungen festzusetzten, um eine spätere Durchführung und Umsetzung zu gewährleisten. Daraus lässt sich ableiten, dass Regelwerke und Richtlinien in der Raum- und Infrastrukturplanung so angepasst werden müssen, dass Flexibilisierung rechtlich verankert und ein Planungsleitsatz ist.

Der vorliegende Artikel zeigt allerdings auch, dass Flexibilisierung in der räumlichen Planung nicht trennscharf von anderen stadt- und verkehrsplanerischen Ansätzen abzugrenzen ist. Flexibiliserung von Verkehrsflächen setzt vielmehr gleichzeitig im Entwurf (des öffentlichen Raumes), einer flexiblen

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Anpassung der Verkehrsträger und -ströme sowie den daraus resultierenden Nutzungsmöglichkeiten gleichermaßen an. Flexibilisierung muss daher als ein Konzept verstanden werden, dass wie in Kapitel 2 dargestellt, einem systemischen Gedanken folgend als Bindeglied zwischen Raum und den in Konkurrenz stehenden Funktionen, Aufgaben, Akteurinnen, Akteuren, Nutzerinnen und Nutzern (Ardeshiria et al. 2016) agiert.

Zwar fokussiert die Publikation den städtebaulichen Ansatz der Flexibilisierung auf und von Verkehrsflächen, jedoch sollte dieser nicht nur sektoral behandelt werden. Vielmehr ist im Kontext der Flexibilisierung im Kontext urbaner Mobilität eine ganzheitliche Betrachtung unterschiedlichster Disziplinen notwendig, woraus auch Synergieeffekte entstehen können. Bei der Planung von Verkehrsinfrastrukturen müssen auch soziale Aspekte eine Rolle spielen. Es gilt daher in Bezug auf Raumpotenziale auch Aspekte der Sicherheit für vulnerable Gruppen zu bedenken: So ist es nicht selbstverständlich, dass alle Verkehrsteilnehmerinnen und Verkehrsteilnehmer in der Lage sind, mit flexiblen Veränderungen der Flächennutzungen umzugehen. Denn, in komplexen Verkehrssituationen brauchen beispielsweise ältere Menschen oftmals mehr Zeit zur Verarbeitung und Reaktion. Für Personen mit Geh- und Sehbehinderungen gilt es zu bedenken, dass festgelegte, taktile Leit- und Warnelemente oder eine kontrastreiche Gestaltung von elementarer Bedeutung zur Orientierung im Raum ist. Über eine Flexibilisierung könnten daher erneute Zielkonflikte und eine Benachteiligung mobilitätseingeschränkter Personen generiert werden. Die Frage ist außerdem, ob flexibilisierte Verkehrsinfrastrukturen dafür geeignet sind, den Verkehr leistungsfähig abzuwickeln oder vielleicht sogar Einfluss auf das Mobilitätsverhalten und die Verkehrsmittelwahl hat – beispielsweise durch Parkverbote bei hohem Parkdruck und gleichzeitiger Förderung einer multimodalen Infrastruktur.

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Following the Smartness: Leipzig as a Follower City in a Horizon 2020 Smart Cities and Communities Lighthouse Project

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1 ABSTRACT

For the European Union, smart cities are cities socially, environmentally and economically sustainable, preparing to be the catalysts of innovative changes for the world. Accordingly, the European Commission (EC) has a series of programmes to support the transition from cities to smart cities, such as the Horizon 2020 programme for research and innovation. The Triangulum project is one of the first projects in this programme, which trusts on the idea of replicating solutions to reduce the risks for decision-makers and business alike. The goal of replication within these projects is to enable the Follower Cities to replicate the implementation of smart solutions done in the Lighthouse Cities.

Triangulum developed the concept and framework of an extensive replication process that relied on workshops, city assessments, on-site visits and other tools, with dedicated personnel, time and budget. Through the funding possibilities of these programmes, the EC mobilises the smart city policy, providing the chance for cities to embark on the smart city world.

Leipzig (Germany) is currently a Follower City within the project. It has changed from a shrinking city to the fastest growing city in Germany and now faces the challenges to accommodate the growing population, secure a new economy while improving its liveability and sustainability, with its ageing infrastructure and financial limitations. By seizing the momentum of growth, Leipzig seeks to overcome its restraints, especially the limited financial resources, exploring its potentials and thus following a new sustainable path through the smart city idea.

This paper aims at identifying the real benefits of the 'replication' process designed within the project. By looking closely at Leipzig as a Follower City in Triangulum, it is possible to reflect on the meaning of replication in the European smart city context.

Keywords: Triangulum, Follower cities, Replication, Leipzig, Smart City

2 INTRODUCTION

The concentration of the majority of the world population in urban areas, a relatively new and fast-paced phenomenon, has conveyed the recognition of the duality and undeniable importance of cities in the face of environmental, economic and social challenges. With the concentration of population, cities concentrate the use of resources and emissions, but also concentrate money, knowledge generation, and innovation potential, creating a duality of being part of both the problem and solution (UN Environment Programme, 2018; UN-Habitat, 2016; United Nations, 2019).

The concept of smart cities arose amidst this recognition of the duality of cities and aims at unlocking the potential of cities to tackle the environmental, economic and social challenges. The concept evolved beyond solely digital technologies and is being embraced by cities worldwide. However, the smart city concept has a multitude of definitions and real-life implications. The technological, efficiency, and connectivity idea of smart cities corroborate with the processes of looking elsewhere, with the search for best practices and continuous benchmarking. As a result, mobilisation, transfer and replication of policies and ideas between cities are increasingly part of urban policymaking and planning. Different actors engage in these processes, in the hope of finding quick-fix solutions. For cities, belonging to this abstract space of globalisation, this signifies unlimited access to the flows of ideas, knowledge, money, people and possibilities, connoting a sense of relevance and attractiveness. Nevertheless, there is still the need to ground policies and solutions in the territoriality of cities and with social and institutional contexts, showing the duality of the fixity-mobility in these processes. That is relevant especially when considering the smart and digital technologies, that already denote a less localized and more abstract idea (Boulanger & Nagorny, 2018; Calzada, 2016; Cochrane, 2007; Cochrane & Ward, 2012; Dolowitz & Marsh, 1996, 2000; Gudmundsson et al., 2005;

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Hollands, 2008, 2015; Macário & Marques, 2008; Macmillen & Stead, 2014; McCann, 2011; McCann & Ward, 2011; Peck & Theodore, 2010; Stead, 2012; Vandevyvere, 2018).

2.1 The Triangulum project

The EC published an open call within the Horizon 2020 work programme at the end of 2013 called 'Smart Cities and Communities (SCC)'. The aim was to identify, develop and deploy replicable, balanced and integrated solutions in the sectors of energy, transport, and information communications technology (ICT) actions through partnerships between municipalities and industries.[1] The Triangulum Project was one of the first three projects from this call and is composed by the Lighthouse Cities (LCs) of Manchester (United Kingdom), Eindhoven (Netherlands), and Stavanger (Norway), with three Follower Cities (FCs) – Leipzig (Germany), Prague (Czech Republic), and Sabadell (Spain). The consortium is made up of 22 partners and is coordinated by the Fraunhofer Institute for Industrial Engineering (IAO). This innovation and demonstration project integrates and deploys smart city solutions in the area of energy, mobility, and ICT to face societal challenges. Moreover, it contributes to sustainable and eco-friendly urban development, reduces CO2 emissions and promotes the use of renewable energy. At the same time, FCs are learning from the concepts, processes and reflecting on these for their own smart city strategies. Triangulum has received a 25 million euro grant from the EC and lasted five-years (2015-2020).

2.2 Follower City of Leipzig

Leipzig is one of the most dynamic cities in the heart of Germany with more than 590,000 inhabitants (2017). From the end of the former German Democratic Republic and reunification of Germany, this city faced numerous challenges, with losing population, deindustrialisation and high unemployment, to cite a few. However, since 2005 the population in Leipzig has been increasing steadily, and projections anticipate that the population growth will continue, making Leipzig one the fastest growing city in Germany (City of Leipzig). After years of population decline and an above-average unemployment rate, Leipzig started to regain popularity during the last years and is successfully turning from a post-industrial into a modern, knowledge-based economy, with a high concentration of small and medium enterprises and a lively start-up scene (City of Leipzig, Triangulum, D6.5 – Revised implementation plan Leipzig).

Leipzig, as a FC, takes advantage of the experiences gained and lessons learnt from the implementation processes in Manchester, Stavanger and Eindhoven respectively. As part of the project, each FCs has to develop a smart city implementation strategy based on the tools and lessons learned from witnessing the implementation in the LCs. Within their strategy, Leipzig´s main objective focuses on setting an integrated approach, understanding the importance of using renewable energy sources and designing a new plan of multimodal traffic/logistics/ICT system solutions.

By taking the case study of Leipzig as a FC in Triangulum in the context of European smart cities through the EC funding programmes, it is possible to get an insight into the processes of mobilisation, transfer and replication and their influence on the implementation of smart city solutions.

3 METHODS

This research is based on extensive desktop research and in-depth expert interviews, supported by literature review. The literature review covered the topics of smart cities, its definition, characteristics, benefits and criticism, and the topic of mobilization of policies, transferability, replication and best practices in the field of urban planning and development. The desktop research comprised the analysis of documents, websites, publications, reports and deliverables from the European Union (EU) and the EC to the Triangulum Project and the municipalities. Semi-structured expert interviews were conducted with experts from the Follower City of Leipzig, the Lighthouse Cities of Manchester and Eindhoven, the Fraunhofer FOKUS, IAO, University of Stuttgart and the University of Manchester covering topics specific from their practice.

4 RESULTS

Subchapter 4.1 will present the results of the desktop research. It is an assessment of the settings that allowed the case study, Triangulum Project, to happen. By analysing the different documents, it was possible to

[1] Work programme: https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-energy_en.pdf

understand the narrative from the different institutions and agencies and the methodologies and processes of their work and results from the project itself. Subchapter 4.2 will present the results of the interviews. From the interviews, it was possible to compare the narrative, objectives and results with the perceived practical experiences and details from the processes, work dynamics and relationships resulting from the project.

4.1 The case study

4.1.1 The Lighthouse and Follower Cities concept within the European smart city scenario

Triangulum is one of the projects that is part of the European Innovation Partnership on Smart Cities and Communities Lighthouse Projects (EIP-SCC). The EIP-SCC was an initiative by the EC as part of the targets of the EU 2020 Strategy, which accounts "for smart, sustainable and inclusive growth"[2], and also aimed at the European targets for climate and energy for 2020. An initial Strategic Implementation Plan (SIP) for the EIP-SCC was developed to guide and "speed up the transformation of European Cities into 'smart cities'" and is intended to set the necessary actions to create a framework so that cities can be improved for life and business, and to be able to reduce energy use, emissions and congestions. Moreover, it outlined the EIP-SCC ideas "on how to best harness innovative technologies, innovative funding mechanisms and innovative public private partnerships" (EIP-SCC, 2013, p. 2). One of the activities proposed in the SIP to ensure its implementation and therefore consolidate the aims of the EIP-SCC was the creation of several 'Lighthouse Initiatives'.

Even though the purpose of these 'Lighthouse Initiatives' suggested the idea to group the participant cities, it was never indicated clearly in the initial bid (2013), as no resources were explicitly allocated for these purposes. Nevertheless, the project coordinators of the first three SCC projects (Triangulum, REMOURBAN and GrowSmarter) identified the need of coming together to discuss common challenges and issues in Berlin at the Fraunhofer Urban Futures Conference in 2015. In the next years, the projects founded the SCC1 Board of Coordinators (BoC) and a Manifesto[3] to ensure cooperation across the projects. After the formation of the BoC, the EC saw the potential of this growing community (2-3 projects per year with a duration of 5 years each) to achieve their goal of scaling up the implementation of smart cities solutions in Europe. Thus, "creating scale and reducing risk for political decision makers as well as investors, to progressively support wider implementation across the EU" (EIP-SCC, 2019), which would also serve as a way to demonstrate the competitiveness of the European industry.

The concept of LCs and FCs works in a way that innovative pilot projects can be tested and demonstrate at the LCs and later replicated in the FCs. The pilot projects focus on sustainable mobility, energy, smart buildings, ICT and business opportunities. The concept creates a diverse experience that covers the main typologies of European cities. All the current seventeen European SCC Lighthouse Projects have the same structure of Lighthouse and Follower Cities, relying heavily on the replication idea, including partners from industry and academia (EIP-SCC, 2019; Smart cities Information System, 2019). In general terms, Triangulum aligns with the EC EIP- SCC SIP across the LCs, so recommendations can be made to the EC in the broader replication process of real solutions for smart cities and hence boosting the transition from cities to smart cities in the European context.

4.1.2 Replicating the experiences from Lighthouse Cities in the project of Triangulum

The LC in Triangulum are Manchester (UK), Eindhoven (NL) and Stavanger (NO), the FCs are Prague (CZ), Sabadell (ES) and Leipzig (DE), so the project reflects urban populations between 100k and 1,2m within six countries, aiming at the different typologies of European cities.

Within the project, a dedicated team from Fraunhofer (FOKUS, IAO), University of Stuttgart IAT and TÜV Süd was responsible for developing and facilitating the replication process. It consists of two different approaches, the technology transfer, and the customer centric approach. Simplistically, these two approaches depart from different poles to try to achieve the same goal, to support replication of smart city solutions.

The technology transfer approach is set on what the EIP-SCC programme has established as an agenda. It structured the learnings and information of the implementation of solutions in the LCs, and supplied it to the FCs, or any other city interested in replicating them. The customer centric approach departs from the other

[2] EC 2020 Climate & Energy package: https://ec.europa.eu/clima/policies/strategies/2020_en [Last access: 04.02.2020]
[3] Triangulum Website: https://www.triangulum-project.eu/?p=3880 [Last access: 04.02.2020]

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pole, from the FCs. It is a supportive process to achieve a smart city implementation plan, through an assessment of the FCs needs so it can be linked with the LCs solutions.

The technology transfer approach outcome was addressed by the development of a replication tool (or Decision Making Tool, the names are used interchangeably), a public excel-based tool that can be downloaded from the site of the project and be used by anyone.[4] It is a user-friendly interface where filters can be applied to search for the smart city use cases from the LCs from Triangulum, and thus find the most suitable one depending on whether the user is a city or industry or if it has a specific goal or challenge. The 'use case' is defined as the unity of replication, employing technology to achieve a specific goal in a defined setting.

Collecting data from the LCs was necessary to develop the tool. During this process, the refinement of the necessary data occurred, where the team responsible for the technology transfer received feedback from the partners, from the LCs and FCs sides, on the type of information that was relevant and interesting for them, as well as making the template for the use cases more user-friendly. .

The second approach, the customer centric approach, was designed to support the FCs in a personalised way to process and develop their smart city implementation plan. The first step had the Morgenstadt City Lab in each FC, where the Morgenstadt Methodology[5] was applied, and a complete assessment of the cities was conducted. With the city assessment cities could identify their strengths, weakness, and the current state of the cities and where lays the smart city potentials. That was made through site visits to the FCs by the team responsible for replication. From that, different formats of activities were used to connect the FCs with LCs smart city solutions, but also to connect all stakeholders within the project. These formats included on-site visits, workshops and webinars with different topics at different stages of the project, where the data collected in the LCs could be shared, and the FCs could develop their implementation strategy gradually. The activities and the respective topics were based on the FCs specific training needs, which the replication team matched with the right partners, so that knowledge exchange could happen.

Both approaches of the replication process fed each other with information, so they were always adapting and transforming throughout the project. The activities and tools that were part of the process were designed with different levels of personalization, some being more directly linked with specific FCs than others, allowing a level of adaptability when necessary. They had ultimately the goal of linking the FCs, and other interested cities, to the implemented solutions of the LCs. Part of the replication process of Triangulum were regular evaluations of the activities by the different partners of the project, what facilitated improvements and adaptations by the replication team when necessary.

4.2 Replication for the FC of Leipzig

As presented before, Leipzig has been experiencing changes in its urban environment in recent years. While most changes are positive, they still bring new challenges for the city. Leipzig has benefited of European and national funds to support urban regeneration projects, and together with active civil engagement has been successfully strengthening its urban development.

The commitment of Leipzig with environmental goals has been on the agenda for a while, yet it gained more relevance over the years. Leipzig was invited by Fraunhofer to be a FC in Triangulum, matching the intentions of the city of exploring the smart city world. The participation of the city within a larger European programme was perceived as an excellent approach to deal with their sustainable goals, decarbonization and promotion of local business. The EU funding possibility and the central role that EU and national funding plays in urban development in Leipzig were relevant in the decision to join the project. Even though there was the intention to pursue a smart city approach, Triangulum gave the city a place to start their smart city process, as there was no institutional or political configuration for that. The work for the Triangulum project in Leipzig initially was done by a team that was allocated in the Office for Urban Renewal and Housing Construction Subsidies. The budget for the team came exclusively from Triangulum and there was no additional budget allocated for smart city solutions within the municipality.

[4] Download of the tool: https://www.triangulum-project.eu/?page_id=3576 [Last access: 04.02.2020]
[5] Morgenstadt City Lab Prague: https://www.morgenstadt.de/content/dam/morgenstadt/de/images/projekte1/4_CityLab_Prague_Executive_summary.pdf [Last access: 04.02.2020]. Morgenstadt City Labs: https://www.morgenstadt.de/de/projekte/city_labs.html [Last access: 04.02.2020]

4.2.1 Challenges within the project

The replication process inside Triangulum was perceived from different angles by the team from Leipzig. When considering replication in a direct way, meaning solution to solution, the process was perceived as laborious for them, with various factors presented as reasons for that. Moreover, as being part of a consortium, they had to comply with the scope of the project and the agreed proposal. The scope of the project determined that they have obligations to follow, such as deliverables, which are concrete documents and actions. Because of the project´s replication scope at the beginning, the city felt a pressure from the coordination side to choose within the implemented solutions in order to comply with the project plan. However, this risk was identified by the replication team and incorporated into the abovementioned replication customer centric approach.

The mismatch between the timeline of the project and the smart city/digitalisation process of the city was perceived by Leipzig as one of the reasons why replication was difficult for them. The project was structured in a way so that the first 36 months the LCs were dedicated to implementing the solutions, having the last 12 months to monitor them. By having to wait for the LCs to implement their solutions, Leipzig had time to start developing their understanding of smart city, but they also did not have anything to show for the city council and other city agencies about the solutions on the LCs, which was essential for them to communicate the possibilities of smart cities. For Leipzig, this had both negative and positive impacts. It was not a linear cause-effect, because they used the experience from the LCs as a best-practice scenario in different ways.

4.2.2 Challenges of replication

Another perceived reason by Leipzig on the difficulty in replicating was concerning the various context-related different conditions from the LCs to Leipzig. For example, the institutional structure of the public utility companies that were involved from the beginning in Leipzig was different in the LCs. Not only in terms of the institutional structure but also in terms of involvement and cooperation. Another example was the distinction between the legal system from Leipzig and Eindhoven, especially in the aspects of data protection, which can hugely influence and determine smart cities solutions. Other context-related differences were recognized between Leipzig and the LCs, in different levels from infrastructure to policies, regulations and cultural. These differences did not facilitate the direct replication of solutions as well.

Leipzig has a tradition with civic engagement in the planning process (Triangulum, D6.5 – Revised implementation plan Leipzig), and during Triangulum, they had different participation formats, like future labs, discussion evenings, series of lectures, where they invited the inhabitants of Leipzig West to discuss specific topics, e.g. mobility, energy. It was relevant for them to collect orientation regarding potentials but also the fears of the inhabitants with the whole smart city discussion. However, Leipzig as a FC had no funds for implementation of smart city solutions within the project of Triangulum, so the participation process stopped due to the lack of concrete results from the inhabitants' perspective. Even though their efforts did not stop; Leipzig had to partially stop the participation process and start to focus on other concrete actions, such as institutional restructuring or applying for new funding opportunities in order to proceed with participation in future projects and re-gain the credibility and approval of smart cities among the citizens.

4.2.3 Achievements

When deploying the replication customer centric approach, it became evident to the Leipzig's team that it was necessary to have structural changes in Leipzig to advance in the topic of smart city. The replication process of Triangulum indicated that every city has its own smart city timeline in mind, they might be facing different challenges in specific moments. That was the case with Leipzig. Their timeline was different from the project because they need to deal with other challenges first.

Triangulum created conditions so that Leipzig could develop new guidelines and evolve in the smart city process. By being part of this pioneering initiative, the city administration needed to commit with the process, and gain legitimation within the municipality to support this new challenge. Inspired by the experience from the LCs, Leipzig realised that they needed structural changes to address these topics. Thus, at the beginning of 2019 a new division, the Digital City Unit was created inside of the municipality responsible for smart city and digitisation issues. Leipzig's team from Triangulum developed together with other departments this new division. Besides being responsible for the final steps of Triangulum, they will consider new guidelines for smart city to have a more city-wide coordination role. Leipzig could also

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determine that they needed first to advance and consolidate the city digital transformation to be able to support the smart city idea, retaking the participation processes. As funding is still a crucial aspect for the implementation of smart city projects, the Digital City Unit also seeks for suitable funding options, as well as managing the two new EC funded projects that they are now part of SPARCs (SCC1) and EfficienCE (Interreg Central Europe Programme).

Both are direct results from Leipzig being part of Triangulum, from the knowledge gained by the team, and from the need for funding to implement smart city projects. It is relevant to emphasize that within SPARCS Leipzig changed from being a FC to become a LC, signalling their smart city development. Within their implementation strategy, Leipzig planned projects that can be linked in their majority to solutions implemented in the LCs from Triangulum. Some of the projects are now part of either SPARCS or EfficienCE, others are under evaluation. Nonetheless, their implementation is still in process.

4.2.4 Lessons Learnt

For Leipzig, the know-how exchange was of utter significance. The different activities and tools of the replication process allowed them to have access to the know-how of the LCs in their smart city pathway. They were able to have contact with relevant stakeholders of the LCs in this process, such as the private partners, which offered them different perspectives. In this way, they could also improve their relationship and create new connections with private partners in Leipzig. The neutral learning environment of the process relieved some of the pressure that such connections can create, and allowed the city of Leipzig to be more prepared in their setting. Nevertheless, to be able to do so, it is essential to have the right people to participate in such process since it will determine their level of engagement. The activities that had a higher level of customization, that were more specific to Leipzig's needs, facilitated the involvement of some partners, allowing a higher level of engagement and better outcomes for the city.

5 DISCUSSION

As previously stated, the EC intended with this new LCs mission, to speed up smart city implementation across Europe by having a programme where smart city implementations could be tested, recognized and validated, thus reducing risks for decision makers and investors. Despite promoting and relying on the idea of transferability and replication in their smart cities' programmes, the EC does not establish a clear framework or concept about how and what is replication means for them. In this way, EC leaves these tasks to be defined and shaped by each project consortium that needs to re-invent the wheel again and again. In their study, Boulanger and Nagorny say that "replication is not a 'natural' process but requires strategic planning and continuous mentoring" (Boulanger and Nagorny, 2018). The replication process of Triangulum exhibit that, indeed, replication requires planning, continuous mentoring, and dedicated time and personnel. That goes against the premise from the EC of having this programme to accelerate smart cities transition, even though the Triangulum process had beneficial outcomes, it is clear that replication is not an easy process.

The literature suggests that these processes (mobilising policies and ideas, transferability and replication) are not fast or straightforward and are subjected to different influences of the different actors. The literature also defends that these processes are complex, strongly dependent on context, and demand a high level of commitment (Dolowitz & Marsh, 2000; Macário & Marques, 2008; Macmillen & Stead, 2014; McCann, 2011; Peck & Theodore, 2010; Stead, 2012). They can be onerous processes. That might be especially true for cities that are trying to follow the 'best cities', trying to be part of the global networks, struggling to have budget and capacity to do so.

The way that the replication process was developed in Triangulum implies that replication cannot happen without having a 'mediator'. The amount of work and data that needs to be handled and the steps that need to be followed cannot take place between different cities outside the boundaries of specific projects or without someone exclusively dedicate to it. Both approaches of the replication process, the technology transfer and the customer centric approach have a setting that demands dedicated personnel and resources. That can be overwhelming to the ones involved and could undermine the learning process, which is perceived as the beneficial part of these processes (Boulanger & Nagorny, 2018; Gudmundsson et al., 2005; Macário & Marques, 2008; Macmillen & Stead, 2014; Stead, 2016). Most of the activities from the replication described here are part of a social process of the mobilisation of policies. Still, McCann (2011) also calls attention to

the fact that these activities can be time and budget dependent, what can limit who engages on them. In Triangulum, these limitations were not present, on the contrary, the project allowed partners to be part of them, and especially for municipalities such as Leipzig that have limited financial resources, this might represent unique opportunities. However, the experience showed the importance of having these cross-learning processes among not only these projects, but to promote urban transformations in general.

The know-how transfer that the replication process of Triangulum supported was what allowed Leipzig to engage in the two new projects SPARCs and EfficienCE. From the know-how, or process learning, where the LCs could show how was their process, it was possible to realise where the organisational and skill blockages are, and how to get around them. From that, it is possible to make a connection with the identification of different actions resulting from the use of best practices made by Macmillen and Stead (2014), even though their study was about sustainable mobility, the parallel is possible. More than heuristic learning, where the practitioners could perfect their understanding and the daily practice of smart cities and the processes that the LCs went through to make the implementation possible, they also did strategic articulations with the examples of the LCs. The strategic articulations motivated a change in the institutional structure of the municipality, thus securing smart city and digitisation in the city's agenda for urban planning. Not only for Leipzig did Triangulum serve as a way of doing strategic articulations. The LCs also saw the value of the demonstration in Triangulum, something similar to an advertisement campaign for smart cities. Even as LCs, they still need to foster the idea within their cities.

For Leipzig, however, most of the actions on the topic are still pilot projects as there is no suitable business model yet. Leipzig still depends on funding from other EC programmes or the national governments. The EIP-SCC, a smart city marketplace promoted by the EC, was developed to showcase the solutions from these 17 SCC1 projects and to display their bankability, as proven risk-free solution so other cities could simply implement them. However, each solution should be adapted to each city's reality, as it is not an easy and fast way, as it was shown in the case of Leipzig. Despite the unlocked smart city process, the commitment and progress that the city did on the topic of smart city, they still depend on funding to do so and the EC realised the importance of developing the business models of each solution rather than seeking for replication. As Leipzig became a LC within the SPARCs project, they could continue in receiving EC funding for their implementation of smart city solutions. Thus, there are no guarantees that demonstrated LC's solutions are risk-free. Leipzig's smart city projects are still considered from their perspective as pilot projects.

Triangulum unlocked a series of possibilities for Leipzig in the path to achieving CO2 reduction and a more sustainable future. However, the gains they had by being a FC were not because they managed to replicate any given smart city solution, but because they managed to identify their organisational blockages. What is possible to conclude is that for Leipzig as a FC, replication meant first, the already mentioned access to the flows of knowledge and capital, access to a global network where now they can actively engage. Secondly, it meant identifying their challenges and being able to define their framework to become a smart city, with a new institutional rearrangement. Finally, it meant learning and knowledge that they shared and exchanged with the other partners, and will continue to do. Triangulum allowed the city to start a new process; nevertheless, a process, not packages or solutions.

6 CONCLUSION

The findings of this research explore the influences in Leipzig of a smart city replication process, promoted by the EC and developed and applied within the scope of Triangulum. What could be perceived from the analyses of data and interviews is that the implementation of smart city solutions was not the direct outcome of Triangulum for Leipzig. Triangulum and the replication process unlocked a smart city process in the city, where they could engage in a network that allowed access to knowledge, ideas and capital. The knowledge sharing, especially concerning the processes of implementation, served as a way of promoting the idea of smart cities within the city government and amongst citizens so that the organisational and skill blockages could be overcome and the necessary changes could happen. The concept of smart cities and digitisation can still be so abstract that being part of such projects helps to foster the idea of what it could be and what can be accomplished through it, both for LCs and FCs.

Different literature, from the social science to the sustainable urban mobility perspective, imply that processes of transferability and replication can be overwhelming and onerous for the ones involved, demanding continuous attention. The findings here corroborate with the argumentation of the literature.

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Triangulum replication process required work from Fraunhofer and the University of Stuttgart even from before the project to be able to take place. They had dedicated personnel, budget, different approaches, several activities, and a considerable amount of data. The process also required careful design and constant guidance. Regardless the name 'replication process', what seemed more relevant while engaging in the replication activities for the practitioners of Leipzig was to learn the know-how, the processes of how to do it and what is behind the solutions. Hence, learning about the processes was more relevant than replicating technologies or solutions per se.

Leipzig is now fully engaged in a smart city agenda. This was just possible through Triangulum. Nonetheless, they still depend on funding to accomplish that agenda. Within the next years, Leipzig will have the opportunity as a LC to implement pilot projects and engage with their citizens again. Despite the learnings from Triangulum, its replication and its deployed solutions, Leipzig still does not have bankable solutions as implementations are not coming in a quick-fix risk-free way. This is not necessarily undesirable, but it is just not what was envisioned by the EC.

The local context of Leipzig was not appropriate for simple replication of Triangulum solutions. The context differences between Leipzig and the LCs of Triangulum were perceived as a hindrance to replication at various levels and for different aspects, including legal, institutional, financial, and cultural. Reduction of CO2 emissions, sustainable development, new economy, digitisation and technology, are and will probably continue to be vital aspects for the future of Leipzig. However, the city will progress these objectives according to its own time, capacities and needs. The relevance of placing and grounding activities in the specificities of a city, the fixity of policies and cities cannot be underestimated, even when digital technologies seem to put everything into a more mobile or abstract place. Reflecting on the intentions of the replication concept might show that they need to be reconsidered. The challenges that persist, such as the lack of bankable solutions and funding opportunities other than EC and the faster pace for changes that might be needed for the environmental goals, should be considered in a new perspective. The network that was formed as one of the outcomes of the programme has the potential to divert from this established concept and explore innovative ways to address these challenges.

The success of smart cities or sustainable cities that can comply with environmental, social and economic goals should not be delimited by replication. Replicating for the sake of replicating will not bring benefits and will not be effective. Replication may not be the solution, but it may help bring the 'smartness' topic into the agenda of a city.

What the experience in Leipzig shows, is that replication was not the action that occurred during Triangulum. Access, rearrangements, changes, redefinition, exchange, learning, etc. occurred as part of a broader process, and technological solutions did not determine that.

Therefore, despite the recent efforts by the EC to hold working groups amongst SCC LC projects to exchange experiences on topics such as replication, this research proposes that it is also essential to recognize the value of knowledge gain as one of the main and key outcomes of such projects. Instead of focusing on replicating specific solutions amongst cities within projects, the EC should focus on using the favourable settings created by these projects to strengthen the competencies of FC to become smart. Moreover, it suggests to dissociate from the terminology replication and redefine what the real process is, balancing the expectation that the terminology could bring. That might be more profitable for the process and the actors involved.

The moment is opportune for this reflection since the projects from the first call of the SCC LC programme are close to conclusion and the evaluation of the actual outcomes of these projects can contribute with valuable insights. On the positive side, these projects might provide detailed sources of data that can generate in-depth understandings for European cities.

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🏆 *reviewed paper*

Forschung, Bildung und Transfer in der Kreativwirtschaft von Klein- und Mittelstädten

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1 ABSTRACT

Städte befinden sich in einem stetigen Transformationsprozess und aktuell rückt die Kreativwirtschaft als Schlüsselbereich und Innovationsmotor für die Gesamtwirtschaft vermehrt auch in das Blickfeld der Stadtentwicklung. Während dieses Themenfeld in Metropolen und Großstädten schon mehrfach städtebaulich und wissenschaftlich untersucht wurde, besteht in Mittelstädten noch Forschungsbedarf. Die zugrundeliegende Forschungsarbeit „Potenzialstudie Kreativ Quartier Detmold“ hatte das Ziel Erfolgschancen, Potenziale, Herausforderungen und Anforderungen an die (Weiter-) Entwicklung der Kultur- und Kreativwirtschaft in der typischen Mittelstadt Detmold und ihrer Bedeutung in einer polyzentralen Region zu untersuchen. Hierfür wurde ein Methodenmix angewendet, der sich in Form einer Umfrage mit den Anforderungen der Akteure auseinandersetzt; den Stadtentwicklungsprozess zweier erfolgreicher Fallstudien untersucht; Detmold städtebaulich auf geeignete Orte zur Ansiedlung von Kreativen analysiert und schließlich in Szenarien vergleichend bewertet. Im Ergebnis zeigt sich, dass die Kultur- und Kreativwirtschaft der Mittelstadt Detmold ein starkes Bedürfnis hat sich zu vernetzen und insgesamt mehr wahrgenommen zu werden. Es zeigen sich starke Wertschöpfungsketten untereinander und besondere Anknüpfungspotenziale im Umfeld von Hochschulen. Die räumliche Analyse offenbart, dass auch in einer Mittelstadt wie Detmold ausreichend Potenzialräume vorhanden sind. Gleichwohl existiert nicht ausreichend Eigendynamik, dass sich diese Räume selbst und in verdichteter Form entwickeln. Das kreative Potenzial ist also auch in Mittelstädten vorhanden. Es braucht aber gerade in einer Mittelstadt einen gesteuerten Stadtentwicklungsprozess der zusammen mit Förderimpulsen gezielt Entwicklungen in diese Richtung stimuliert.

Keywords: Stadtentwicklung, Mittelstadt, Kreativwirtschaft, Innovationsmotor, Kreativquartier

2 EINFÜHRUNG IN DAS THEMA KREATIVWIRTSCHAFT

2.1 Kultur- und Kreativwirtschaft als Schlüsselbereich für die Gesamtwirtschaft

Die Kreativwirtschaft wird vom Bundesministerium für Wirtschaft und Energie als Schlüsselbereich und ein Innovationsmotor für die Gesamtwirtschaft eingeordnet (Bundesministerium für Wirtschaft und Energie 2019). Sie ist ein wichtiger volkswirtschaftlicher Faktor und Impulsgeber für die gesamte Wirtschaft. Die Kultur- und Kreativwirtschaft fungiert mit ihren kreativen und innovativen Ideen als zentraler Impulsgeber von der viele traditionelle Wirtschaftszweige in NRW profitieren (Ministerium für Wirtschaft, Energie, Industrie, Mittelstand und Handwerk des Landes Nordrhein-Westfalen 2013). Insgesamt erzeugen die Unternehmen der Kreativ- und Kulturwissenschaft mit ihren individuellen, vielfältigen, kreativen Leistungen und Nutzungen einen Mehrwert in verschiedenen gesellschaftlichen sozialen und ökonomischen Bereichen. Die wirtschaftlichen Kennzahlen der Kultur – und Kreativwirtschaft haben sich stets positiv entwickelt. Die Zahl der Kernerwerbstätigen, Selbstständigen und sozialversicherungspflichtige Beschäftigte, sowie der Umsatz sind weiter gestiegen und konnte im Jahr 2018 neue Spitzenwerte erreichen. Insgesamt ist die Umsatzentwicklung in der deutschen Kultur- und Kreativwirtschaft ist seit dem Jahr 2014 positiv. (vgl. Bundesministerium für Wirtschaft und Energie 2019)

Trotz der hohen Bedeutung der Kultur- und Kreativwirtschaft werden die Teilmärkte und Wirtschaftszweige immer wieder unterschiedlich definiert. Sowohl Teilmärkte als auch Wirtschaftszweige sind nicht scharf umrissen und weisen zahlreiche Überlappungen auf. Um eine möglichst hohe Vergleichbarkeit zu den Monitoring-Berichten des Bundes und des Landes NRW sicherzustellen, zieht die Forschungsarbeit die Definition des Bundes bzgl. der Teilmärkte heran und erweitert diese um die definierten Wirtschaftszweige innerhalb dieser Teilmärkte des Landes NRW (s. Abb. 1).

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Abbildung 1: Teilmärkte & Wirtschaftszweige der Kreativwirtschaft (Cardinali et al. 2019, nach BMWE 2017 & MWIDE NRW 2016)

2.2 Kultur- und Kreativwirtschaft im Fokus der Stadtentwicklung

Richard Florida beschäftigte sich früh mit dem Zusammenh¬ang zwischen der kreativen Klasse und der Anziehungskraft des städtischen Raums. Er zeigte, wie sich die Wettbewerbsfähigkeit der Städte steigern lässt, indem sie aktiv um die kreative Klasse werben und so neue wirtschaftliche Aktivitäten und Impulse erzeugen (Florida 2002). Dazu wiesen Eckert et al. für europäische Städte nach, dass die kreative Klasse eine hohe Mobilität aufweist und stets auf der Suche ist nach Städten in denen die Bedingungen mit ihren Idealen zusammenpassen (Eckert et al. 2010). Darüber hinaus zeigt sich, dass sich die Unternehmen der Kultur- und Kreativwirtschaft räumlich gesehen nicht gleichmäßig verteilen, sondern regionale Cluster ausbilden (Bundesministerium für Wirtschaft und Energie). In der Folge führt das zu einem Wettbewerb der Städte, die jeweils für sich eine möglichst hohe Sichtbarkeit des kreativen Milieus erzeugen müssen, um auf sich als Standort aufmerksam zu machen. Dies gelingt bisher fast ausschließlich Großstädten und Metropolen. So dass Klein- und Mittelstädte tendenziell Schwierigkeiten haben, ihre oftmals selbst ausgebildeten Kreativen zu halten. Auf Grundlage der Erkenntnisse Richard Floridas liegen zahlreiche weitere Studien vor. Die Publikationen befassen sich mit europäischen Großstädten (Eckert, et al. 2010), den deutschen Bundesländern (Berlin-Institut für Bevölkerung und Entwicklung 2007), deutschen Kreisen und kreisfreien Städten (Martin 2015), aber auch dem gesamten Bundesgebiet (Fritsch, Stützer 2007). Klein- und Mittelstädte werden in den bisherigen Forschungen noch nicht auf der städtebaulichen Ebene untersucht. Dazu bleibt aktuell offen, ob die Kultur- und Kreativwirtschaft in Mittelstädten wie Detmold vor besonderen Herausforderungen steht oder schlicht andere Anforderungen an Standorte stellt. Mehr als die Hälfte der deutschen Bevölkerung lebt jedoch in Klein- und Mittelstädten. Insbesondere durch die Digitalisierung wird dem ländlichen Raum von vielen Kultur- und Kreativschaffenden ein besonderes Entwicklungs- und Wachstumspotenzial zugesprochen. Die anhaltende Digitalisierung führt dazu, dass Hemmnisse durch räumliche Distanzen an Bedeutung verlieren. Eine verbesserte Sichtbarkeit des Innovationspotenzials nach außen und nach innen ist für die Kultur- und Kreativwirtschaft in diesen Räumen essentiell (Bundesministerium für Wirtschaft und Energie).

Als Schlüsselakteur für die Wirtschaftsförderung einer Stadt und als Impulsgeber für die Stadterneuerung von Transformationsräumen innerhalb der Stadt, steht die Kultur- und Kreativwirtschaft in einem besonderen Fokus. Vielerorts ist die Kreativwirtschaft eine Art Vehikel für die Implementierung von neuen Strategien in der lokalen Wirtschaftspolitik geworden (Overmeyer et al. 2014).

Insbesondere in Zeiten der Reurbanisierung und doppelten Innenentwicklung fungiert die Branche auch als Impulsgeber und Nährboden für Stadterneuerung. Sie ist nicht nur in der Lage wohnverträgliche Arbeitsplätze zurück in die Innenstadt zu bringen. Sie wirkt sich auch wertsteigernd auf das gesamte Viertel aus und befördert Investitionen. In der Gestaltung urbaner Transformationsprozesse wird die Wieder- bzw. Neuentdeckung der kulturellen und ökonomischen Kreativität der Stadt und deren Fähigkeit zur Erneuerung eine zentrale Aufgabe geworden, die auch die Mittelstädte erreicht hat. Es existieren jedoch in sehr wenigen Kommunen Praxiserfahrungen mit ressortübergreifenden Strategien und dem Zusammenspiel zwischen Wirtschaftsförderung und Stadtentwicklung für eine verdichte Entwicklung von Kreativclustern im Besonderen oder Wirtschaftsclustern im Allgemeinen.

Dabei können solche Agglomerationsvorteile auch abseits der großen Städte generiert werden, wie Danielzyk et al. in ihrer Veröffentlichung zu erfolgreichen metropolenfernen Regionen gezeigt haben (2019). Netzwerke aus Wissenschaft, Dienstleistungen und Unternehmen tragen dazu bei, innovative Impulse in die Praxis umzusetzen. Innerhalb eines Verbundes sind neben Unternehmen in der Regel auch staatliche Behörden, Forschungsinstitutionen, Bildungs- und andere Einrichtungen angesiedelt. Aufgrund des netzwerkartigen Zusammenwirkens aller Clusterteile kann die Produktivität und Innovationsfähigkeit gestärkt werden. Cluster üben einen starken Anreiz auf Unternehmensgründung aus, da das Markteintrittsrisiko gesenkt wird und durch die Bündelung eine hohe Sichtbarkeit erzeugt wird. Diese innovativen Milieus machen deutlich, dass nicht nur ökonomische Faktoren für die regionale Innovationskraft entscheidend sind. Insbesondere städtebauliche, soziale und kulturelle Aspekte sind wichtige Kriterien für eine hohe Sichtbarkeit und Anziehungskraft. Insgesamt messen Danielzyk et al. der Förderung der regionalen Innovationsfähigkeit in der Regionalentwicklung eine zentrale Bedeutung zu (2019). Unter ganz ähnlicher Prämisse entstanden in Deutschland viele Hochschulen in Mittelstädten im letzten Jahrhundert, abseits der Metropolen, in der Hoffnung auf Anwesenheits- und Aktivitätseffekte der Hochschulen für die regionale Entwicklung (Pasternack, Zierold 2018).

Detmold besitzt mehrere Hochschulen und Berufsschulen die Akteure aus der Kreativ- und Kulturwirtschaft ausbilden. Seitens der Stadt Detmold, Kreis Lippe Wirtschaftsförderung, Hochschule für Musik sowie der Technischen Hochschule OWL wurde der Forschungsschwerpunkt urbanLab beauftragt zu untersuchen ob die Mittelstadt Detmold geeignet ist und entsprechende Voraussetzungen mitbringt um den Wirtschaftszweig der Kreativ- und Kulturwirtschaft zu stärken und im städtebaulichen Raum zu konkretisieren. Demzufolge lautete die zugrundeliegende Frage der Studie, wie der Transfer zwischen Bildung, Forschung, Wirtschaft und Gesellschaft im Bereich der Kultur- und Kreativwirtschaft in Detmold durch gezielte städtebauliche Entwicklungen zu einem Cluster und lokalem Innovationsökosystem verdichtet werden kann.

3 METHODIK

Um sich dem hochkomplexen Thema und seinen Entwicklungsanforderungen, den Steuerungsnotwendigkeiten und den städtebaulichen Möglichkeiten in einer Mittelstadt wie Detmold systematisch zu nähern, wurden verschiedene Methoden eingesetzt.

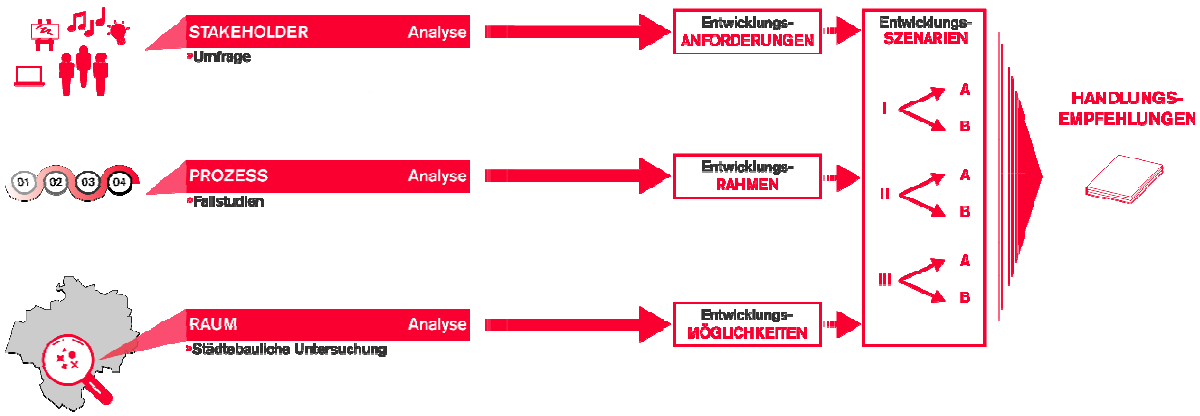

Abbildung 2: Methodik (Cardinali et al. 2019)

3.1 Stakeholderanalyse

Als Grundlage fungierte eine Stakeholderanalyse, welche Informationen zu Bedürfnissen, Anforderungen und Vernetzungspotenzialen der Kultur- und Kreativwirtschaft generierte. Die Stakeholderanalyse wertete vorhandene statistische Erhebungen auf Bundes-, Landes- und Regionaler Ebene aus. Zusätzlich erfolgte eine Recherche nach Berufsbildern sowie übergeordneten Begriffen der Kreativbranche anhand der obengenannten Definitionen der Teilmärkte. Mit dieser Methodik konnten ca. 1100 Akteure der Kultur- und Kreativwirtschaft in Ostwestfalen-Lippe ermittelt werden, die dann um Beteiligung an der Umfrage gebeten worden sind. Die Akteure lassen sich in Kreativwirtschaft, freischaffender Künstler und Kulturinitiativen

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unterteilen und bilden die erste Säule der Adressaten. Der Fragebogen war in acht verschiedene Kategorien eingeteilt und hat folgende Themen abgefragt:

(1) Einschätzung der KuK Allgemein,

(2) Beschreibung Unternehmen/Organisation,

(3) Standortfaktoren,

(4) Mitarbeiter/Mitglieder,

(5) Infrastruktur & Arbeitsformen,

(6) Kooperation & Wertschöpfungsketten,

(7) Fortbildung,

(8) Allgemeine Angaben

Eine zweite Säule ist der Bildungs- und Ausbildungsbereich der Kreativwirtschaft, der durch bestehende Verteiler an den teilnehmenden Hochschulen in Detmold (Hochschule für Musik Detmold und Technische Hochschule OWL - Fachbereich Architektur & Innenarchitektur, Fachbereich Medienproduktion, Fachbereich Bauingenieurwesen) sowie den teilnehmenden Berufsschulen in Detmold breit unter Absolventen, Studenten und Berufsschülern gestreut werden konnte. Dieser Fragebogen hatte ebenfalls acht Kategorien, die allerdings teilweise nur an Absolventen adressiert wurden (mit A gekennzeichnet):

(1) Einschätzung der KuK Allgemein,

(2) Angaben zu Studium & Ausbildung

(3) Standortfaktoren,

(4) Ambitionen zur Selbstständigkeit,

(5) Übergang in den Arbeitsmarkt (A),

(6) Beschreibung Unternehmen (A),

(7) Beschreibung Tätigkeit (A),

(8) Allgemeine Angaben (A),

Insgesamt haben 278 Akteure an der Umfrage teilgenommen: 51 Vertreter eines Unternehmens, 15 Vertreter eines Vereins/Initiative, 24 Freischaffende Künstler, 60 Absolventen, 97 Studenten, 31 Berufsschüler. Im Verhältnis von Stichprobe zur Gesamtpopulation der Kultur- und Kreativwirtschaft in Ostwestfalen-Lippe ergibt sich eine Fehlertoleranz der Ergebnisse von 10%.

3.2 Fallstudien

Das Instrument der Fallstudien gab einen Einblick in bestehende Kreativquartiere in Deutschland und ihre Umsetzungsstrategien. Mit 306.000 Einwohnern diente die Stadt Mannheim als Best-Practice Beispiel für die Folgeeffekte einer Kreativquartierentwicklung. Die weit fortgeschrittenen Entwicklungen zeigen Möglichkeiten und Impulswirkungen öffentlicher Förderungen im Bereich der Kreativ- und Kulturwirtschafts auf. Die Voraussetzungen im Vergleich zu Detmold sind durchaus unterschiedlich, dennoch zeigen sich wichtige Einblicke in den Prozess zur Entwicklung eines Kreativquartiers und in mögliche Folgewirkungen. Die Fallstudie der Mittelstadt Coburg analysiert einen Prozess der mit der Mittelstadt Detmold und seinen Hochschulen gut vergleichbar ist. Allerdings ist hier der Prozess noch nicht so weit fortgeschritten. Mit Hilfe der Untersuchung von Fallstudien entstand das Bild eines möglichen Entwicklungsrahmens und notwendigen Steuerungsprozessen.

3.3 Städtebauliche Analyse

Eine städtebauliche Analyse identifizierte schließlich Neubau- Umbau- Umnutzungs- und Aneignungspotenziale zur Etablierung eines Kreativquartiers in der bestehenden Stadtstruktur. Dazu wurde der Stadtraum nach den vier von Overmeyer et al. definierten Raumkategorien (2014), die von den kreativen Milieus nachgefragt werden, untersucht:

(1) Transformationsräume,

(2) Leergefallene Erdgeschosslokale,

(3) Leerstehende Büroimmobilien,

(4) Neubaugebiete

Neben der Vorortung von Potenzialräumen sind die bereits bestehenden Standorte von Kultureinrichtungen und Akteure der Kreativwirtschaft wichtig um potenzielle Synergieeffekte zu identifizieren. Dazu wurden weitere flankierende Nutzungen und Wegebeziehungen von Studierenden, Berufsschülern und Kunden des Einzelhandels analysiert. In der Folge wurden auch die weichen Faktoren und die Belebtheit bestimmter öffentlicher Räume sichtbar.

3.4 Städtebauliche Szenarien

Um abschließend zu validen Entwicklungsschritten zu gelangen, wurden drei städtebauliche Szenarien entwickelt und anhand der vorher in der Stakeholderanalyse geäußerten Standortfaktoren der Kultur- und Kreativwirtschaft miteinander in einer Bewertungsmatrix verglichen. Die Bewertungskriterien teilten sich in vier Themenblöcke auf:

(1) Sichtbarkeit und Identität,

(2) Entwicklungsstufen und Realisierbarkeit,

(3) Erreichbarkeit und Anbindung,

(4) Gemeinschaft und Netzwerk

Die einzelnen Faktoren wurden dabei nicht weiter gewichtet. Das Ergebnis ist eine Gesamtsumme von möglichen 110 Punkten, die schließlich gegenüber gestellt wurden, um zu einer abschließenden Bewertung zu gelangen.

4 ERGEBNISSE

4.1 Stakeholderanalyse

Die Verteilung der einzelnen Unternehmen der Kreativwirtschaft zeigt deutlich, dass Detmold gemessen an der Einwohnerzahl ein überdurchschnittlich ausgeprägter kreativer Hotspot der Region ist. Die kreative Dichte Detmolds ist hoch. In der Region OWL weisen die Städte einen Wert von unter 1 Einrichtung pro 1.000 Einwohner auf, Detmold hingegen erreicht einen Wert von 2,5 Einrichtungen pro 1.000 Einwohnern. Gleichzeitig äußern die Befragten aber, eine geringe Wahrnehmbarkeit der kreativen Dichte in der Stadt. Es zeigte sich außerdem, dass die Teilmärkte untereinander starke Wertschöpfungsketten aufweisen, aber nur 32% in Netzwerken organisiert sind. Dabei ist die Bereitschaft sich gemeinschaftlich zu organisieren ausgesprochen ausgeprägt. Als Standortfaktor erscheinen urbane und nutzungsgemischte Räume vorteilhaft, um die nachgefragten flankierten Dienstleistungen und den Kontakt zu Endkunden sicherzustellen. Das Interesse an einer generellen Zusammenarbeit mit Hochschulen ist mit 68% stark ausgeprägt. Noch deutlicher wird der Zugang zur technischen Infrastruktur der Hochschulen, wie z.B. 3D Drucker, Tonstudio oder Veranstaltungsequipment nachgefragt. Hier äußern durchschnittlich über 80%, dass sie davon (sehr) profitieren würden. Als Gegenleistung für diesen Zugang ist mehr als die Hälfte der Befragten bereit Arbeitsstunden für die Gemeinschaft zu leisten oder Ausleih-/Nutzungsgebühren zu bezahlen. Immerhin 41% wären bereit dafür einen Mietaufschlag zu zahlen. Für die Implementierung der Wertschöpfungskette zwischen Bildung und Wirtschaft kann Nähe und Zugang ein wesentlicher Schlüssel sein. Daneben ist die Ausbildung der angehenden jungen Fachkräfte und das Halten dieser in der Region eine wichtige Säule für eine dynamische starke Kultur- und Kreativwirtschaft. Auf Grundlage der Stakeholderanalyse wurde deutlich, dass Detmold einige der Absolventen aus der Region dazu bewegen kann in Detmold zu bleiben. Bezogen auf die gesamte Region OWL wandern derzeit jedoch noch ca. die Hälfte der jungen Fachkräfte aus Detmold in das übrige Bundesgebiet ab. Nicht zuletzt das sehr hohe Gründungsinteresse der Befragten Studierenden (55%), Absolventen (47%) und Berufsschüler (26%) und der hohe Bedarf nach Fortbildungsangeboten unter den etablierten Unternehmen, weisen auf einen hohen Unterstützungsbedarf und eine bisher nicht ausreichende Sichtbarkeit bestehender Angebote hin (siehe Abb. 3).

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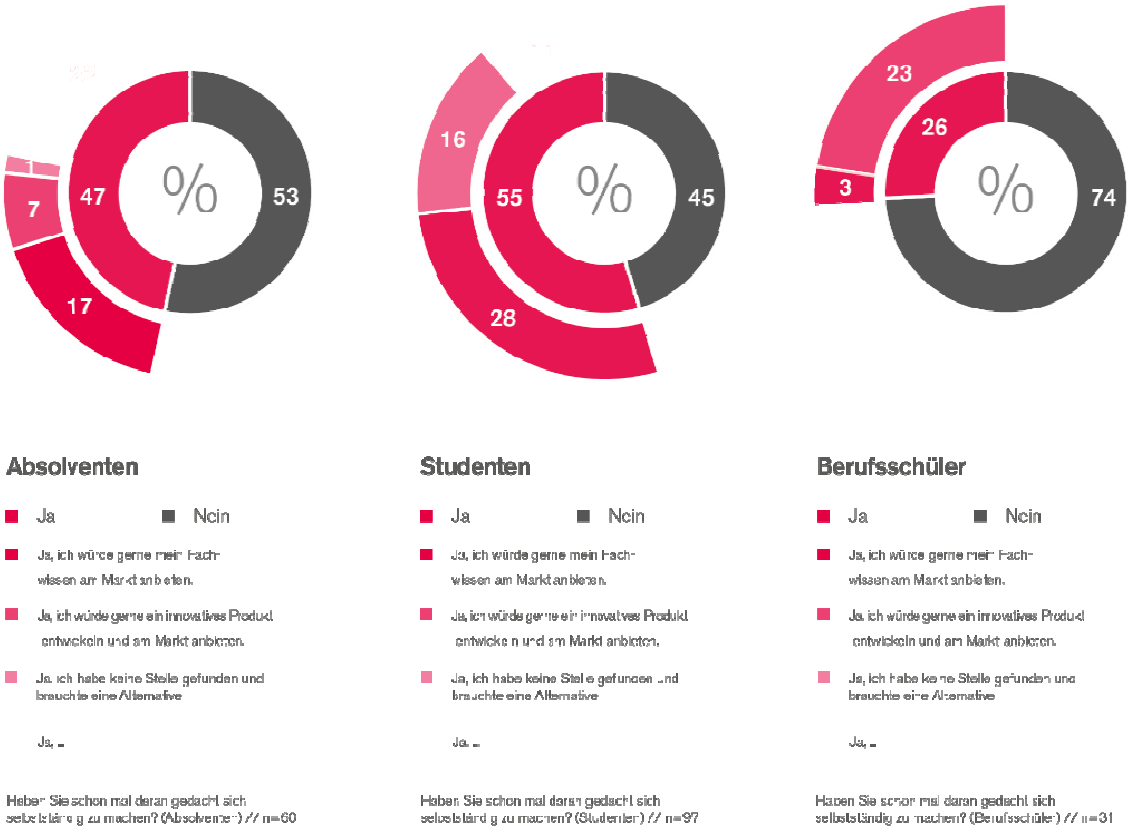

Abbildung 3: Gründungstendenzen (Cardinali et al. 2019)

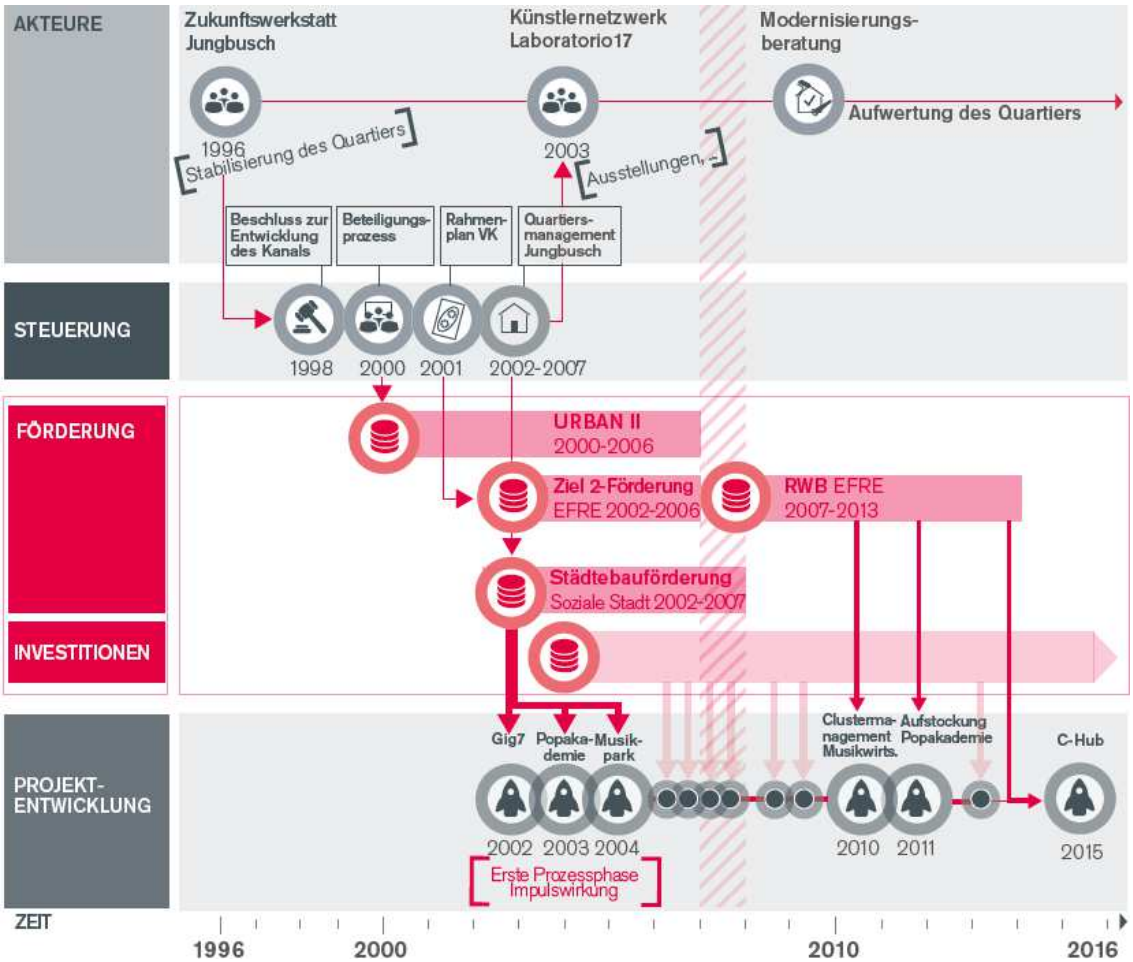

Abbildung 4: Prozess „Kreativquartier“ Mannheim-Jungbusch (Cardinali et al. 2019).

4.2 Fallstudien

Die Untersuchung der Fallstudien in Mannheim-Jungbusch und Coburg zeigte auf, wie aus einzelnen Hochbauprojekten und verschiedenen Akteuren ein integriertes Stadtentwicklungskonzept entstehen kann, das in der Lage ist einen attraktiven Standort für die Kreativ- und Kulturwirtschaft in der Stadt gebündelt zu entwickeln (siehe Abb. 4). Die Nähe zu den Hochschulen sorgte für eine messbar erhöhte Gründungsrate.

Integrierte Stadtentwicklungskonzepte sowie Rahmenpläne sind in Bezug auf die Entwicklung eines Kreativquartiers nicht nur dazu geeignet Synergieeffekte zwischen einzelnen Projekten herzustellen, sondern auch um eine tragfähige Gesamtentwicklung zu erreichen. Gründungszentren stellen in den Fallstudien eines der ersten wichtigen Leitprojekte dar, gerade unter der Einbeziehung der Hochschulen besitzen sie eine starke Impulswirkung und Anziehungskraft. Mit Hilfe von Gründungszentren entsteht ein erster Kommunikationskanal zwischen Hochschule und Wirtschaft. Neben den Gründungszentren sind offene Werkstätten Teil erfolgreicher Konzepte und Treiber für das Ansiedeln kreativer Unternehmen im Umfeld. Die offenen Werkstätten sind darüber hinaus ein Unterstützungsangebot für angehende Gründer. Viele der Maßnahmen sind Einzelimpulse die aufeinander aufbauen, kombiniert und eingebettet in einen attraktiven gut erreichbaren öffentlichen Raum wirken sie am besten. Vervollständigt wird der Nährboden für die angehende Kreativwirtschaft mit gemeinschaftlich nutzbaren Räumen. Eine räumliche Nähe zu den Hochschulen erleichterte die Etablierung von Dienstleistungen durch eine größere Nachfrage. Regelmäßige Veranstaltungen ergänzten das Maßnahmenpaket und förderten den Ort im Bewusstsein des lokalen und regionalen Umfelds.

4.3 Städtebauliche Analyse

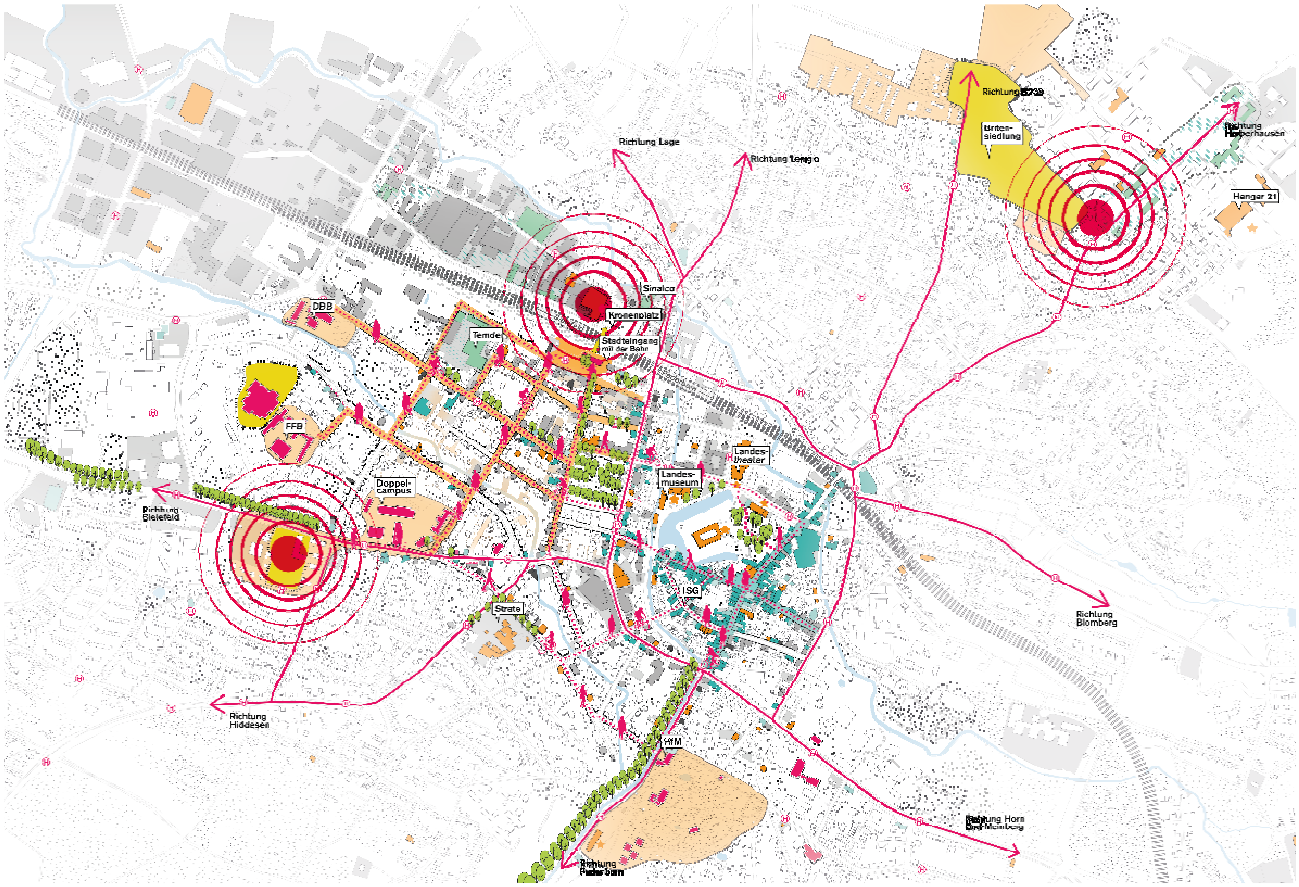

Abbildung 5: Entwicklungsräume (Cardinali et al. 2019)

Die räumliche Untersuchung zeigt, dass die nachgefragten Räume auch in Mittelstädten vorzufinden sind. Alle Kategorien der Transformationsräume in Detmold sind in den klassischen Lagen rund um den Bahnhof und darüber hinaus in den Kasernenarealen und der Nähe der Hochschule zu finden (siehe Abb. 5). Im Umfeld des Bahnhofs sind leerstehende oder mindergenutzte Gewerbeimmobilien, welche Potenzial für die Nachnutzung von Kreativen aufweisen. Neben dem Transformationsraum am Bahnhof befindet sich ein großflächiger am ehemaligen Standort der britischen Streitkräfte. An diesem Standort hat die Transformation

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bereits begonnen. Einige Kasernen wurden bereits in eine neue Nutzung überführt, vereinzelt auch durch die Kreativ- und Kulturwirtschaft. Das Areal und die Kasernen bieten darüber hinaus viel Raum zur Aneignung und Nachnutzung. Die westlich befindliche Britensiedlung hingegen ist aufgrund ihrer Wohntypologien nicht ohne weitere Maßnahmen durch die Kreativwirtschaft nutzbar. Des Weiteren liegen westlich des Kronenplatzes weitere Neubaupotenziale, als möglicher Impuls für eine weitere Transformation des Gewerbeareals und der Leerstände im Umfeld des Bahnhofs, sowie an der Bielefelder Straße. Im Zentrum Detmold befinden sich leerstehende Erdgeschosslokale, sowie im angrenzenden Westen und Süden der Innenstadt. Im Untersuchungsraum befinden sich zudem ehemalige Büroimmobilien. Demzufolge sind ehemalige Gewerbeareale, leerstehende Büroimmobilien aus der Nachkriegszeit und leere Erdgeschosslokale in Detmold zu finden, welche für Kreative besonders attraktiv sind. Ungenutzte Brachflächen mit Neubauentwicklung sind ebenso denkbar. Auf Grundlage der Untersuchung von den Potenzialflächen, mit der Überlagerung von bestehenden Akteuren und Standorten sowie den Bewegungen von Studierenden und Berufsschülern werden im Raum vier potenzielle Entwicklungsräume erkennbar. Die bereits angesprochenen großflächigen Entwicklungsräume wie der Kreativ Campus an der Bielefelder Straße, Bahnhofsareal und Britensiedlung inklusive der Kasernen besitzen jeweils eigene Herausforderungen und Potenziale. Die Entwicklungsstandorte besitzen ihre eigene Identität. Der Standorte des Kreativ Campus an der Bielefelder Straße fällt unter den Typus Neubau mit Campusflair. Die direkte Nähe zur Hochschule ist sehr auffällig. Das Bahnhofsareal ist ein Mix aus geschichtsträchtigen Transformationsräumen sowie leerstehenden oder mindergenutzten Gewerbehallen. Der historisch bedeutendste Ort ist hingegen das Kasernenareal. Angrenzend im Westen befindet sich zudem die Britensiedlung. Die gründerzeitliche Struktur im Detmolder Westen ist der vierte Entwicklungsraum. Leerstände und Bewegungslinien weisen auf ein großes Potenzial des Detmolder Westens hin, der insbesondere in den Erdgeschosszonen absehbar kleinteilige privatwirtschaftliche Folgenentwicklungen aufnehmen kann. Im Ganzen wird deutlich, dass eine bauliche Entwicklung in den drei größeren Entwicklungsräumen am Kreativ Campus, im Umfeld des Bahnhofs und im ehemaligen Areal der Briten möglich ist. Die potenziellen Entwicklungsräume weisen jeweils eigene Stärken, Herausforderungen und Entwicklungschancen auf. Die Räume bieten zudem unterschiedliche Flächenverfügbarkeiten und Potenziale für weitere Entwicklungen.

4.4 Städtebauliche Szenarien

Die städtebauliche Analyse legte mögliche Entwicklungskerne offen und gab Aufschluss über die räumlichen Qualitäten. Zusätzlich ermöglichten die untersuchten Fallstudien Einblicke in mögliche Konzepte und Strategien in der Entwicklung von Kreativquartieren. Die Umfrage verdeutlichte Anforderungen, Notwendigkeiten und Bedürfnisse der Kreativen. Darauf aufbauend wurden drei städtebauliche Szenarien entwickelt und anhand der identifizierten Anforderungen und räumlichen Potenzialen bewertet. Die Szenarien orientieren sich an bereits beschlossenen baulichen Entwicklungen an der Bielefelder Straße, dementsprechend nehmen alle Szenarien die Impulse der Entwicklung auf und versuchen sie weiterzuentwickeln. Das Szenario „Kreativ Campus+“ beschreibt eine verdichtete Neubauentwicklung rund um den bestehenden Campus der TH OWL. Folglich wird der bestehende Campus erweitert. Der Entwurf nimmt die vorhandenen Strukturen und Campi auf und integriert sie in eine neue städtebauliche Entwicklung und entwickelt ein gemeinsames Cluster. Das Ergebnis zeigt hochwertige öffentliche Platzsituationen, die eine hohe Aufenthaltsqualität bieten. Das Szenario „Kreativ Rahmen“ setzt zusätzliche Impulse am Bahnhof und platziert sich mit maximaler Sichtbarkeit in der Stadtmitte. Die Impulse des Fachbereiches Medienproduktion an der Bielefelder Straße und den Anschluss des Detmolder Nordens durch eine Unterführung am Bahnhof werden genutzt. Das Szenario weist eine geringe Anzahl an notwendigen Neubauten auf, da viele Bestandsgebäude umgenutzt werden. Das Szenario „Kreativ Hotspots“ nutzt die Große Flächenverfügbarkeit der leergefallenen Kasernen im Stadtteil Hohenloh und die Impulswirkung an er Bielefelder Straße. Beide Impulse werden verknüpft. Der Detmolder Norden wird dabei großflächig neustrukturiert.

Das Szenario verfolgt einen integrativen Ansatz mit Bestandsnutzungen und Inwertsetzungen in Kombination mit Neubauten. Der Vergleich dieser drei städtebaulichen Szenarien zeigt, dass das Szenario „Kreativ Campus+“ aufgrund seiner kurzen Wege und die maximale Nähe zu einigen Konsortialpartnern besticht (siehe Abb. 6). Die Vernetzung der Wirtschaft mit den vorhandenen Bildungs- und Forschungseinrichtungen wird dadurch voraussichtlich positiv beeinflusst. Das Szenario „Kreativ Rahmen“ ist ansprechend durch die starke Impulswirkung am Kronenplatz und seine Positionierung in der

Stadtgesellschaft. Besondere Stärke dieses Szenarios ist die große Flexibilität und die Nutzung vieler Leerstände. Die Offenheit wiederum birgt die Gefahr vieler Einzelentwicklungen, die nicht als Kreativquartier wirken und keine Gemeinschaft oder Netzwerk erzeugen können. Das Szenario „Kreativ Hotspots“ weist eine große Flächenverfügbarkeit auf. Die Neugestaltung des Raums zwischen den beiden Kasernen als neue Platzspange und Mittelpunkt des Kreativclusters kreiert zudem einen hochqualitativen öffentlichen Raum und bietet die Möglichkeit für einen Open-Air Makerspace. Der Vergleich zeigt auf, dass die Szenarien vor unterschiedlichen Herausforderungen bzgl. Flächenverfügbarkeit, Impulswirkung und Anbindung stehen. Deutlich wird, dass eine größtmögliche Nähe zur Innenstadt erstrebenswert ist um ohne Mehraufwand eine hohe Sichtbarkeit in der Stadtgesellschaft und eine höhere Nutzerfrequenz für angebotene Dienstleistungen zu erhalten. Darüber hinaus wäre eine räumliche Dichte vorteilhaft um die Gemeinschaft unter den Akteuren zu fördern.

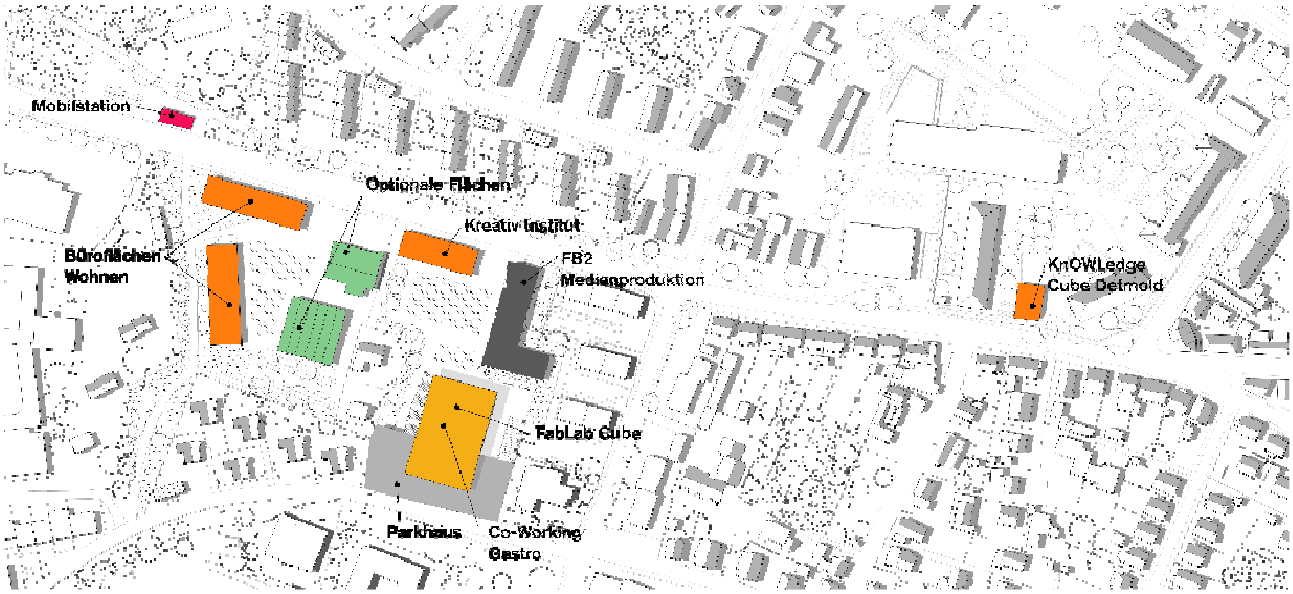

Abbildung 6: Szenario „Kreativ Campus+“ Nutzungen ohne Maßstab (Cardinali et al. 2019)

5 CONCLUSIO

Auf Grundlage der Forschungsarbeit ist erkennbar, dass gerade in einer Mittelstadt wie Detmold der Bedarf der Akteure der Kultur- und Kreativwirtschaft ausgesprochen hoch ist, sich untereinander zu vernetzen. Es lässt sich außerdem ableiten, dass diese Cluster und Netzwerke eines gesteuerten Prozesses bedürfen, da die eigenen Marktkräfte hierfür in einer Mittelstadt nicht ausreichen. Um eine entsprechende Sichtbarkeit und Impulswirkung zu erzeugen, sind urbane stark frequentierte und nutzungsgemischte Räume zu entwickeln, die ausreichend Sogwirkung erzeugen. Es hat sich gezeigt, dass insbesondere die Hochschulen in den Mittelstädten dafür ein entscheidender Akteur sind. Die Öffnung der technischen Infrastruktur ist ein entscheidender Schlüssel zur Implementierung der Wertschöpfungskette zwischen Bildung, Forschung und Wirtschaft. Durch Formate wie OpenLabs kann auch eine gesteigerte Wahrnehmung in der Stadtgesellschaft erreicht werden. Zusätzliche Fortbildungsangebote und flankierende Dienstleistungen, wie z.B. Gastronomie, sind zudem in der Lage zusätzliches Publikum in das Quartier zu ziehen und so die Vernetzung der Akteure untereinander zu fördern.

Zudem hat sich gezeigt, dass eine Mittelstadt wie Detmold genauso wie eine Großstadt urbane Transformations- und Entwicklungsräume aufweist, die sich als potenzielle Entwicklungsräume eignen. Gleichzeitig zeigte sich aber auch, dass nicht genügend Entwicklungsdruck auf den Flächen liegt und sich eine verdichtete Entwicklung nicht aus den inhärenten Kräften der Branche einstellt. Insbesondere in Mittelstädten wird so die Notwendigkeit eines gesteuerten Prozesses deutlich, der durch (Förder-)Impulse in Gang gesetzt wird und einzelne bauliche Entwicklung zu einem städtebaulichen Gesamtkonzept zusammenführt. Rahmenplanungen und Stadtentwicklungskonzepte erscheinen als notwendige Grundlage für eine solche Entwicklung und sind darüber hinaus in der Regel notwendige Fördergrundlage. Neben der städtebaulichen Entwicklung empfiehlt sich eine strategische Unterstützung durch eine Vereinsstruktur als strategischer Unterbau, der es erlaubt Unternehmen eine aktivere Rolle in dem Netzwerk zu übertragen.

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Besonders anspruchsvoll erscheint vor diesem Hintergrund die Herausforderung, dass Kreativität nicht planbar ist. Entsprechend müssen bei der Planung dieses Prozesses die höchst dynamischen und kaum mit konventionellen Planungskategorien zu fassenden kreativen Nutzungen behutsam integriert werden. Demgemäß steigt die Bedeutung indirekter Einflussnahme in Form von Möglichkeitsräumen und einer Strategie der Befähigung. Gerade solchen Räumen kommt in der Nähe der Hochschulen als kreativem Nährboden und Schlüsselakteur im Innovationsökosystem eine besondere Rolle zu, die städtebaulich urban und öffentlich sichtbar umgesetzt werden will.

Die zugrundeliegende Studie macht insgesamt deutlich, dass auch abseits der Großstädte und Metropolen eine ausgesprochene Dichte dieses urbanen Wirtschaftsbereichs vorhanden sein kann und dass die Bedarfe und Anforderungen an eine verdichtete Entwicklung eines Clusters – zumindest im Fallbeispiel Detmold - ausgesprochen hoch sind. Eine städtebauliche Entwicklung eines Kreativquartiers ist dabei nicht nur ein Konzept für eine Stadterneuerung, sondern richtig platziert ein wesentlicher Hebel für die Wirtschaftsförderung der Mittelstadt. Gerade in metropolenfernen Regionen und mit der Hochschule als Nährboden vor Ort können Mittelstädte mit einer solchen Entwicklung absehbar auch ausreichend Sichtbarkeit und Nachfrage erzeugen, die eine solche Entwicklung benötigt. Weiterer Forschungsbedarf besteht sicher in der Frage, ob eine solche Entwicklung generell in Mittelstädten auf ausreichend Nachfrage stößt, oder ob zum Beispiel eine Hochschule mit kreativen Studiengängen vor Ort eine notwendige Grundlage für eine solche Entwicklung ist. Die Potenzialstudie für ein Kreativ Quartier Detmold zeigt in jedem Fall, dass es auch in einer Mittelstadt ausreichend Potenzial für eine solche Entwicklung geben kann.

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🏆 *reviewed paper*

French Connections – Examining the Residential Clustering and Dispersion of Francophones in the Toronto Area

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1 ABSTRACT

Toronto is known as a city of neighbourhoods, many of which are defined by the cultural origins and traditions of immigrant groups. Examples of official or unofficial neighbourhood names include Chinatown, Koreatown, Little Tibet, Gerrard India Bazaar, Corso Italia, Little Portugal, Greektown, and more. Other major immigrant groups such as Scandinavian, German, and French are notably absent from the place names in Toronto and other major global cities, and we wanted to examine whether this reflects different patterns of residential clustering and dispersion. We chose to analyze the Francophone population in the Toronto metropolitan area, since French is an official language of Canada as well as being spoken by a number of different immigrant groups, which allows for comparisons of both, language and culture as a factor in settlement decisions. We found that French speakers, including those born in Toronto as well as intra-Canadian migrants, tend to live in clusters, while none of the individual Francophone immigrant groups examined in this research are clustered at a statistically signifcant level. Based on this finding, language rather than culture is a key factor in residential location decision-making.

Keywords: Language, Clustering, Spatial Analysis, Settlement, Immigration

2 INTRODUCTION AND RESEARCH CONTEXT

Cluster analyses of the settlement patterns of specific ethnic groups within cities are few and far between. However, analyses of populations at larger scales and relating to concentrations rather than clustering are more common. Ethnic neighbourhood analysis has been conducted in many of the world's most notable cities, including Toronto. This field of study tends to concentrate on the factors that lead to settlement decisions. Factors such as pre-existing concentrations (Gross & Schmitt, 2003), mnemonic institutions (Harold & Fong, 2018), economic standing and resources (Fong & Chan, 2010) have all been covered in Toronto. Gross & Schmitt found that pre-existing ethnic clusters of settled immigrants were considered strongly in settlement decision-making of newly landed immigrants. Another study identified mnemonic institutions (institutions which related to collective memory) such as religious centres of gathering, to contribute to ethnic cluster growth. For example, Harold & Fong found that higher concentrations of Jewish residents were found near synagogues and Jewish community centres. More traditional schools of thought on ethnic settlement, such as the spatial assimilation model developed by the Chicago School of Ecology tied settlement patterns uniquely to economic opportunity. The model indicates "that immigrants first concentrate spatially in older, less-expensive housing close to the centre of the city and, upon improving their economic status, move outwards through increasingly higher-status residential zones, ultimately ending up at the urban periphery" (Murdie & Ghosh, 2010). Fong and Chan's study expands on this model, suggesting that economic opportunity is one of three main factors, the other two being ethnic information sources (ethnic community centres and real estate agents) and ethnic resources (help and advice from community members).

In contrast to spatial assimilation, the heterolocalism model sees "communities without propinquity" as a possibility (Zelinsky & Lee, 1998). This model infers that a community does not need to live together spatially as their interactions could happen at ethnic centres between communities. The Price et al. (2005) study of Washington DC found that ethnic groups did not always follow the traditional spatial assimilation concept. They noted instead that cities exemplified numerous paths to settlement with different results, ranging from the traditional perspective to a new one where ethnic community members could relate to each other via ethnic institutions. This echoes Qadeer and Kumar's (2006) sentiment that "mere living side by side...does not make an ethnic neighbourhood". In all of these scenarios, the study subject were distinct ethnic groups. In the present study of French-speaking people, there may be a variation of both models at play, perhaps depending on other factors. Literature regarding French-speakers in Toronto and their spatial

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residential distribution is scarce. Francophones in Toronto come from various ethnic backgrounds, income levels, religions, etc. so it is expected that their spatial relationships will be complex and multifaceted.

On the other side of the spectrum, cities, rather than people, have been analyzed to understand how they accept newcomers. Gateway cities in immigrant-receiving countries like Canada, the US and Australia have all been studied to understand why these cities attract mass immigration (Gross & Schmitt, 2003). Each city, province/state and country are different in their immigration history and policy (Bauder & Sharpe, 2002). These may govern how settlement patterns at every level of geography may manifest themselves. The city of Washington had a simple colonial cultural makeup until the late 20th century (Price et al. 2005). Thus it would not be surprising that its immigrant population composition and spatial distribution differs from that of e.g. New York and Los Angeles in the US (Logan, Zhang, & Alba, 2002) or Toronto in Canada. New York's demographic distribution has emerged over several hundred years. Like Toronto, it has been the home of various European immigrants (Italians, Irish, Dutch, etc.), but more recently, it received more diverse migrants. Los Angeles, on the other hand, like Vancouver, has been built more on a foundation of Asian immigration but differs from the Western Canadian city in its massive acceptance of Latin Americans, due to its proximity to the Mexican border (Logan, Zhang, & Alba, 2002). Unlike the aforementioned cities, Toronto is located in Eastern Canada, which has French and English as official languages. As the largest city in the country, it is not surprising that it has a sizeable French-speaking population, but it is still dwarfed by Ottawa's and Quebecois cities' Francophone populations. According to the Ontario Office of the Commissioner of Official Languages, 42,7% of Francophones in Ontario resided in Ottawa in 2016, while only 19% were in Toronto, and another 20.7% were spread across Northeastern Ontario in smaller communities like Timmins. Ottawa's Francophone population is twice the size of Toronto's, despite Toronto's CMA total population being almost 5 times that of Ottawa (Statistics Canada, 2019a). So despite, Toronto's size, the influence of the French language on the city is felt far less than other Canadian cities. This could possibly push Francophones residing in Toronto to stay together, as they are a minority.

While similarities exist between large American and Canadian cities, research shows vast differences as well. Many studies focus on the segregation of minorities in the US, most notably blacks (Price et al., 2005). Even though in Canada such segregation does not occur to the same extent, many Canadian cities like Toronto are home to large ethnic enclaves (Bauder & Sharpe, 2002). The terminology used to designate ethnic neighbourhoods relates to the freedom that people have in regard to their housing situation, and what the future may hold for them. Ghettoization refers to the residential segregation of populations who are not be able to relocate. Enclaves, on the other hand (following the rationale of the spatial assimilation model), act as a place for an ethnic group to remain until they inevitably attain the economic capital to move on to better housing (Logan, Zhang, & Alba, 2002). When analyzing a group like Francophones in Canada, this is important to keep in mind as lower-income Francophones may reside in enclaves but will likely be able to move away eventually. On the other hand, higher-income Francophones may have enough capital to choose their residences more freely. Thus, economic differences between different subgroups of Francophones may result in spatial clustering or the lack thereof, with some subgroups living in ageing, more affordable housing and others in better kept, more expensive housing. Another significant difference between large American and Canadian cities, and more specifically Toronto, are the areas in which different income classes settle. In the US and some Canadian cities, the suburbs are usually more affluent and homogenous, while inner cities are typified as less safe, cheaper to live in, and dominated by minority groups (Logan et al., 2002; Bauder & Sharpe, 2002). In contrast, some of Toronto's highest value property is just outside of the Central Business District (CBD), like in the Rosedale neighbourhood. Furthermore, many ethnoburbs have sprouted along the edges of Toronto, such as Indian neighbourhoods in Brampton and Chinese in Markham (Murdie & Ghosh, 2010). While these suburbs are often middle-income neighbourhoods, the majority of Toronto's lower-income neighbourhoods are found outside of the CBD in the inner suburbs. Gentrification has also played a large part in changing the traditional view of settlement patterns in cities. Immigrant enclaves across the city of Toronto, which were once settled due to being cheaper housing opportunities, are being filled with educated high-income professionals. Murdie & Ghosh (2010) have found that this has led certain immigrants to avoid the traditional settlement patterns and to settle directly into the suburbs. Some studies found similar results in the US, declaring that in some cases, lower-income residents were forced to relocate as a result of increasing costs in their own neighbourhoods (Vicino, Hanlon, & Short, 2011). As a result of these processes, higher-income Francophones such as native-born Canadians or immigrants from industrialized

countries may settle in different areas than those from developing nations, who may not have the resources to live with other Francophones. Poorer Francophones may thus find themselves clustered together in ethnic enclaves, away from more affluent Francophone communities.

Within the Francophone community are many ethnic variations. An infographic from the Office of the Commissioner of Official Languages (2019) revealed that 58% of Franco-Ontarians were born in the province, that 25% came from other Canadian provinces or territories, and the remaining 17% was comprised of foreign-born immigrants. Within this immigrant population was a relatively even split between continents, with 17% coming from the Americas, 27% coming from Europe, 20% coming from Asia and a slightly larger 37% coming from Africa. Many of the immigrants coming from outside of Europe are immigrating from former French colonies. These include but are not limited to Algeria, Djibouti and the Democratic Republic of the Congo (DRC) in Africa, Vietnam and Syria in Asia, and French Guyana, Haiti and the state of Louisiana in America. One can notice that these various countries may vary significantly in race, culture, language and religion, even within the same continent. As observed by Fong & Harold's (2018) analysis of mnemonic institutions, and more specifically, institutions tied to religion, we can assume that different Francophone people may distribute themselves spatially based not only on race and language but also religion. The religious beliefs of some Francophone subgroups may draw them to churches, mosques, synagogues, temples or community hubs associated with their beliefs like community centres. Some may even prioritize minimal distances to these institutions over proximity to other settlers with a common language or geographical origin. Furthermore, specific subgroups may conscientiously avoid each other due to religious beliefs. In their analysis of Jews in Toronto, Fong & Harold (2018)found that Jews and Muslims would not be found in large concentrations in the same neighbourhoods, instead choosing to co-exist with other groups such as Catholics. This effect may be more apparent between two groups from different regions like Israeli Jews and Saudi Muslims but could also occur to different religious groups coming from the same country. North African countries, in particular, have seen a mass exodus of a large Jewish population following independence movements and their newly installed Muslim governments (Gruen, 1994).

In other cases, the existence of established language-based communities may separate people rather than cluster them. The city of Montreal is well known to have established French-speaking and English-speaking neighbourhoods . Because of this, Hiebert (2000) discovered that specific immigrant populations would unintentionally segregate themselves from one another upon arrival in Canada, even if coming from the same regions. In Montreal, Jamaican immigrants, who speak English, moved into established English-speaking neighbourhoods while Haitian immigrants, who speak French, moved into French areas (Hiebert, 2000). Algerians, one of the test groups for this study, were also observed to move into French-speaking parts of the Quebecois city, possibly due to fewer language barriers and thus better integration (Manaï, 2015).

As previously mentioned, 83% of Francophone residents of Ontario are born within Canada. Unfortunately, there are no detailed data on the birthplaces of this population for recent time frames. While Toronto is very often seen as a gateway for international immigrants, it could also be one for inter-provincial migration. Langlois's 1993 study on Quebec and Ontario's inter-provincial migration revealed that in 1986, 672 Ontarians emigrated to Quebec, consisting of 271 Anglophones, and 305 Francophones, with an additional 39 being bilingual. However, 1616 Quebecers moved to Ontario in that same year; 862 Anglophones, 492 Francophones and 50 bilingual individuals. A few fundamental pieces of information can be pulled from this observation. Francophones are actively leaving Ontario for Quebec, most likely to find a home with an official language they speak, but more Francophones are still leaving Quebec for Ontario, perhaps due to Ontario's economic pull. Also important is to understand that almost twice as many Anglophones leave Quebec compared to Francophones. Langlois cites a 1986 study by Baillargeon in which he writes that Anglophones are 17 times more likely to leave Quebec compared to Francophones, yet the province's Francophone migration patterns reveal a deficit of Francophone migration. In addition to this, Langlois found that two-thirds of the Francophones leaving Ontario for Quebec were born in Quebec. This shows that while Quebec is known to be the French-speaking hub of Canada, non-Quebecois French speakers still make up the vast majority of Ontario's Francophone population (roughly 72% based on Langlois' findings in 1986) (Langlois, 1993). Unfortunately, until data that detail place of birth by province, are publicly available, the detailed spatial distribution of Canadian-born Francophones will remain unexplored.

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3 DATA AND METHODS

3.1 Case Study Data

The data for this study were obtained from the SimplyAnalytics (2020) tool. The spatial unit of analysis is the census tract (CT) defined by Statistics Canada, as this is a commonly used level of geography for similar studies and related data would also be available at this level. While the finer dissemination area (DA) level contains more detail, it can also create a mosaic effect that is visually deceptive. Such a high level of detail could also be difficult to map. We do, however, acknowledge that census tract level data average out differences within the tracts, which may increase clustering. The case study data include a Shapefile of the CT boundaries for the Toronto Census Metropolitan Area (CMA).

As shown in Table 1, three categories with several variables from SimplyAnalytics' (2020) Demographic Estimates and Projections (DemoStats) for 2018 were analyzed. The variables obtained were already normalized using total CT populations as the denominator. The first variable is the proportion of population in private households who indicated French as their mother tongue. This variable represents people exclusively based on their common language. If clustering only occurs at this level, we could conclude that the study population clusters based on language.

The second group of variables represent the proportions of household population who are immigrants from a specific country. The countries of origin included in the study are France, Switzerland and Belgium for French-speaking populations from Europe, Morocco and Algeria from (Northern) Africa, and Haiti from the Caribbean. These variables test whether immigrants from the same country cluster together, with other populations from a specific geographical region or not at all.

The third variable aggregates the previous six immigrant groups into a new category that identifies French-speaking immigrants. This variable differs from the first because it does not consider Canadian born French speakers (native Franco-Ontarians or Quebecers). This variable is imperfect as it may miss Francophone countries not included in the specific country variable (such as Cameroon, Americans, etc.), but no pre-existing Francophone immigrant data is currently available.

Also included are two control variables: Chinese immigrants and total immigrants. Chinese immigrants have been shown to cluster in Toronto (Murdie & Ghosh, 2010), so the inclusion of this variable will allow for validation of the methodology as well as aid in the visual comparisons with the study populations. Clustering of all immigrants will be compared with areas in which Francophone immigrants settle to determine whether Francophones simply settle in a similar manner as other immigrants.

Variable	Category	Purpose
French mother tongue % of CT population	Language	Test for clustering based only on language
French immigrant % of CT population	Immigrant country of origin	Test for clustering based on country of origin, immigrant status or language
Swiss immigrant		
Belgian immigrant % of CT population		
Algerian immigrant % of CT population		
Moroccan immigrant % Of CT population		
Haitian Immigrant % of CT population		
Chinese immigrant % of CT population		Control variable
Francophone immigrant % of CT population (combination of first five variables above)	Aggregate immigrant population	Test for clustering based on immigrant status and language
Total immigrant % of CT population		Control variable

Table 1: Normalized variables used in the analysis. Data source: SimplyAnalytics.

3.2 Cluster Analysis Methods

Clustering was analyzed in two stages, at a broader scale and a narrower scale. Using the Spatial Auto-correlation (Global Moran's I) tool in the Spatial Statistics toolbox in ArcGIS, we determined whether there are significant clusters of Francophones, Francophone immigrants and/or immigrants from specific French-speaking countries in the Toronto CMA. The tool returned a report, which included the Moran's I index

score and corresponding p-values. Positive index scores indicate clustering of similar values, and the strength of this clustering, while negative index scores indicate spatial dispersion of similar values. A p-value < 0.05 indicates that the spatial distribution is not random, i.e. it is either clustered or dispersed.

We used contiguity to conceptualize spatial relationships in a way that polygons that share an edge or at least a corner with the target polygon are included in the calculations. The ArcGIS software help recommends this method for scenarios, in which the analyst is "dealing with continuous data represented as polygons," which applies to this study. However, inverse distance weighting was also tested to see how much the results would be affected by the conceptualization of spatial relationships. Row standardization was enabled in order to avoid polygons with more neighbours being treated differently than those with fewer neighbours (such as those on the edge of the study area).

The second stage of the analysis employs the Hot Spot Analysis (Getis-Ord Gi*) tool to visualize clustering at a local level. While Anselin Local Moran's I could have been used for this task, that tool is more suited to finding outliers, a goal that is less relevant to this study. The combination of the two stages of analysis will answer the question of whether any French-speaking groups cluster in Toronto, and if so, where they do.

Since clustering depends on the spatial and numeric distribution of the data, we also provide the total number of people in each group along with the total population of the Toronto CMA for reference. Table 2 reveals that some of the immigrant groups are quite small in comparison to all Francophones as well as the Chinese and total immigrant control variables.

Variable	**Number of People in Toronto CMA**
# Household Population by Mother Tongue | Household Population For Mother Tongue | Total Single Response | **French, 2018**	77,049
# Household Population by Total Immigrants and Place of Birth | Total Household Population | Total Immigrant | Western Europe | **France, 2018**	9,551
# Household Population by Total Immigrants and Place of Birth | Total Household Population | Total Immigrant | Western Europe | **Switzerland, 2018**	1,888
# Household Population by Total Immigrants and Place of Birth | Total Household Population | Total Immigrant | Western Europe | **Belgium, 2018**	2,151
# Household Population by Total Immigrants and Place of Birth | Total Household Population | Total Immigrant | Northern Africa | **Algeria, 2018**	1,761
# Household Population by Total Immigrants and Place of Birth | Total Household Population | Total Immigrant | Northern Africa | **Morocco, 2018**	4,008
# Household Population by Total Immigrants and Place of Birth | Total Household Population | Total Immigrant | Caribbean And Bahamas | **Haiti, 2018**	3,317
# Household Population by Total Immigrants and Place of Birth | Total Household Population | Total Immigrant | Eastern Asia | **China, 2018**	302,468
# Household Population by Total Immigrants and Place of Birth | Total Household Population | **Total Immigrant, 2018**	3,066,986
# Basics | **Total Population, 2018**	6,419,713

Table 2: Case study population groups in relation to total population of Toronto Census Metropolitan Area. Data source: SimplyAnalytics.

4 RESULTS AND DISCUSSION

4.1 Global Cluster Analysis

The results obtained using the contiguity conceptualization can be classified into a few different outcomes. Immigrants from Belgium and Algeria do not cluster in a statistically significant manner. Both groups exhibited very small negative index scores, suggesting a minimally dispersed spatial distribution. French and Swiss immigrant populations were found to cluster at a 95% confidence level (meaning there is a 5% chance that this pattern is not significantly different from random). However, the strength of clustering indicated by the Global Moran's I score is again minimal. Moroccan and Haitian immigrants were shown to cluster at an above 99% confidence level. However, the level of clustering is still very small with an index score around 0.12 and 0.16. The same applies to the variable that aggregates all immigrant groups into French-speaking

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immigrants, with a statistically significant (99%) yet very small index score of 0.08. By contrast, the general French-speaking resident group clusters at the 99% level with a clustering intensity of 0.68, only surpassed by the total immigrant and Chinese immigrant control groups with I = 0.76 and 0.82, respectively.

Groups		**Contiguity**	**Inverse distance**
Language	French mother tongue	0.684934**	0.453577**
Countries	French	0.036183*	0.052183**
	Swiss	0.034149*	0.015265**
	Belgian	-0.006484	0.008898
	Algerian	-0.002174	-0.002669
	Moroccan	0.162411**	0.034573**
	Haitian	0.116389**	0.046939**
	Chinese (control)	0.818422**	0.490387**
Immigrant status	French speaking immigrants	0.086070**	0.040065**
	Total immigrants (control)	0.764930**	0.530928**

Table 3: Results of global cluster analysis using contiguity and inverse-distance for spatial neighbourhood definitions. Asterisks mark statistically significant Global Moran's I scores, with * representing a 95% confidence interval and ** representing a 99% confidence interval. Higher positive scores indicate a greater degree of clustering.

These results were mostly consistent with those found using the inverse distance conceptualization. The notable differences include markedly lower index scores for the French mother tongue and the Chinese and total immigrant variables, yet with values of 0.45, 0.49, and 0.53 these groups are still highly clustered at a 99% confidence level. Clustering of French and Swiss immigrants is significant at a 99% level rather than 95% using the inverse distance method, although the index scores remained in the same order of magnitude. Lastly, the score for Belgian immigrant clusters changed from negative to positive, but since it remained extremely close to zero, like the score for Algerian immigrants, this change does not have practical significance.

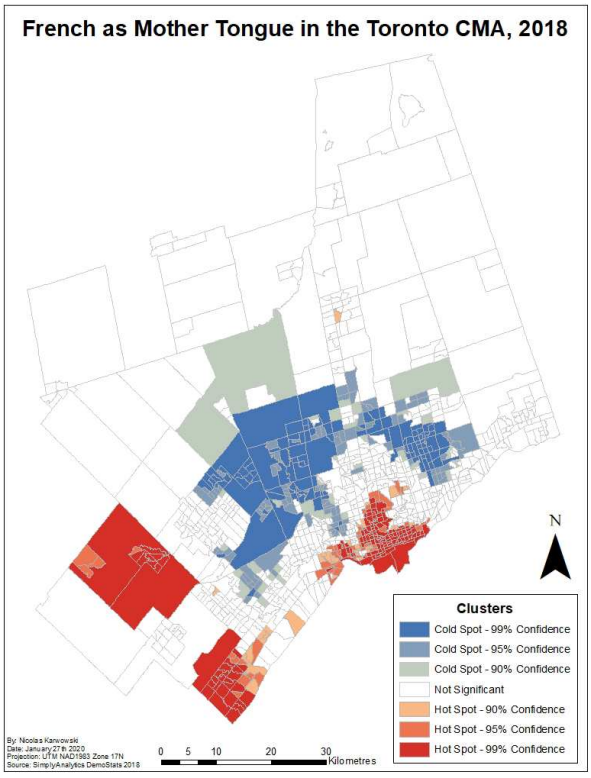
4.2 Local Cluster Analysis

The results of local cluster analysis are shown on the maps in Figure 1. The output feature classes for the Getis-Ord Gi* tool highlight clusters of high values and low values, known as hot spots and cold spots, respectively. While hot spots of the highest significance (the 99% confidence level) are perhaps of more interest than other ones of lower significance, we will discuss all hotspots above 90% for this analysis, unless they are not part of bigger clusters.

While clustering did not necessarily occur in the same areas for each group, each group did cluster in one or multiple areas of the Toronto CMA. In the six country-specific immigrant variables, clustering occurred in downtown areas as well as suburban areas. However, the mix of clustering between these two areas varied from group to group. Algerians, Moroccans and Haitians (Figure 1e, 1f, and 1g) clustered almost exclusively outside of Toronto's downtown core. Haitians were found in two main clusters on the Scarborough-Pickering border in the East as well as on the Etobicoke-Brampton-Mississauga boundary in the West. The two North African immigrant groups clustered together in North and East York just north of the old city of Toronto, as well as in Oakville on the western extremity of the CMA. The spatial distribution of these North African communities is reminiscent of the Petit Maghreb community in Montreal, where the same immigrant groups clustered (Manaï, 2015). While this study does not seek to understand why these groups cluster, this demographic group may possibly stay together based on their common language, religion or geographical region. Based on the spatial assimilation model, there may also be a link between the immigrants' socio-economic status and where they live. Visible minority immigrants have historically had fewer resources than their non-minority European counterparts, leading them to being pushed to the outskirts of the city to find affordable housing (Logan, Zhang, & Alba, 2002).

The three European groups, in comparison, found themselves clustered within the city boundaries as well as in the outer suburbs of the city, with very few residents in the inner suburbs. French immigrants find themselves in a large cluster spanning across the entire core. Another sizable cluster can be seen on the Brampton-Caledon border in the West, while a smaller one was in Oakville in the Southwest. Belgians

clustered in a slightly smaller area to the east of Yonge Street downtown and along the lakeshore as well as in Vaughan to the North of the city of Toronto. The Swiss were the least clustered of the three, with several small clusters across the CMA. While a Swiss cluster exists in the old city of Toronto, similarly-sized clusters are also seen in Brampton, Newmarket, Vaughan and Mississauga.



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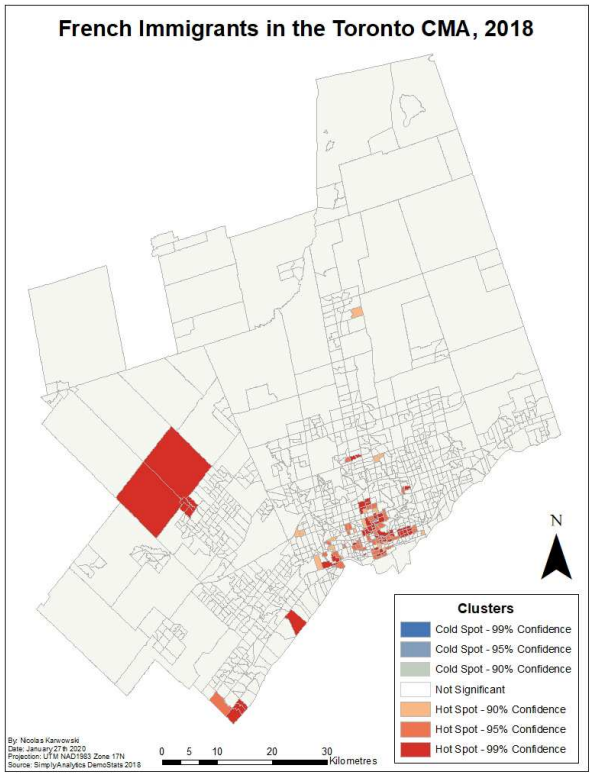

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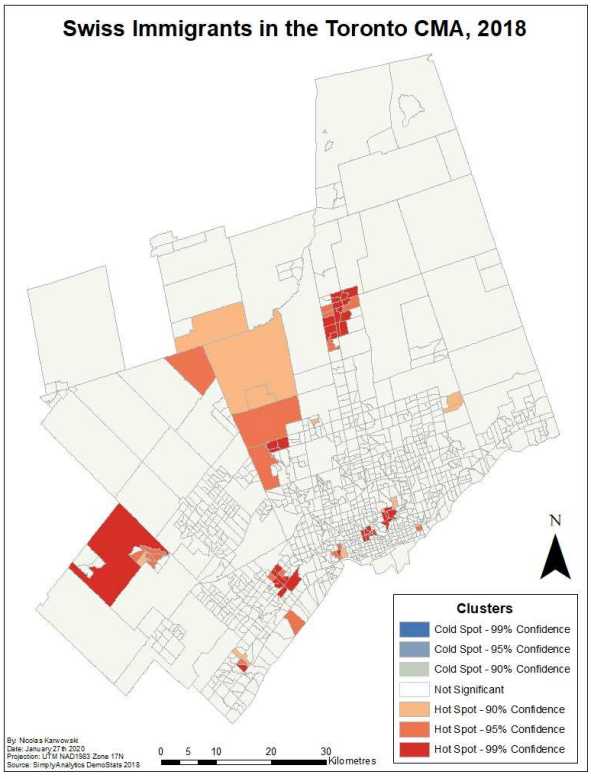

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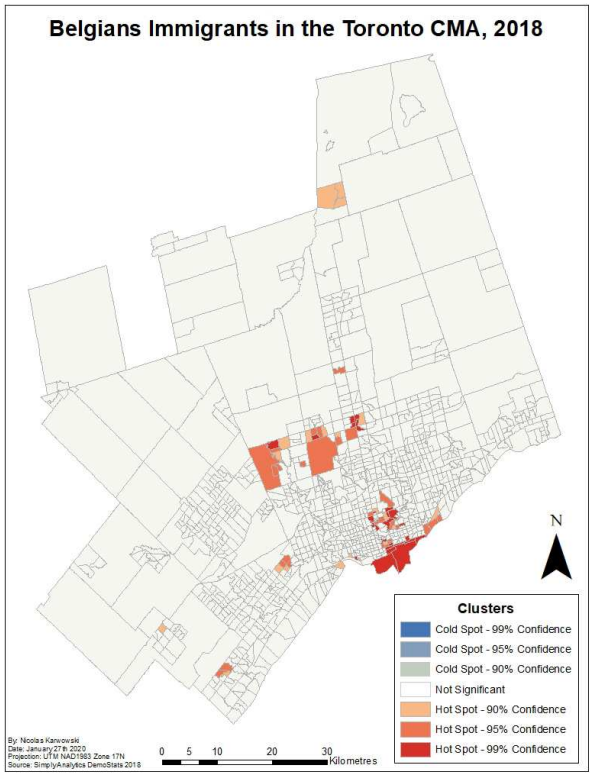

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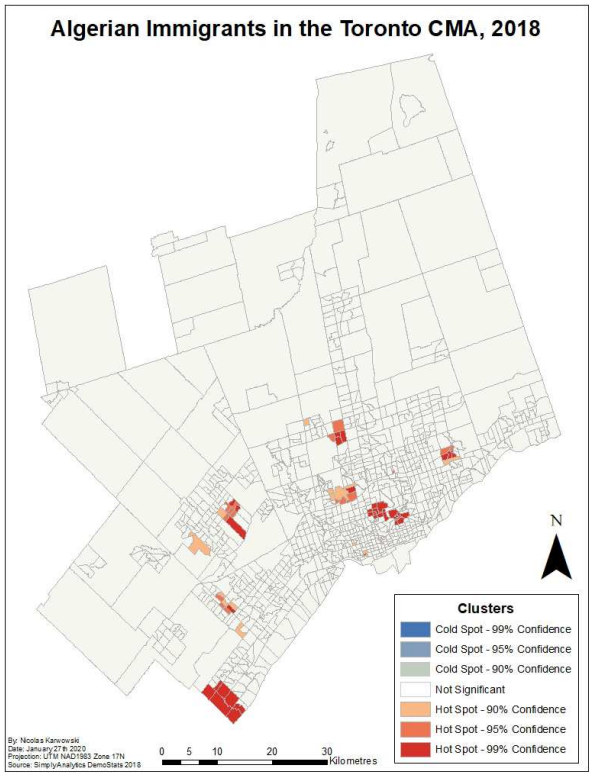
Algerian Immigrants in the Toronto CMA, 2018
N
Clusters
Cold Spot - 99% Confidence
Cold Spot - 95% Confidence
Cold Spot - 90% Confidence
Not Significant
Hot Spot - 90% Confidence
Hot Spot - 95% Confidence
Hot Spot - 99% Confidence
0 5 10 20 30
Kilometres

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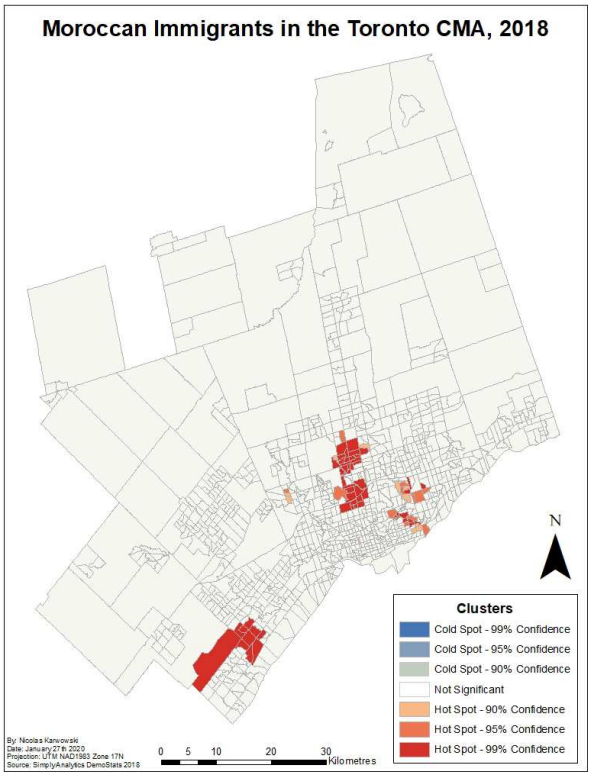
Moroccan Immigrants in the Toronto CMA, 2018
N
Clusters
Cold Spot - 99% Confidence
Cold Spot - 95% Confidence
Cold Spot - 90% Confidence
Not Significant
Hot Spot - 90% Confidence
Hot Spot - 95% Confidence
Hot Spot - 99% Confidence
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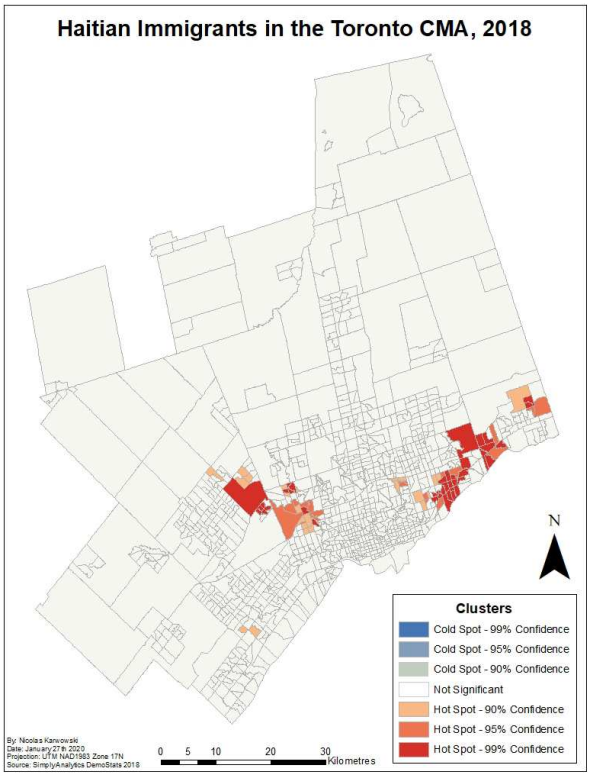
Haitian Immigrants in the Toronto CMA, 2018
N
Clusters
Cold Spot - 99% Confidence
Cold Spot - 95% Confidence
Cold Spot - 90% Confidence
Not Significant
Hot Spot - 90% Confidence
Hot Spot - 95% Confidence
Hot Spot - 99% Confidence
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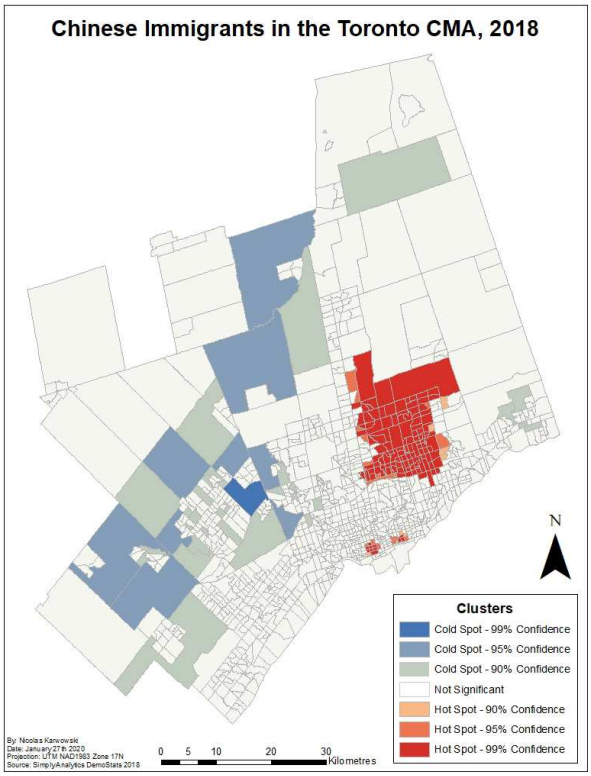
Chinese Immigrants in the Toronto CMA, 2018
N
Clusters
Cold Spot - 99% Confidence
Cold Spot - 95% Confidence
Cold Spot - 90% Confidence
Not Significant
Hot Spot - 90% Confidence
Hot Spot - 95% Confidence
Hot Spot - 99% Confidence
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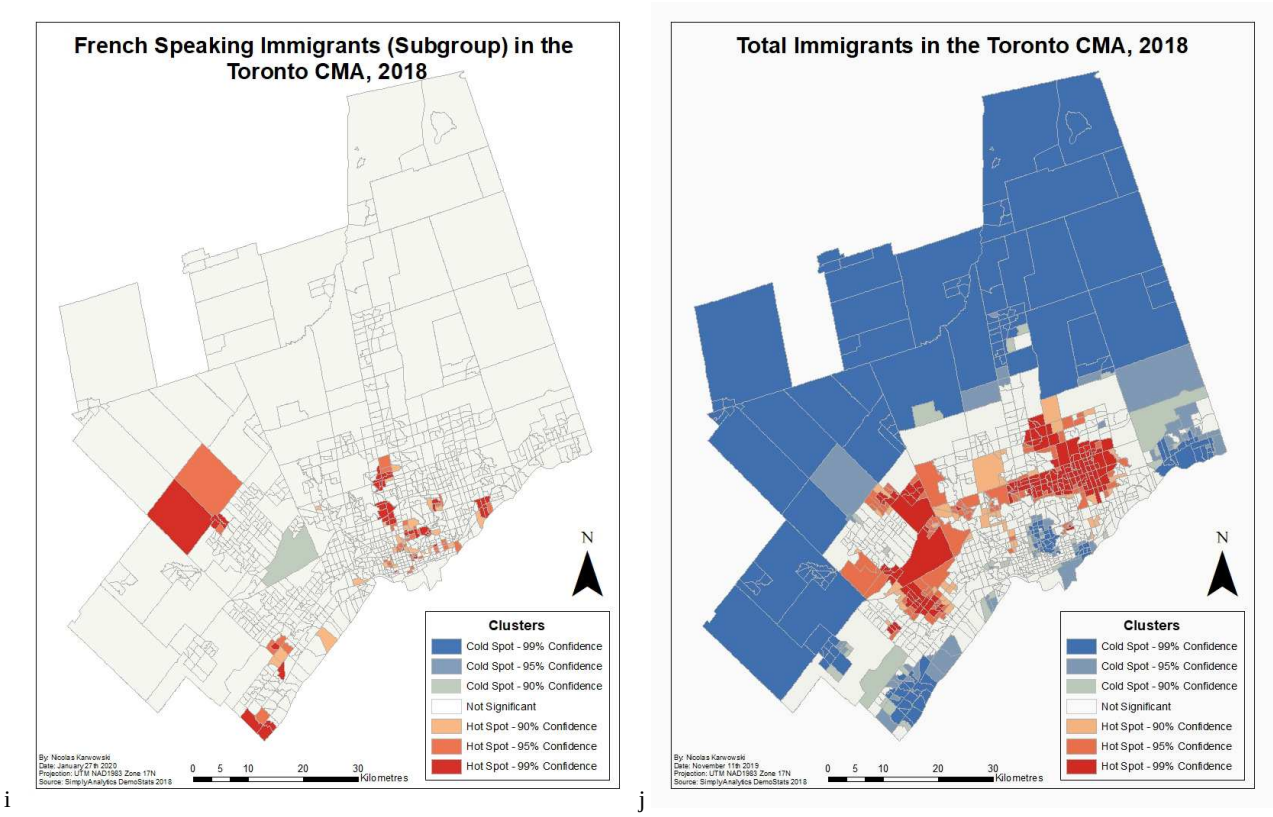

Figure 1. Local clustering of different immigrant and language groups: a) all speakers of French as their mother tongue; b) French immigrants; c) Swiss immigrants; d) Belgian immigrants; e) Algerian immigrants; f) Morrocan immigrants; g) Haitian immigrants; h) Chinese immigrants (control variable); i) combination of French-speaking immigrant groups; j) total immigrants (control variable).

When compared to the Chinese immigrant control variable, the difference in the type of clustering is apparent. The Chinese cluster both in Chinatown within the city of Toronto but also in the suburb of Markham. This cluster is almost entirely significant at the 99% level and is geographically approximately twice as large as the French immigrant cluster, which ranks second in size.

When all the Francophone immigrants were aggregated, clustering did occur, but it consisted of smaller groups of CTs scattered across the CMA. On the other hand, the French mother tongue variable, which adds native-born Canadians and other Francophone immigrants to the previous variable, revealed completely different results (Figure 1a). Three distinct clusters appeared across the CMA, with the most populous one being in the heart of Toronto, whereas the other two are found in Halton Hills and Oakville. A ring-shaped cold spot surrounds the Toronto cluster, stretching from northern Scarborough across Vaughan to Eastern Brampton. Interestingly, while the French mother tongue hot spots do correspond with some of the immigrant group clusters, the cold spot does as well. It may be that the individual groups have a significant presence, but as a communal Francophone group, their presence is no longer significant. The results for the total immigrant group (Figure 1j) show different settlement hot spots as compared to those of Francophone immigrants, indicating that immigration in itself was not the only factor contributing to the aforementioned patterns.

5 CONCLUSION AND OUTLOOK

This study proposes a statistical and visual analysis of the clustering of French-speaking people within the Toronto CMA. Global Moran's I was used for statistical testing of global clustering and Getis-Ord Gi* visually identified smaller-scale clustering. Ten variables were passed through these two tests. Six of them represented immigrants from Francophone countries on three continents to test whether clustering occurred based on country of origin. One was the aggregation of these six countries to test whether their immigrant status contributed to their clustering. Another was a French mother tongue variable to test whether language was the unifying factor. The last two variables were different immigrant populations, used as control variables to ensure a viable methodology and compare patterns with the Francophone variables. Both tests confirmed clustering at various scales and locations.

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The limitations of the study stem primarily from the types of data and methods used but also from the lack of prior research on this topic. Cluster analysis could be done in several ways. While Getis-Ord Gi* was appropriate to identify local hot spots rather than outliers, outlier analysis using Local Moran's I may result in different findings. Different spatial relationship conceptualizations may also result in different outcomes. The use of the control variables was to ensure that the methodology delivered results consistent with past research on these test groups.

In terms of the input data, the six countries of origin do not fully represent the French-speaking immigrant populations of Toronto. It is also possible that small segments of some groups (Swiss, Belgian) do not speak French but another official language of their place of birth. Additionally, the variables do not account for second- (and later) generation immigrants and their spatial dispersion in the study area. Unfortunately, at the current time, French-speaking immigrant data by country of origin and generation is unavailable. Finally, it must be reiterated that the visual comparisons of clusters can be affected by the size of the spatial units of analysis, here CTs. A future study could compare results across different Census geographies.

While this study did not seek to verify connections between the clustering of the groups and specific explanatory factors, hopefully it lays down the groundwork for follow-up research. We can conclude that clustering does occur at global and local scales. However, this study has shown that the clustering of French-speaking people is not cut and dry, and that further analysis of individual subgroups will be needed to understand the factors and processes that lead to these spatial distributions. Such future results could have implications on the planning of service locations and programs for population groups based on French language and/or regional culture of their birth place.

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From Urban Design to Energy Simulation – a Data Conversion Process Bridging the Gap Between Two Domains

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1 ABSTRACT

Rapid urbanisation and the ever-growing world population have put a heavy toll on world climatic conditions especially in the way existing and new urban developments emit carbon. As per an estimation[1], 28% of all energy related carbon emission worldwide accounts for energy used to heat, cool and light the buildings. In this context along with new approaches in urban designs, it requires continuous new technological developments, smart tools, and processes that can audit these urban designs particularly based on its energy efficiency. This calls for the development of a common process which supports urban designers, sustainable technology experts, and geospatial technology experts alike in producing results which help a) to reach sustainable city targets and b) to create climate change mitigation and adaptation strategies. A major technical challenge in developing such a process is the heterogeneity of tools, methods and data formats that architects, urban designers, sustainability experts, and geospatial pundits traditionally work with. This paper tries to counter this challenge and derive an exemplary data exchange process between commonly used urban design tools Rhinoceros3D, AutoCAD, Esri CityEngine and the Open Geospatial Consortium (OGC) standardised open data model of CityGML version 2.0 aiming to assess new urban designs regarding cities' energy demands using 3D City Models.

Keywords: Data Interoperability, Geometric Modelling, Urban Design, Energy Simulation, CityGML

2 INTRODUCTION

Urban design, on the one hand, as a process of shaping and characterising new neighbourhoods are becoming more complicated due to the rapid expansion of cities. On the other hand, urban design is getting more scrutinised than ever before, particularly regarding carbon emission reduction, as well as climate-responsive building designs. Conventional urban design methods focused more on designing and characterising the physical arrangement of urban elements in the neighbourhood but lacked performance assessments such as building stock energy audits for the proposed urban design. However, with the rapid evolution of computer science and geospatial technologies, modern urban design methods involve continuous use of 3D city modelling for better understanding, planning, and visualisations of the urban design (Chundeli, 2017). In present times, applications of 3D city models have gone far beyond visualisation (Biljecki et al., 2015). One such domain, where these virtual 3D city models find themselves increasingly used is in City Energy Modelling (CEM). CEM relies on a bottom-up approach to know the total energy demand of cities and districts by analysing its building stock's energy demand. One way to analyse building stock energy demand is by using individual building geometries and their characteristics. To store and share such semantically rich 3D city models, City Information Models (CIM) has been developed. One such standardized open data model to store and share 3D semantic city models is CityGML.[2] With the continuous development and implementation of CityGML, as of today, buildings of more than 100 megacities (under open data initiatives from different governments) are freely available for public use on different Level of Details (LoD):[3] LoD1 represents buildings in block models while LoD2 includes additional roof geometries. LoD3 in addition to LoD2 also includes building openings e.g. doors and windows. LoD4, in addition to LoD3 also includes building interiors (Biljecki, 2013) (LOD4 data are normally not distributed as open data due to privacy issues). CEM software, such as SimStadt[4], make use of these CityGML models to calculate building stock

[1] Global Status Report 2017 published by International Energy Ageny, United Nations.
[2] https://www.opengeospatial.org/standards/citygml
[3] https://3d.bk.tudelft.nl/opendata/opencities/
[4] An urban energy simulation platform developed at University of Applied Sciences – HfT Stuttgart.

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energy demands. Additionally, SimStadt also helps in simulating energy demands based on different refurbishment scenarios (Nouvel et al., 2014).

The application of SimStadt, an energy demand simulation for existing buildings has been successfully demonstrated by Nouvel et al. (2015), but it remains interesting to see how new urban designs can be converted into CityGML based open data model e.g. for use in SimStadt. A challenge in such a study is to produce error-free CityGML building geometries which can be used for analysis and simulations tasks within the tools which were initially used to sketch new urban designs (Biljecki et al., 2016). To address this challenge, the three case study regions, namely Gowanus (Brooklyn – New York, USA), Nordwestbahnhof (Vienna, Austria) and Wienerplatz (Stuttgart, Germany) were probed. The case studies regions of New York and Vienna were modelled using Rhinoceros3D. In the case of Vienna, the project also utilised the Rhinoceros3D'S parametric plugin of Grasshopper before converting it to CityGML LoD1. For the CityGML conversion, the Feature Manipulation Engine (FME) has been used to create the buildings' and building parts' geometry. The case study region of Stuttgart was modelled in LoD2 using Esri's CityEngine before converting it to CityGML, also using FME. The resulting CityGML geometries were then simulated with SimStadt to compute their heating demand. Additionally, in the Stuttgart case, the photovoltaic potential of roof surfaces was also calculated using the converted LoD2 models.

The aim of this paper is, to describe the data conversion process leading to above-mentioned datasets and shall serve as a guideline to generate simulation ready semantic CityGML building models. Such a well-defined data exchange process, between commonly used 3D modelling urban design software and energy simulators, supports initiating a workflow especially between urban designers and sustainability experts to produce enhanced outcomes of both the domains.

The work presented by the authors in this paper is carried out during an ongoing project "Integrated analysis and modelling for the management of sustainable urban food water energy ReSOURCEs (IN-SOURCE)".[5]

3 TOOLS, TECHNIQUES AND DATA FORMATS USED FOR 3D CITY MODELLING

3D city models are georeferenced, digital semantic models representing real-world physical elements such as buildings, vegetations, street furniture, terrain surfaces and landscapes in three dimensions. Past decades have witnessed the evolution of many different tools, techniques and data formats that are used for developing, managing and visualising 3D city models. A typical city model can be constructed automatically or semi-automatically from various acquisition methods such as aerial images and maps (Buyukdemircioglu et al., 2018), stereo satellite images (Kocaman et al., 2006), synthetic aperture radar (SAR) (Sharafzadeh et al., 2018) and LiDAR point clouds (Buyuksalih et al., 2019). Along with these photogrammetric and remote sensing tools and techniques, processes for constructing 3D city models using vector datasets from computer-aided design (CAD) and geographic information systems (GIS) have also been in practice for a long time. Last but not least, using shape grammar for 3D city models (Dobraja, 2015), implementing urban planning with procedural modelling using Rhinoceros3D (Fink, 2018), utilising OpenStreetMap to generate 3D models (Over et al., 2010) and, modelling 3D buildings using CAD-based software such as Autodesk InfraWorks or SketchUp (Wang et al., 2012) have all been widely used techniques to create a digital twin of cities.

Elements of 3D city models are encoded in data formats. Each tool used to generate the 3D city models will produce outputs in its own readable data format. Exemplary data formats, used by architects, urban designers, geoinformatics experts, and municipalities worldwide, range from CAD software such as AutoCAD (.dwg) or (.dxf) over 3D multipatch shapefiles from Esri ArcGIS and CityEngine (.shp) to COLLADA (.dae) and the native data format of Rhinoceros3D (.3dm). Moreover, during the last decade, the XML based open data model of CityGML has gained a lot of user attraction because of its capability to not only store georeferenced 3D city models but also the ability to store semantics and topological information of these 3D city models (Kolbe, 2009). OGC approved CityGML encoding standards[6] form the basis on how real-world physical elements must be stored and represented as virtual 3D city models in CityGML. Storage and representation of these 3D city models should follow a certain set of rules and regulation defined as conformance requirements in the encoding standards. These conformance requirements are particularly

[5] https://www.hft-stuttgart.de/Forschung/Projekte/Projekt208.html/en
[6] https://portal.opengeospatial.org/files/?artifact_id=47842

important when 3D city models in CityGML are to be used beyond visualisation such as in analysis and simulation (Coors et al., 2020). The 3D City Database (a.k.a 3DCityDB), an open-source 3D geo-database is used to store, represent and manage CityGML datasets in a relational database which is providing the additional capability to perform complex analytical tasks beyond visualisation. Additionally, to store 3D objects and their semantics which are not a part of core CityGML schema, CityGML application domain extensions (ADE) can be developed. As of 2018, 44 CityGML ADEs supporting various applications have already been developed and used (Biljecki et al, 2018). However, it is worth mentioning that new geometrical objects and related properties, introduced as a part of any CityGML ADE, by default inherit characteristics of the CityGML encoding standard and do not relate with data interoperability between CityGML and any other data formats. In a simple term, CityGML ADEs are placed on top of CityGML to enrich its core schema to accommodate application-specific new objects and their features.

As there are so many different tools and data formats available and used by various domain experts, one of the current issues and challenges in 3D city modelling is the definition and development of a data exchange interface to produce joint outputs when combining different domains (Billen et al., 2014). This is, in particular, true for architects and urban designers, who, along with their building stock designs, are also interested in the assessment of these building stocks based on their energy demands. Typically, architects and urban designers use tools like Rhinoceros3D (with its parametric plugin Grasshopper), AutoCAD and Esri CityEngine for proposing new urban designs, while geospatial and urban energy simulation experts use CityGML as an input for their CEM software such as SimStadt. Neither Rhinoceros3D nor AutoCAD or Esri CityEngine can produce CityGML datasets out of the box. In a related paper, Jesus et al. (2018) demonstrated a data conversion process from Rhinoceros3D to CityGML. As an input, a shapefile was first imported into Rhinoceros3D with its Heron plugin and then extruded to produce a 3D geometry. This 3D geometry was later exported to COLLADA file using Rhinoceros3D built-in file export functionality before converting it into CityGML LoD1 using FME. However, since the focus of this work was on visualisation, conformance requirements for CityGML buildings were not considered during the conversion process. Such a translation process justifies visualisation output but is not recommended for analysis and simulation exercises such as calculating energy demands of buildings using 3D city models. Furthermore, the building footprint shapefile, when extruded, produced a uniformly extruded block model, which, in reality, is not always a relevant geometry for all building types as most buildings have building parts, too, which can have different building geometries and attributes than the main building. In particular for architects and urban designers who are not always GIS users, unanswered questions still remain, like (i) how to translate building geometries to CityGML buildings which are originally modelled in a non-georeferenced local coordinate system using Rhinoceros3D without importing georeferenced shapefiles of building footprints? (ii) How to translate Rhinoceros3D buildings having building parts and related attributes to CityGML adhering to the conformance requirements of the encoding standard for CityGML?

In another study, Billen et al. (2014) mention that Esri CityEngine shows LoD1 modelling for CityGML well, but there is still a problem in using it to model buildings with roofs and building openings for translating it to valid CityGML LoD2 and LoD3 geometries respectively. This issue was once again highlighted by Janečka (2019) in their Esri shapefile to CityGML conversion. Output CityGML dataset only contained property of gml:building having multisurface geometry to justify their results for visualisation purpose. However, as per CityGML conformance requirement 10.3.9.4, required semantic information of ground, wall and roof surfaces for LoD2 buildings were missing. Considering both the studies ones again the same question stands, how to translate 3D geometries particularly of LoD2 from CityEngine to CityGML with semantics which is following the CityGML conformance requirements?

4 GEOMETRY VALIDATION IN CITYGML FOR ANALYSIS AND SIMULATION

The quality of results produced by any analytical or simulation software directly relies on the quality of the input data. The same is true for 3D city models and CityGML. With an increasing number of users using CityGML models for various analysis and simulation (Biljecki et al., 2015) use cases, such as solar radiation analysis, visibility analysis, noise propagation in traffic planning, wind flow analysis, flood damage analysis, data quality and consistency approaches of CityGML datasets are now being thoroughly investigated. OGC itself launched the CityGML Quality Interoperability Experiment to study and investigate aspects of schema conformance, geometry and, semantics validation and validation of conformance requirements for CityGML

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datasets (OGC, 2016).[7] As an outcome of the experiment, different software packages were developed, and several recommendations were given to improve the quality and consistency of CityGML models. In his article, Biljecki et al. (2016) have synthesised most regularly occurring geometric and semantic errors in CityGML datasets. Based on his findings and other similar investigations (Coors et al., 2020), several tools such as val3dity (Ledoux, 2018), FME geometry validator and CityDoctor[8] are in continuous development. Furthermore, based on the validation report, FME geometry validator and CityDoctor can also automatically heal building geometries of CityGML to a certain extent. (Alam et al., 2013).

Since this paper is also dealing with an energy demand simulation test case, in particular, validation of building solid geometries and face orientation of building surfaces is critical as those directly affect the building volume calculation and therefore energy demand calculations. In their article, Coors et al. (2020) proved this by comparing the building volume of a correct building solid geometry with an error-prone building solid geometry. Hence, to compute a correct building volume, it becomes very important that building solid geometries in CityGML are created correctly following the conformance requirement 10.3.9.4 of the CityGML encoding standard. As an example, based on this CityGML conformance requirement, Padsala and Coors (2018)[9] explained how to insert building solid geometry in CityGML building and building part datasets using FME.

Considering the above-mentioned validation parameters and adhering to the CityGML encoding standard, this paper tries to overcome some data interoperability limitations mentioned in chapter 2 and explains how to translate valid CityGML geometries from Rhinoceros3D and Esri CityEngine that can be used for analysis and simulation such as of energy demand calculation using SimStadt.

5 DATA CONVERSION FROM URBAN DESIGN TO ENERGY SIMULATION

5.1 Case Study 1: Gowanus (Brooklyn, New York, USA)

The case study region of Gowanus (previously known as South Brooklyn) represents a neighbourhood in the New York City (NYC) borough of Brooklyn. Formerly, a dominant industrial zone, it is now under rezoning led by NYC's planning department, the American Institute of Architects New York Chapter (AIANY), New York Institute of Technology (NYIT) and community stakeholders.

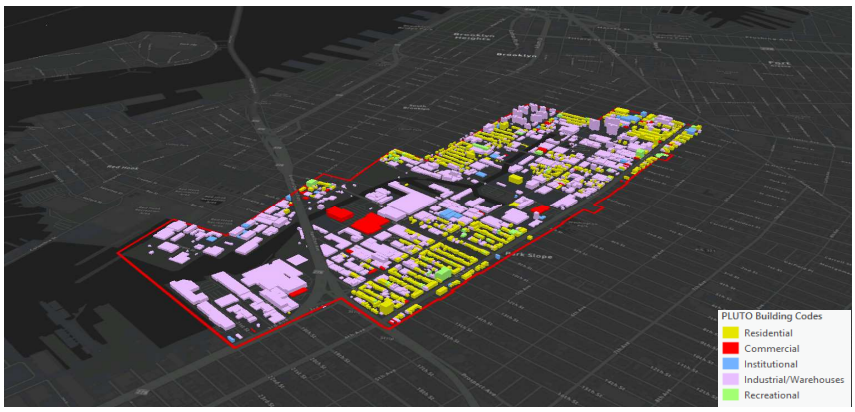


Fig. 1: Gowanus existing land use 3D map

Based on population projections and following NYC landuse mapping guidelines, a full build-out redeveloped 3D scenario was modelled in LoD1 using Rhinoceros 3D. i.e all the building footprints were applied with the highest and best use of available zoning laws. The redeveloped 3D scenario was modelled in a non-georeferenced local coordinate system.

[7] http://mail.opengeospatial.org/lists/lt.php?id=fR4CDVYeAlJfHwhTCwA
[8] https://www.citydoctor.eu/index.php/citydoctor_main.html?language=en
[9] https://gitlab.com/volkercoors/CiD4Sim/-/wikis/usefulTools/FME-Workbenches

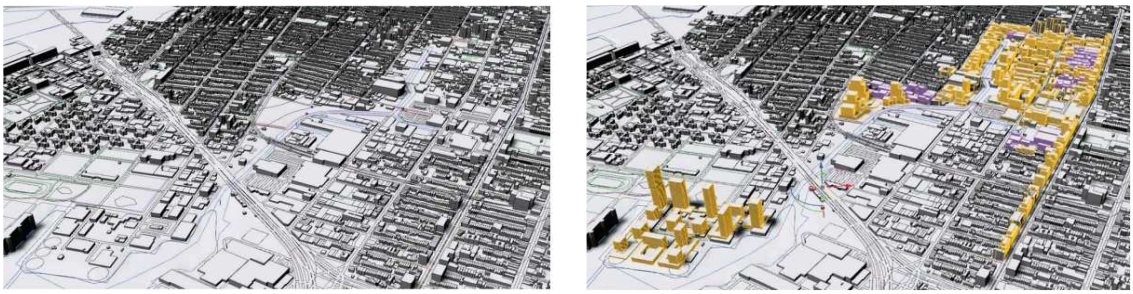
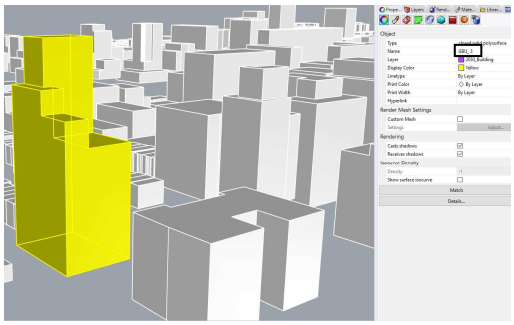


Fig. 2: Left figure shows existing building stocks, the right figure shows new building stocks modelled in Rhinoceros3D

Each building geometry was given a unique ID to be later used during the conversion to CityGML. In a separate spreadsheet, related building attributes of the year of construction and building functions were maintained, for each building ID, which represents the minimum set of attributes to calculate an energy demand using SimStadt. In this particular use case, overlapping, intersecting or adjacent building parts, belonging to the same building but having different building heights, were modelled as single building geometries, instead of an individual building part of the building. Since Rhinoceros3D cannot export semantics for geometries, a comment column with the value “Building” was specified against each building ID in the above-mentioned spreadsheet.



	B	C	D	E
1	ID	Year	Land Use	Comment
2	GBU__0	1970	E1	Building
3	GBU__1	1930	E1	Building
4	GBU__2	1917	C1	Building
5	GBU__3	2050	RC	Building
6	GBU__4	2010	RM	Building
7	GBU__5	2035	RC	Building
8	GBU__6	2045	RC	Building
9	GBU__7	2045	RI	Building
10	GBU__8	2035	RW	Building
11	GBU__9	2045	O5	Building
12	GBU__10	2050	F5	Building
13	GBU__11	2050	F4	Building

Fig. 3: Left figure shows building geometry with ID in Rhinoceros3D, the right figure shows its related information

For this use case, the end to end workflow from urban design to the energy simulation can be represented as below (Fig. 4). The FME workbench used for Rhinoceros3D to CityGML conversion will be discussed in chapter 6 section 6.1.

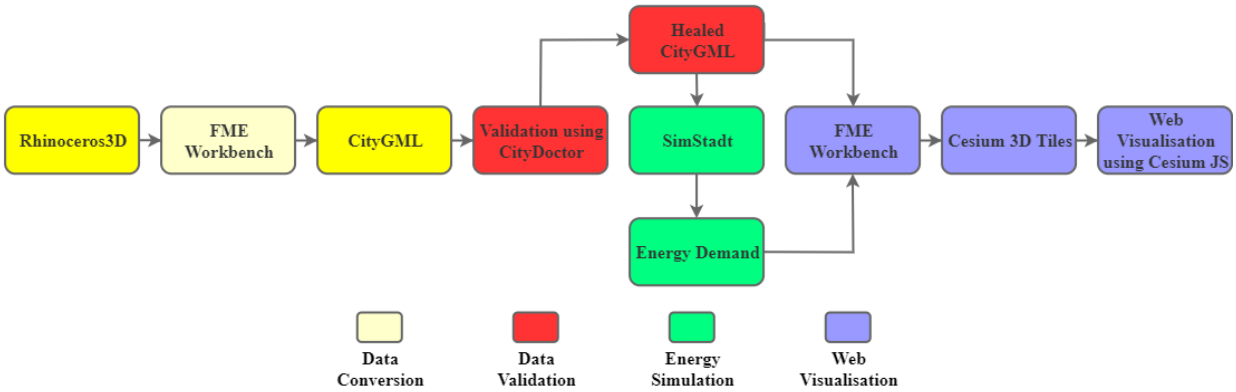


Fig. 4: Workflow Diagram

5.2 Case Study 2: Nordwestbahnhof (Vienna, Austria)

The Nordwestbahnhof case study focuses on the application of the parametric urban design strategy on a central site in Vienna. The use of parametric modelling techniques allows generating a broad set of urban design variants that meet the criteria of sustainable development targets. The goal is, to create and simulate different designs to achieve a decision basis and to draw a possible outline for further steps. As a first step, the described urban development model of the Nordwestbahnhof was modelled in LoD1 using Rhinoceros3D and its parametric plugin of Grasshoper3D based on a georeferenced building footprint shapefile.

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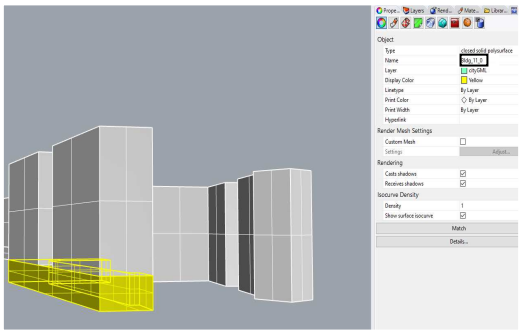
Fig. 5: A 3D Map of Nordwestbahnhof

This use case differs from the previous use case of Gowanus in the way the building models are designed. As, in the case of Gowanus, overlapping, intersecting or adjacent building parts, belonging to the same building but having different building heights were modelled as single building geometries, for Nordwestbahnhof, algorithms were applied in Grasshopper to correctly classify the volumes into single buildings and buildings coupled with their building parts. Each building geometry was given a unique ID to be later used during the conversion to CityGML. In a separate spreadsheet, for each building ID related building attributes of the year of construction and building functions were maintained. Furthermore, to preserve the hierarchical structure of CityGML (i.e building consists of building parts) for each unique ID, a parent ID was introduced. “Building” and “BuildingPart” were used as semantic parameters within the comment column to identify buildings with or without building parts.



Bldg_Parent_ID	Bldg_ID	Comment	block	use	m2	floors	height[m]
Bldg_0	Bldg_0_0	BuildingPart	11b	office	14656	9	27
Bldg_0	Bldg_0_1	BuildingPart	11b	commercial	1628	1	4
Bldg_0	Bldg_0_2	BuildingPart	11b	residential	11815	20	60
Bldg_0	Bldg_0_3	BuildingPart	11b	residential	3568	12	36
UUID_1	Bldg_1	Building	3s	school	6347	2	8
UUID_2	Bldg_2	Building	6	school	5987	2	8
UUID_3	Bldg_3	Building	6	school	3278	2	8
UUID_4	Bldg_4	Building	6	school	3470	2	8
UUID_5	Bldg_5	Building	13	school	3497	2	8
UUID_6	Bldg_6	Building	13	school	3622	2	8
UUID_7	Bldg_7	Building	13	school	3631	2	8
UUID_8	Bldg_8	Building	13	school	3557	2	8
UUID_9	Bldg_9	Building	2	office	15524	13	39
UUID_10	Bldg_10	Building	2	office	8806	13	39
Bldg_11	Bldg_11_0	BuildingPart	2	commercial	4725	2	9
Bldg_11	Bldg_11_1	BuildingPart	2	office	16217	13	39
Bldg_11	Bldg_11_2	BuildingPart	2	office	10598	13	39
UUID_12	Bldg_12	Building	8	office	804	1	3

Fig. 6: Left figure shows building geometry with ID in Rhinoceros3D, the right figure shows its related information

For this use case, the end to end workflow remained the same as in the use case of Gowanus (See chapter 5, section 5.1, Fig.4). However, the FME workbench used to convert Rhinoceros3D to CityGML was updated to write both gml:Building and gml:BuildingPart, this is further discussed in chapter 6, section 6.2.

5.3 Case Study 3: Wienerplatz (Stuttgart, Germany)

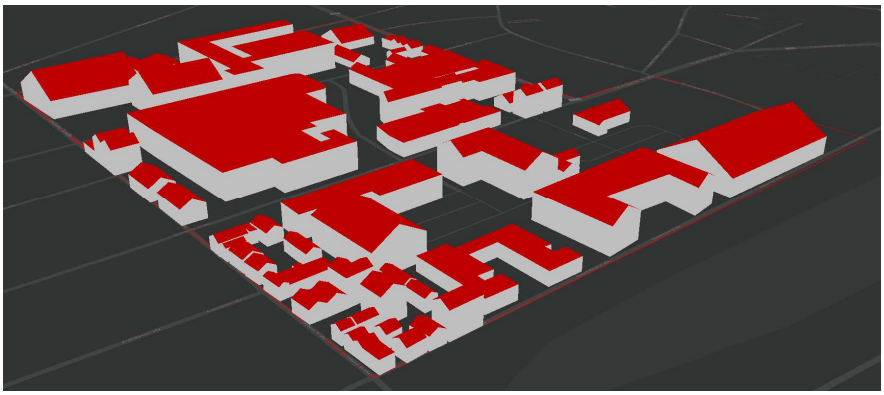


Fig. 7: A 3D Map of Wienerplatz

The case study region of Wienerplatz was modelled using Esri’s CityEngine. Initially, building footprints from AutoCAD were converted to a georeferenced 2D shapefile before importing it into CityEngine. Unlike the above two use cases, instead of a spreadsheet, attributes related to each building footprint such as

building height, roof type, year of construction and building function were stored in a shapefile. Inside CityEngine, a certain rule-based algorithm known as computer generated architecture (CGA) shape grammar[10] was applied on the shapefile dataset, which generated LoD2 building models based on its geometry and attributes.

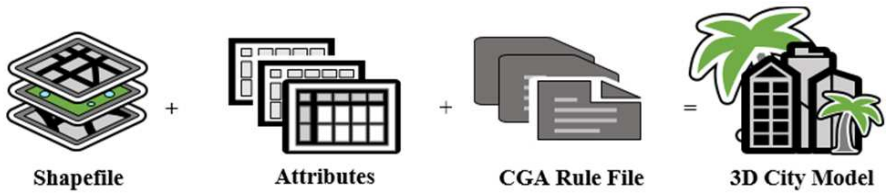


Fig. 8: 3D city modelling workflow in Esri CityEngine

An end to end workflow for the use case of Wienerplatz can be represented as below (Fig. 9). The FME workbench used for CityEngine to CityGML conversion is discussed in chapter 6 section 6.3.

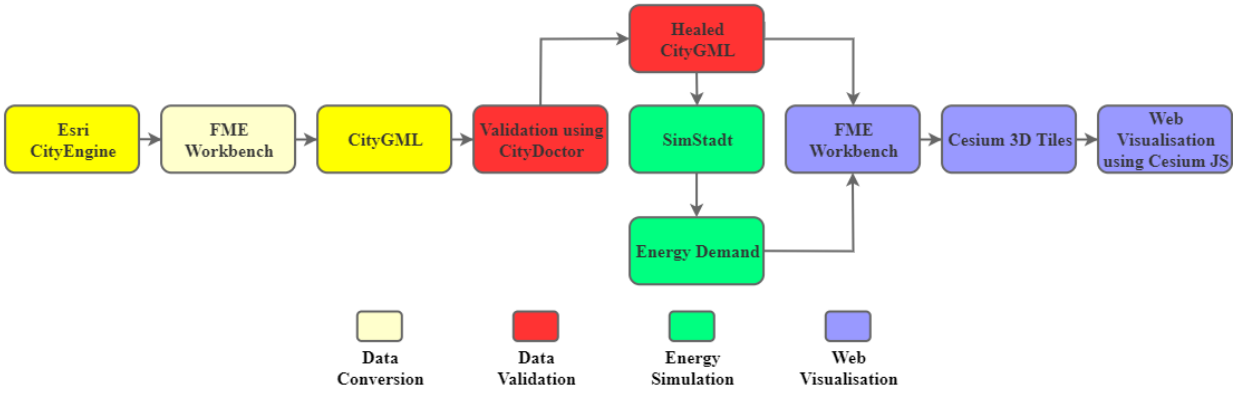


Fig. 9: Workflow Diagram

6 RESULT AND DISCUSSION

6.1 Case Study 1: Gowanus (Brooklyn, New York, USA)

The workflow represented for the use case of Gowanus resulted in the following output

Fig.10: Left figure shows 3D models in Rhinoceros3D, the right figure shows its heating demand visualised on cesium globe

The FME workbench, used to generate the CityGML LoD1 building dataset from Rhinoceros3D data, can be represented as shown below (Fig. 11). Since FME doesn't support the native data format of Rhinoceros3D (.3dm), 3D building models from Rhinoceros3D were exported to COLLADA using inbuilt COLLADA exporter as a first step and were then imported into FME alongside its relevant attribute spreadsheet.

[10] https://doc.arcgis.com/en/cityengine/2019.0/cga/cityengine-cga-introduction.htm

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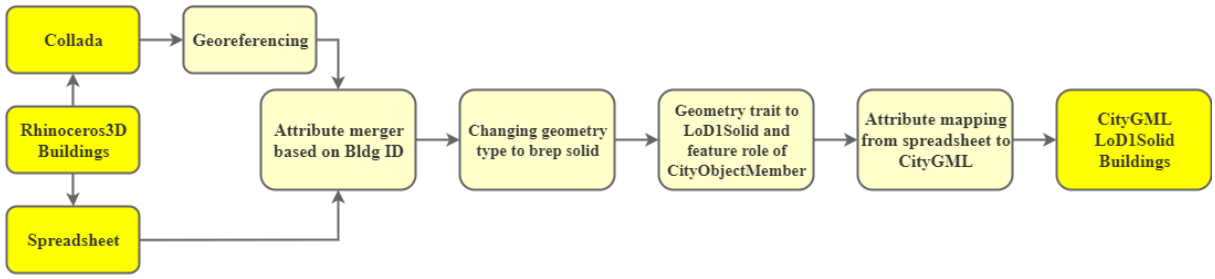

Fig. 11: FME Workbench Diagram

Since the redeveloped 3D scenario of the use case of Gowanus was modelled in a local coordinate system of Rhinoceros3D, georeferencing was done in FME using "3DAffiner" transform. An openly available CityGML dataset of NYC was used as a reference. Alternatively, if no such georeferenced datasets are available for reference, the "EarthAnchorPoint" command in Rhinoceros3D can also be used to georeference the data in the WGS84 spatial reference system. The data can then be projected to the required projected coordinate system using FME. In the case of the Gowanus data, misoriented surface normals of the 3D models were encountered which lead to wrong orientation in Rhinoceros3D and in return, to an incorrect translation into CityGML during the conversion process. In the end, CityDoctor was used to validate the resulting CityGML geometry and to heal wong surface normals. Alternatively, the geometry validator of FME could also be used to perform validation and repair tasks. The healed CityGML dataset was then used for the simulation within SimStadt to compute the heating energy demand of the buildings. Afterwards, the results were again combined with CityGML to visualise them on the web framework CesiumJS[11] by using 3D Tiles.

6.2 Case Study 2: Nordwestbahnhof (Vienna, Austria)

Workflow represented for the use case of Nordwestbahnhof resulted in the following output

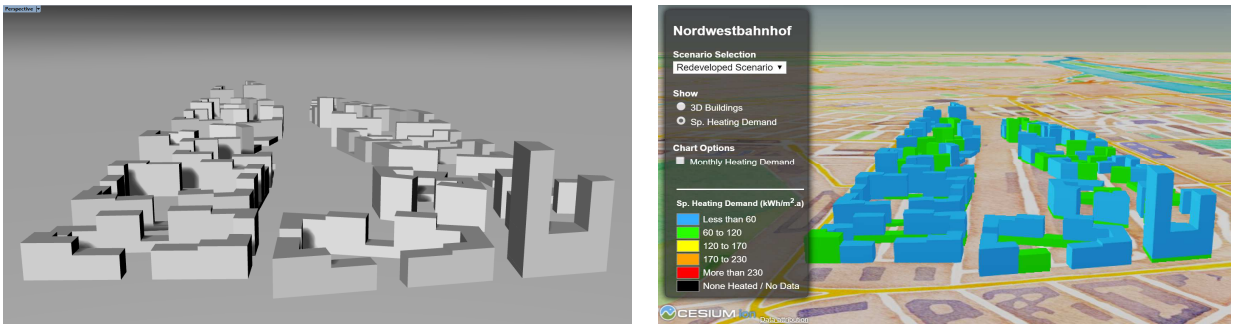

Fig.12: Left figure shows 3D models in Rhinoceros3D, the right figure shows its heating demand visualised on cesium globe

The FME workbench used to generate CityGML LoD1 building with its building part dataset from Rhinoceros3D can be represented as below (Fig. 13).

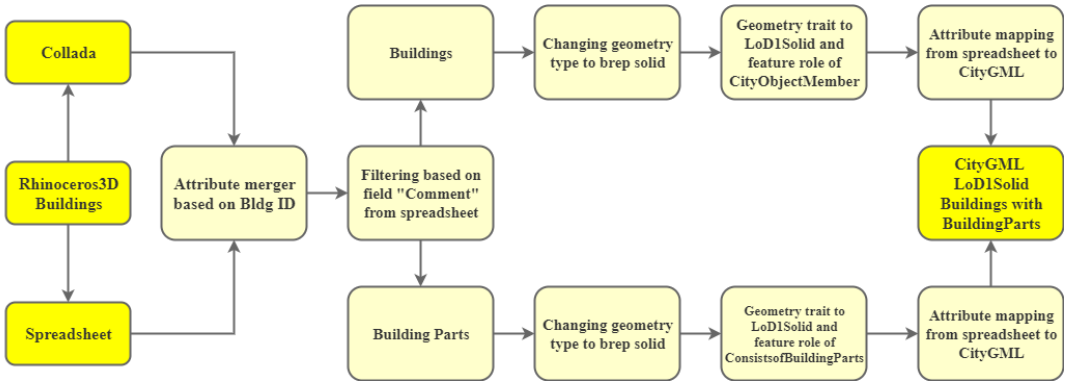

Fig. 13: FME Workbench Diagram

[11] CesiumJS is an open source javascript library used to develop interactive 3D geospatial applications for web.

For the case of Nordwestbahnhof, 3D building geometries in Rhinoceros3D were modelled on top of an imported georeferenced building footprint shapefile. Hence, "3DAffiner", as used in the use case of Gowanus, was not needed. Furthermore, separate geometries with relevant semantics for building parts and integrating them with its related attributes', proved to be an added benefit, particularly during the energy calculations in SimStadt. In this way, heating energy demand for individual building parts within the same building, taking into account different building uses and geometrical appearance, could be calculated.

6.3 Case Study 3: Wienerplatz (Stuttgart, Germany)

Workflow represented for the use case of Wienerplatz resulted in the following output

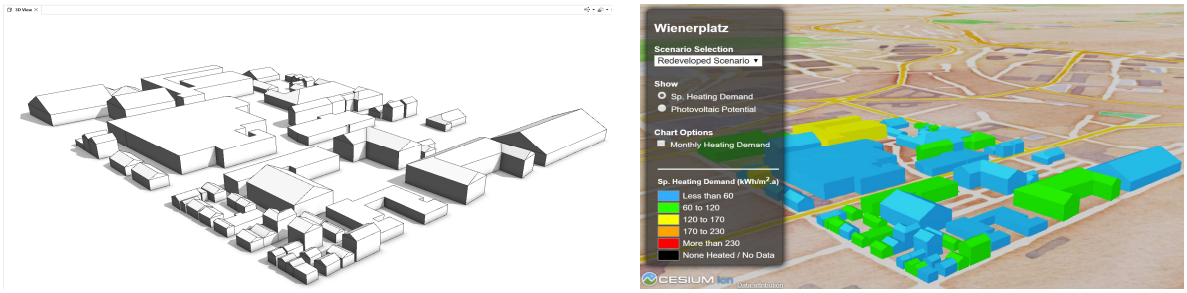

Fig. 14: Left figure shows CityEngine 3D model, the right figure shows its heating demand visualised on cesium globe

The FME workbench used to generate CityGML LoD2 building from Esri CityEngine can be represented as shown below (Fig. 15). As an input to FME, 3D building models from CityEngine were first exported as a 3D multipatch shapefile using its inbuilt shapefile exporter and then imported into FME for further conversion to CityGML.

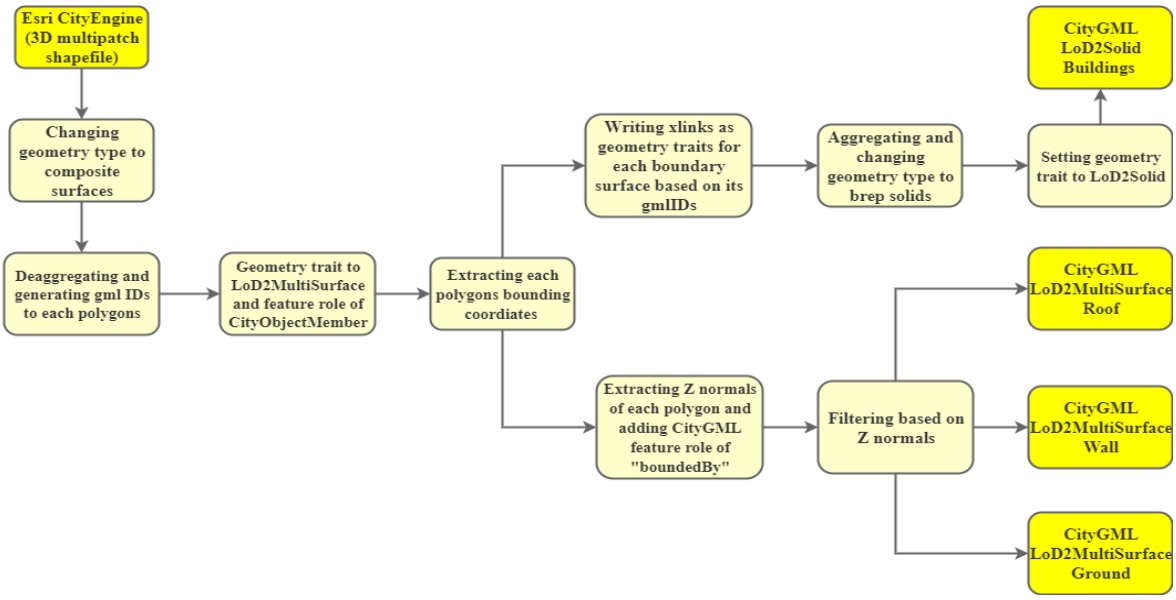

Fig. 15: FME Workbench Diagram

Since LoD2 CityGML building datasets were produced for Wienerplatz, a photovoltaic potential analysis of roof surfaces for individual buildings was also made possible within SimStadt.

As an alternative to the workflow described for Wienerplatz, Esri's data interoperability extension for ArcGIS Pro was also tested. However, the produced CityGML building geometry was defined as a generic city object having a LoD4 multi-surface geometry which was not following the encoding standards of CityGML for LoD2 building datasets. As a result, even though the produced CityGML dataset could have been used for visualisation purposes, it could not be used for heat demand and photovoltaic potential analysis within SimStadt.

A reverse workflow from CityGML to 3D multipatch shapefiles, with integrated heating demand and photovoltaic potential results from SimStadt, is explained by Padsala and Coors (2015) in their article.

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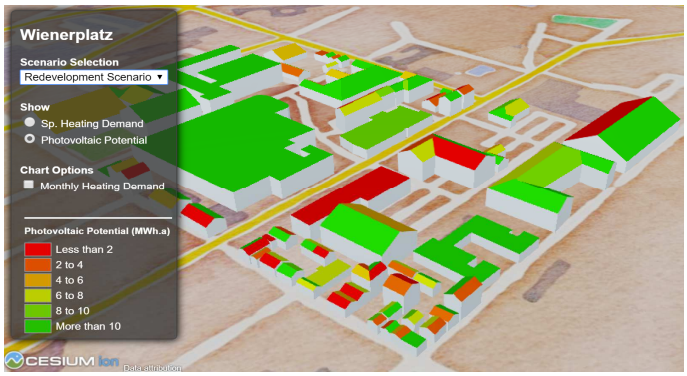

Fig. 16: SimStadt's photovoltaic potential analysis of roof surfaces visualised on cesium globe

7 CONCLUSION

Since 3D city models encoded in the open data format of CityGML are increasingly used for analysis and simulation, it becomes critical that the geometries and semantics are modelled correctly following the encoding standards set by the OGC. Thus, this article sought to identify and explain some of the difficulties and obstacles encountered when implementing data interoperability between commonly used 3D city modelling tools like Rhinoceros3D, Esri CityEngine and CityGML using three use cases as examples. The differences among the use cases lay in the way building geometries were modelled in Rhinoceros 3D for the use case of USA (LoD1 buildings) and Austria (LoD1 buildings with their building parts), while for the use case of Germany, 3D building models were created using Esri's CityEngine. These 3D building models, once converted to CityGML, were then used as an input to the urban energy simulator SimStadt. They were based on the geometry, semantics and other attributes such as building function and year of construction. Buildings were analysed and heating demands, along with photovoltaic potentials of roof surfaces (only in the case study of Germany), were calculated and visualised on the web using CesiumJS. Thus, the method presented in this paper successfully demonstrates one approach were different tools, techniques and data formats used by urban designers, sustainability experts and geospatial pundits can be integrated to deliver joined outcomes that fulfil the targets of a sustainable city and the climate change mitigation and adaptation goals. This forms a starting point in developing an intelligent digital environment that supports informative decisions and facilitates the exchange of information between stakeholders. This investigation also opens further research in data exchange methods for LoD3, LoD4, and BIM-CityGML scenarios which can be further used for analysis and simulations.

8 ACKNOWLEDGEMENTS

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🏆 *reviewed paper*

Geographies of Ageing in Flanders (Belgium)

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1 ABSTRACT

In line with other regions and countries in Europe, Flanders (Belgium) is characterized by an ageing population. The share of population older than 65 will increase from approximately 20 percent in 2018 towards 25 percent in 2030. Of course, this goes together with several challenges, not only related to the sustainability of the healthcare and retirement system, but also in terms of housing, mobility and planning. Although ageing-in-place is stimulated from a policy perspective, there is very limited insight into which neighbourhood characteristics stimulate or limit the possibility to get older at home and if family networks are capable of taking up a bigger role in informal care. Although several indicators point to less potential informal caregivers in the future, a geographical perspective on informal care and the importance of distance in informal care provision are largely lacking. For tackling this a clear view on patterns of ageing can be seen as a precondition. Therefore this paper sheds more light on the relation between ageing-in-place and informal care, both from a theoretical as from a policy perspective. Furthermore it tries to set the scene in terms of geographies of ageing in Flanders on which future research can build. In this way more insight can be gathered in the tensions mentioned above and in factors that can potentially contribute to age-friendly care environments, as well as more insight in neighbourhoods that are suitable for ageing-in-place. In other words, this paper tries to disentangle geographies of aging by following a multiple-scale approach making use of national population databases (2002 – 2017). It looks into patterns of ageing on different spatial scales (ranging from NUTS 2 to statistical districts). The results clearly indicate that there is not a single 'wave' of ageing characterising every locality in the same way. Although regional differences are relatively easy to interpret and straightforward, on a lower level patterns become more complex and less clear. A cluster analysis re-arranges the data in an attempt to get better insight in different ageing profiles on the level of municipalities and statistical districts.

Keywords: Distance, Informal care, Ageing, Flanders, Belgium

2 INTRODUCTION

Although ageing is slowly gaining attention in the fields of geography and urban planning, it is still an under researched and underdeveloped theme. In general there is a lack of insight in the conditions of neighbourhoods or homes that support or limit the possibility to get older at home. The negligence of elderly is not limited to geography and urban planning. There is a need for more trans- or multidisciplinary research when it comes to ageing-in-place (Woolrych & Sixsmith, 2017). Our research is part of a four-year research project in which we try to disentangle the concept of ageing in place and try to enhance our knowledge about this concept from a perspective of geography, architecture and social sciences. The emphasis in the geographical part of the research is focusing on "environment", "distance" and "sustainability". Environment relates in this study to age-friendly neighbourhoods and the presence or lack of facilities and care networks. Sustainability is not only considered from an urban planning perspective, but also from a more social perspective, namely in terms of inclusive space, whereby for example gender relations in care are considered as well. Distance is thereby seen as a relative concept with both a physical and a social component. More specifically, from a geographical perspective, this research project wants to develop a better understanding of the geographical setting when it comes to aging and care relations. In terms of physical distance it aims at getting more insight in distances between older people and adult children as well as patterns of co-residence and how these shift over time (including moving patterns). When it comes to the emotional or social distance, family solidarity and informal networks, as well as characteristics of the living-environment are at stake. In all of the abovementioned aims and goals there will be a specific focus on informal care, due to an increasing importance appointed to this from a policy perspective.

This specific paper aims at presenting a framework for other research(ers) to build upon, by providing more insight in geographies of aging based on general population statistics. Although this sounds like a

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straightforward proces, untill now there is very limited insight and the ageing of the population is often assumed to be more or less evenly spread (with the exception of differences between rural and urban areas). Section 3 focuses on ageing-in-place from a theoretical and general viewpoint, while section 4 looks into ageing-in-place from a policy perspective in Flanders. In section 4 the methodology will be explained in more detail as well as the data used. Section 5 will present the results followed by some reflection as well as desirable next steps in the last section.

3 AGEING-IN-PLACE

3.1 Ageing-in-place: preference or imposed from above?

Ageing-in-place or getting older at home is not something new, although it gets more attention in policy making since the 1990s (Skinner et al., 2015; Wiles et al., 2012; Andrews et al., 2007). Severel reasons can be distinguished. Although it is often seen as a way for the government to stabilize or even decrease the expenses towards the health sector, it is in line with the wish of most elderly people (Wiles et al., 2012; Milligan, 2009; Ahn & Goss, 2006). Although motivated by cost savings the results are at least ambiguous (Huduser, 2013; Graybill et al., 2014). In the American context the so-called 'woodwork effect' is often mentioned (Doty, 2000). This means that people who are not eligible for institutional care will make use of community-based home care, offsetting initial planned cost savings (Weissert & Frederick, 2012), although others do not find such an effect (Berish et al., 2018). Furthermore ageing-in-place can lead to higher costs when needs are not detected in time and certain treatments would have been preventable in an earlier stage (e.g. Horner & Boldy, 2008).

In the European context, the Netherlands provides an example where the long-term (elderly) care system was reformed and became more decentralized and thus largely a responsibility of local municipalities. Institutional care homes saw their roles being changed and were largely closed (Verbeek-Oudijk & Campen, 2017). This is partly a consequence of a decline in the amount of people staying in care homes due to the preference of ageing-in-place (Alders & Schut, 2019), and partly as a consequence of the reforms focused on increasing the financial sustainability of the care system (Maarse & Jeurissen, 2016). However, Alders & Schut (2019b) point to a probable mismatch between supply and demand for institutional care, in the Netherlands as well as in other OECD countries. They stress that although ageing-in-place initially lowers the demand in institutional (residential) care, there will be a bounce back in the demand, especially when it comes to higher-need institutional care. In other words, while there is (currently) an oversupply in low-need institutional care, there will be a (further) lack of supply when it comes to more higher-need care (ibid.).

In practice, this is confirmed by several recent statements of the Association of Dutch Municipalities who are worried about increasing costs for elderly care not only due to a need for expensive facilities for home care (VNG, 2019; 2019b), but also due to a large gap between ageing-in-place and institutional care (VNG, 2020). The commission "Future Care- Independent living at home" published a report 'Old and Independent in 2030' in which this gap is also mentioned combined with an advise to re-consider and revalue collective and semi-collective living arrangement for older people (Dutch Government, 2020). It stresses that independent living should not (always) be understood as 'living longer at home'. This is in line with several researchers who point towards a too narrow or ambiguous definition of ageing-in-place (Martens, 2018). Fret et al. (2018) stress that ageing-in-place in Belgium is not necessarily affordable for everyone and that especially older women, older tenants on the private market and bigger households are at risk. This is confirmed by other researchers (Ewen et al., 2017; Kendig et al., 2010), who also stress that both, in general and for specific groups, care needs are not always easily detectable combined with ageing-in-place (De Witte et al., 2010; Pijpers, 2019).

Even as there are some (very small) recent shifts and developments ageing-in-place is still the main policy mantra in most OECD countries. The foregoing indicates that ageing-in-place is not always the best option – either due to financial troubles or due to a specific care need- but that other options or choices are not always available. Nevertheless, it should be prevented that people are forced to age-in-place and that it becomes too much of a normative framework in which moving to institutional residential care is seen as a failure of both the person itself and policy (e.g. Vasara, 2015). As active ageing is not possible or desirable for everyone (e.g. Golant, 2011; Holstein & Minkler, 2003) the same can be said regarding ageing in place. We should not forget that a home that is not adjusted to older age, can limit the competence and autonomy of elderly people

(Golant, 2011) while an unsafe and non-supporting neighbourhood limits the quality of ageing-in-place (Lee et al., 2017). From this perspective we should ask ourselves if we should stimulate a moving in time framework instead of ageing-in-place (Golant, 2015; De Decker et al., 2018). Therefore, there is a need to look in more detail into the consequences of ageing-in-place and changes in geographies of care and ageing as well as the impact of the neighbourhood and home.

3.2 Ageing-in-place: shifting geographies of (informal) care

It is already stressed implicitly that ageing-in-place is related to changes in care relations, but also with shifts in the localities in which care is provided. Milligan (2009) points to the impact of extramuralisation and the institutionalisation of the home. Ageing-in-place is often combined with more attention and pressure on informal care whereby care is often seen as a shared responsibility. Fret et al. (2018) speak in this respect about the 'socialisation of care', which fits into the broader trend of rolling back or reconfiguring the welfare state. In Flanders this is presented as the so-called 're-communitizing' of care (e.g. Flemish Government, 2016;2016b). Furthermore, the emphasis on informal care is often combined with a decentralisation or re-scaling of governmental care responsibilities (with or without transfer of financial responsibilities) towards regional or local governments. The example of the Netherlands was already mentioned, but also in Japan there is a trend towards community-based integrated care and a decentralisation of responsibilities to make ageing well in place possible (Morikawa, 2014; UNESCAP, 2015). In this 'Community-based Integrated Care system' informal care (of the family and broader society) has an important role to play which is reflected in the core components of the system: self-help (Ji-Jo), mutual aid (Go-Jo), social solidarity care (Kyo-jo) and governmental care (Ko-Jo) (Sudo et al., 2018). Of course one can imagine several consequences, some of them being regional (spatial) differences in care provision and resilience or the care capacity of an community. It is clear that a more decentralised implementation of care leaves room to take the local context better into account and consequently deliver better (integrated) care. The Japanse system can be traced back to a specific rural village, which was characterised by a higher share of older population compared to adjacent regions. It was able to develop and implement a new community-based integrated system which led to less bedridden elderly and lower costs and which was later seen as an example throughout reforms in Japan as a whole (Hatano et al., 2017). On the other hand, it can lead to (even stronger) regional and spatial differences in terms of care provision and supply and discrepancies in (un)met care needs of several groups. Traditionally, several researchers point to differences in acces to health care between urban and rural areas. Dewulf et al. (2013) found through a spatial analysis that mainly rural and suburban areas (in Belgium) are characterized by a shortage of physicians, while the same can be true when it comes to home care provisions (e.g.Mitchell et al., 2006; Allan & Cloutier-Fisher, 2006; Van Noort et al., 2018). At the same time it should be noticed that most research on formal care does not take into account informal care (e.g. Allan & Cloutier-Fisher, 2006). Although some researchers point to the more close-knit network in rural areas, others indicate the higher availability of services in urban areas (e.g. Vanhoof et al., 2018). Therefore, it is difficult to decide which neighbourhood might be the best to age-in-place (Chaudbury et al., 2012). Insights in geographies of aging and movement patterns between parents and children can help to gain more insight in these complexities.

3.2.1 (In)formal care and distance

Although the emphasis on informal care is not completely new – around 58% of care in Europe is informal (Verbeek-Oudijk et al., 2014)- the context changed considerably. We can refer to globalization and related aspects such as increased mobilities, different perceptions of distance, changes in neighborhood compositions, changing family arrangements and individualisation. This can have impact on the identification with a specific place and thus challenge the concept of ageing-in-place, but also on the social network and the possibility to receive informal care (Thómese et al., 2018; Buffel et al.,2018). Some insights can be gained from a broader European perspective, although results are often ambiguous and loaded with uncertainties. Hank (2007) emphasize that 85 percent of all people aged 50+ in Europe have at least one child living within 25 kilometres. Nevertheless, Knijn and Liefbroer (2006) mention that distances below or above 5 kilometres can make a big difference when it comes to exchange of care and support (in the Netherlands). Although there are some indications that a need for care and/or support leads to smaller distances, this is often not in function of the older generation (Michielin & Mulder, 2007). Van Diepen & Mulder (2009) and Mulder & Kalmijn (2016) confirm this, pointing out that distance between parents and

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children is mainly influenced by the presence of grandchildren. Van der Pers & Mulder (2013) show regional differences (in the Netherlands) when it comes to intergenerational proximity, which can be explained by the level of urbanisation and the regional culture. Nevertheless, they stress that, in general, the distance between adult children and parents increases with age. Furthermore an effect is found related to urbanisation: while parents have a bigger change to live close to their children when they live in an urban area, for adult children the chance to live closer to parents is bigger while living in a more rural areas (ibid.).

When discussing the relation between distance and informal care, we should not forget the gender dimension. Blaauboer et al. (2011) found that married couples live closer to the parents of the man, due to a greater importance of the socio-economic position of the man when it comes to locational decisions, which is in line with the male dominance in migration in general. However, when there are young children the distance to the woman's parents is decreasing while the distance to the man's parents remains stable (ibid.). Van der Pers & Mulder (2013) also stress that sons live closer to parents than daughters, although this is less explicit when parents are older. Considering that women in general fulfill more care tasks than men, the results are at least partly surprising and ask for more insight in the relation between informal care and distance. At the same time we should not forget that distances, gender roles and informal care are concepts that can be interpreted in different ways. In some families specific tasks are appointed to women while, in other families, the same tasks are considered as typical for men (e.g. Potting, 2001). The same is true for distance, for some 5 kilometers is already considered a hindrance to provide care, while others are happy to travel 50 kilometres multiple times a week (ibid.). For example, in Flanders there are indications that people with a migration background have a higher tendency for multigenerational living and another interpretation of distance (Draulans & De Tavernier, 2016). In addition it can be mentioned that there is often a too big focus on the primary informal carer, while informal care is often a shared responsibility. This can not only result in an overestimation of the care load of the primary carer, but also in an underestimation of the tasks of others, and men in particular (Potting, 2001), without denying the potential for conflict when care tasks are shared (e.g. Luyten & Emmery, 2016). A lot of people do simply not consider themselves as informal carers, while they actually are (Vandeurzen, 2016b).

Except for the importance of distance, it can be mentioned that the link between formal and informal care (in combination with distance) is not always clear. Verbeek-Oudijk et al. (2014) stress for example that while there are indications that in the Netherlands formal and informal care seems to be complementary, in Germany it seems more justified to consider them as substitutes. Bremer et al. (2017) also found a substitution effect (across Europe), whereby more informal care is connected to a lower demand for formal care services at home among people with dementia. Brandt et al. (2009) find not such an effect and speak about a specialization whereby the state takes care of physical care and children help parents with other less intensive tasks. Although Hank (2007) finds differences across European countries when it comes to familial solidarity, there are no indications that solidarity is declining throughout generations. However, the Dutch case warns us that even though informal care and solidarity may not decline, it does not mean it will automatically fill the gap left behind by a policy that emphasize informal care (Kromhout et al., 2018).

3.3 Ageing-in-place from a health policy perspective in Flanders

Although the focus in this section is on the specific health care policy targeted at the elderly, it should be stressed that the social policy in Flanders, in general, is putting more emphasis on informal care (e.g. Dermaut et al., 2019 – related to care for disabled people) and thereby following the earlier mentioned international trend of reconfiguration of the welfare state. From this perspective, the policy in Flanders can therefore not be seen in isolation from the World Health Organization (WHO) policy and initiatives on the level of the European union. It should be stressed that (elderly) care in Belgium is to a large extent a responsibility of the regions (Walloon region, Flemish region, Brussels Capital region) and that therefore the focus in this section is on Flanders (northern Dutch speaking part). In the Flemish governmental policy agreement it is explicitly mentioned that one tries to stimulate to 'live as long at home or in the neighbourhood'. This is also reflected in the other policy papers, in which it is furthermore stressed that one tries to strengthen the social tissue and cooperation between citizens and (in)formal caregivers (Vandeurzen, 2014). At the same time it is acknowledged that the demand for care will increase due to shrinkages in the social network, which seems to be in contrast with the foregoing. Except for the general health and care policy we can point to a policy paper which specifically focuses on the welfare and care policy for elderly,

and which can be seen as the framework for (future) policy. According to this document the main goal is: "To realize a demand-driven and person-centred care for elderly. Thereby, they are supported by an individual care budget […]" (Flemish Government 2016b:4, translated from Dutch). Furthermore, the vision consists of several core concepts or principles which are considered as starting points for further (local) policy making. Most of them have a strong link with ageing-in-place. It emphasizes the own competences and capabilities of elderly, while it acknowledges a role for the family, community and the government. This comes together in the principle of "vermaatschappelijking" (re-communitizing) in which it is stressed that when someone needs care, this must be provided in the own environment (neighbourhood) and by the 'own environment', being the family, friends and the broader local community.

As a conceptual framework the Flemish policy uses the framework as proposed by the WHO (2015) (figure 1). This framework consist of several concentric circles in which the previously mentioned principles are used. It illustrates that the person with a care need can be seen as a focus, whereby care needs are a shared responsibility between the family, the community and the government, which cannot be separated from each other and are embedded in a specific context. This context has to provide a universally accessible, person-centred and integrated care and support system. Of course this implies a holistic view on ageing, whereby it is also necessary to take into account the living environment and stress interdisciplinary cooperation. It is therefore not surprising that these aspects are reflected by the 15 objectives (or so-called) perspectives which are described in the Flemish policy paper.

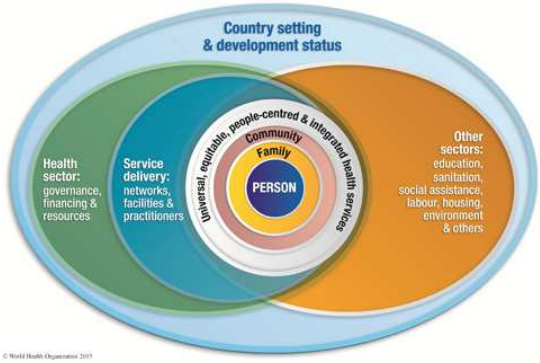

Figure 1 Conceptual framemework person-centred and integrated care and support (WHO, 2015: 13)

Besides the fact that the objectives remain very abstract, most of them relate to the activation or stimulation of social participation, self-development and ageing in the own environment. Although it is mentioned that both, the house as the neighbourhood, need to be suitable and adjusted, very little attention is paid to this. Nevertheless, several other policy documents look into this in (slightly) more detail. First of all it is useful to consider the policy on residential elderly care, even when focusing on ageing-in-place. It should be stressed that only elderly with the highest care needs are admitted to residential care settings, which means that on average more care and expertise is needed to fulfill the needs of the inhabitants, compared to a situation in which also elderly with a lower care profile are admitted to these facilities. Nevertheless, the residential care facilities are evolving into a kind of local care hub in which expertise is also related to for example day care or respite care and functioning as an important link within the primary health care (Flemish Government, 2017). It is stressed that a residential care facility is and should be part of the society and is not to be considered as something closed. In line with this, residential care facilities are an important link between the different kind of housing and care options. The activation and strengthening of the social network(s) is consequently seen as an important role for these facilities as well. They should contribute towards the liveability and social cohesion in the neighbourhood and thus contribute to a neighbourhood-centred approach on housing and care with the end goal of creating "lively and careful neighbourhoods" (ibid.).

The Flemish Government (2017b) listed some transition priorities in their 'vision 2050' one of them being 'care and living together'. In this, the two concepts of 'social cohesion' and 'vermaatschappelijking' are at the core. The latter is defined as: "the shift in the care sector which aims to give people with disabilities, the chronically ill, and frail elderly their own position in the society, and support them and deliver the care as integrated as much in the society" (Flemish Government, 2017b:3). Thereby it is mentioned that (specialized) institutional care should be the exception and that self-care, family care and informal care will receive priority. Although it is mentioned that this priority should be considered as interdisciplinary and thus

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beyond the departments of welfare, health, culture and sport, the link or referencing towards other disciplines and departments seems to be rather limited. The importance of 'health in all policies' is stressed but no explicit link with urban planning or housing and attention to age-friendly environments is lacking. Even the policy paper which is explicitly focused on neighbourhoods: "Caring Neighbourhoods" (Vandeurzen, 2018) remains abstract and vague and does not mention explicit measures or goals. It rather tries to spark a discussion on the role of the neighbourhood and which factors can contribute to the so-called caring neighbourhoods.

As became clear from the foregoing, the focus on informal and family care is increasing. 'Shared responsibility' and 're-communitizing' can be seen as the keywords. But as mentioned before, this cannot simply be an assumption and thus requires an extensive and well-balanced policy towards informal care. At the same time and as mentioned before, there is often a lack of information related to informal care, especially when it comes to distance. The most important policy document in this respect is the so-called 'Flemish Family Care plan' (Vlaams Mantelzorgplan – Vandeurzen, 2016b) in which the focus is explicitly on family care. Several broader demographic and social changes are mentioned influencing the demand and supply for informal family care. Thereby it is mentioned that distances are getting bigger, although this is a mere assumption not supported by data. Most data about family carers is based on the so-called 'social-cultural shifting' surveys (2014, in Vandeurzen, 2016b) and on numbers of officially registered family carers, as well as the 'health survey'(2013, in Vandeurzen, 2016b). The latter for example concludes that 8 percent of people (15+) provide informal care at least once a week. Based on the SCV-surveys and registered family carers it becomes clear that most informal family carers are between 45 and 64 years old, although the share of older people providing care should not be underestimated. In general, there are more female informal carers, which is especially true when it comes to persons with heavy care needs. Regarding the socio-economic position it is mentioned that informal family carers, in general, have a lower labour participation and educational level. Although most informal family carers fulfill care tasks in the own household or family, slightly less than one fifth of the care is provided to neighbours or friends. More than half of the informal family carers living in the same household are over 65, which implies providing care to a spouse. This is often done to prevent a move to a residential care facility, which is reflected in a stronger intensity in the informal care provided (Vermeulen & Declerq, 2011 in Vandeurzen 2016b). That there is a need for additional attention for informal carers is also illustrated by Bronselaer et al. (2016) who stress that the quality of life of informal family carers is lower than average. It is therefore not surprisingly that "supporting informal family carers to limit the burden and increase the capacity" is one of the main policy goals, as well as "acknowledging and recognizing informal family carers" and "improving the cooperation between formal and informal carers". It is acknowledged that better information provision for informal carers is needed, as well as a pro-active stance to reach them. The stimulation of social cohesion and adjustments to home are mentioned as well, as is the focus on digital health and care. Furthermore it stresses that the informal carer should be seen as a fully acknowledged actor in the care system, which means that there is need for a better integration.

3.4 Ageing-in-place from a housing and spatial policy perspective in Flanders

Although, from a health perspective, it is acknowledged that there should be a more interdisciplinary approach towards aging, and the importance of housing is often briefly mentioned, we cannot speak about a real integrated policy perspective. The same can be said when we look in more detail into the housing and planning policy in Flanders. In general it can be mentioned that there is very little attention being paid to the elderly when it comes to housing. Although there is a strategic goal related to quality, sustainability and a tailor made housing offer, whereby there is a reference towards the extramuralisation of care and demographic change, no specific or tangible measures are mentioned (Homans, 2014). Not much is mentioned about adjustments of the housing stocks for older people or policy related to this. Also when it comes to communal living or other housing alternatives there is barely attention for the elderly. This is especially surprising since it is acknowledged that there is a discrepancy between supply and demand on the housing market. Most properties which are available on the market are larger suburban houses which are not suitable for most elderly. The aim is to come to a better balance on the housing market and at the same time stimulate housing mobility. Thereby, it is stressed that living in the same home during the complete life course is often not the best solution (Agentschap Wonen, 2018). Stimulating housing mobility is also something which is stressed in the policy paper "intelligent housing and living". In this document 4 pillars

are distinguished: sustainable homes and environments, the right location, fulfilment of the needs and wishes, influencing and trying to shift the ideal picture of living (from a detached house with a garden towards more compact living arrangements). It is for example stressed that there is a need for more flexible, compact, and multi-functional arrangements, specifically at well-connected locations, whereby the link with spatial planning is mentioned. There are high expectations with regard to technological developments which are seen as a transversal innovation. Nevertheless, also when it comes to this policy paper there are no concrete measures or objectives. It aims at creating a platform where several policy domains can discuss future challenges and start some experiments (Agentschap Wonen, 2017).

When it comes to the spatial planning policy there is barely attention for the needs of the elderly. Belgium is characterised by a high level of urban sprawl and spatial fragmentation (ribbon development). This is especially true in Flanders with a population density of more than 450 inhabitants per square kilometre (Verbeek & Tempels, 2016). Flanders and Belgium in general are considered to have one of the highest levels of urban sprawl in Europe (EEA, 2016). Furthermore, the level of sprawl is still increasing, partly due to path dependency (EEA, 2016; De Decker, 2011). Verbeek et al. (2014) stress for example that the length of ribbon development increased considerably between 1989 and 2012. Poelmans & Engelen (2014) stress that the additional net land take per day is around 6 hectare. Nevertheless, and as mentioned in an earlier paper (Gruijthuijsen et al., 2018) the Flemish policy is focused on limiting additional land take by focusing on concentration, increasing the spatial yield, increasing densities and stimulate multifunctional and mixed land-use and interweaving of activities. In other words, it is aiming at a more sustainable management of land, whereby the aim is to avoid additional land take altogether in 2040 (Departement Ruimte Vlaanderen, 2018). Thereby it should be stressed that it is still only limited to a strategic vision, and no decrees were yet agreed on or adopted, which means no changes are visible at the moment.

And although the potential shift in spatial planning means there are possibilities to limit the sprawl and sustain or create more open space and benefit for example from shrinkage in certain localities (Segers et al., 2020), there are also potential conflicts between the spatial policy on the one hand and the health policy on the other hand, especially when one takes into account the needs and capabilities of elderly. A strong concentration of facilities in well-connected localities can result in a limited acces to facilities for the elderly which not seldom live in suburban areas characterised by a strong sprawl. Cant (2019) for example shows that there are so-called 'food-desert' detectable in Flanders, in particular in suburban localities with an increasing share of older inhabitants. The same is probably true when it comes to formal care facilities, which makes it even more important to get insight in the relation between informal care and distance and if informal care can bridge spatial developments and compensate for a lack of facilities. Furthermore, it is conceivable that a lack of facilities not only limit the possibilities for formal care, but also complicates informal care provision and is therefore not always stimulating or facilitating ageing-in-place. There is need for strategic cooperation between different policy domains, and this requires more insight into geographies of ageing and care. This not only true when it comes to planning on the national, regional or provincial level, but also when it comes to the neighbourhood.

There is in general a lack of insight into the factors that can contribute to an age-friendly environment (e.g. Scharlach, 2017; Hwang, 2017). There are some initiatives in the right direction such as the WHO Age-Friendly Cities – which also list up several indicators, but no Belgian municipality is part of this initiative which also indicates a lack of attention at the local level. According to Scharlach (2017) these initiatives often neglect the more dynamic relation between the person and the environment. Furthermore, there is limited (academic) evidence for the effectiveness of these initiatives. Sun et al (2018) stress that even when it goes about the person-environment fit, this is often limited to housing and thus neglecting the neighbourhood. Greenfield et al. (2019) therefore bring the term 'community gerontology' to the forefront. They argue that much of the research is either focused on the macro-level (housing policy) or on the micro-level (house), while the meso-level is largely neglected. And this is true for the case of Flanders. There is very limited information about for example the relationship between neighbourhood or environmental characteristics and formal and informal care. Vandenboer et al. (2010) and Demaerschalck et al. (2012) can be mentioned as exceptions. They conclude that municipal characteristics have no influence on informal care. Contrary to the expectation, the offer of formal care is not influencing the use of informal care, although a higher use of formal care can be noticed. Besides, they conclude that the higher the ratio of the population older than 80 compared to the population of 50 – 59 years, the higher the chance to use formal

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care. In other words, the less potential caregivers, the higher the usage of formal carers (Vandenboer et al., 2010; Demaerschalck et al., 2012). As will be illustrated later, this ratio is increasing, which means that it is likely that there will be an even bigger pressure on informal caregiving in conjunction with the current health policy. This also makes it more relevant to look into geographies of ageing.

4 METHODOLOGY AND APPROACH

As mentioned in the introduction we used general population statistics to get more insight in geographies of aging (and care) and demographic developments. The focus is on ageing, both the share of elderly in the general population as well as ratios between older people and for example the working population or the population that traditionally provides most care. In total around a dozen of ratios were used, based on common definitions (e.g. Statistics Belgium, 2019) of which the following can be considered the most important:

1) Ageing: Population aged 65 or above in % of total population

2) Silvering: Population aged 80 or above in % of total population

3) Old age dependency ratio: Population aged 65 or above compared to the population between 20 and 64

4) Family care ratio: The ratio between the population with the biggest care needs and the population that provide most informal care: population aged 80 or above compared to the population aged between 50 and 59.

The data we used is received from Statistics Belgium and relates to the period between 2002 and 2017 (Algemene Directie Statistiek – Statistics Belgium, 2019). Calculations are made by making use of Excel and SPSS and visualized by making use of ArcGis. With regard to the visualization we used the authentic source of the Belgian administrative borders (FOD Financien, 2019). It concerns the version of 2018 due to merging of some municipalities in 2019.

As a first step we visualized several of these shares and ratios for both Flanders, Walloon and Brussels Capital Region and looked into general patterns. At first instance we did this on both the spatial level of the provinces (NUTS 2) and the administrative regions (NUTS 3). Afterwards, we tried to discover more fine-grained and detailed ageing patterns at the level of the municipalities and statistical districts (being the level of the neighbourhood). In this paper we will show a very limited selection of this, focused on Flanders. Thereby, we interpreted the results mainly based on visual aspects combined with some descriptive statistics.

As a second step we used cluster analysis to get more insight in different ageing profiles across both administrative regions, municipalities and statistical districts. In this paper we will mainly focus on the latter. For identifying the clusters we used both ArcMap (Spatial Statistics Toolbox) and SPSS. We mainly used K-means clustering and the two-step cluster method. K-means clustering divides a data set in several clusters and attempts to minimize the difference within a cluster, while the difference between clusters is maximized (Heremans, 2001). This method comes with several drawbacks, the most important being that the results depend on the chosen parameters and pre-defined number of clusters. Therefore, we used other clustering methods to get better insight in the optimized amount of clusters through this method. Furthermore, we worked with standardised scores (Z-score) to circumvent the sensibility of the method for measurements on different measurement levels. An advantage of this method is that it can handle large datasets, although only on ratio or interval level. The two-step cluster method can also handle categorical variables and is thus mainly used when it comes to enrichment with for example urbanization typologies or other datasets. This method pre-clusters data in a first step before carrying out a conventional hierarchical cluster analysis (e.g. Norusis, 2011). Another advantage is that it automatically select the optimal number of clusters. Although the method assumes that variables are not strongly correlated and are normally distributed, a lack of this does not seem to influence the robustness of the method, whereby an interpretation can give the decisive answer (ibid.). It is mainly in the third step that we make use of this method. After the identification of the initial cluster based on only demographic data, the third step tries to enrich the results. In this paper we will only focus on the level of urbanization, but several other enrichments will be possible as well, depending on the research goal. To name an example, we compared some results from the first step with the availability of facilities, in which there are indications that the municipalities with the highest level of ageing do not necessarily have the best facilities for the elderly, something which will also be possible to relate the different clusters.

5 INSIGHTS IN GEOGRAPHIES OF AGING

The first step and visualization of different demographic ratios informs us already that there are several differences visible across Belgium, both on the regional level (Flanders, Walloon, Brussels Capital Region) (see figure 2), but also on the level of provinces and municipalities (figures 3 and 4). Figure 2 shows that the ageing of the population increased, although not uniform across the country. Although the differeces between the regions were relative small in 2001, we can notice that there was not an uniform path towards ageing across the country. While in Belgium the share of population older than 65 increased from 16,9% in 2002 towards 18,7% in 2018, in Brussels Capital region it decreased from 16,5% towards 13,2%. In Flanders the increase (from 16,9% to 20,0%) was larger than in the other regions. In Flanders differences between provinces can be detected. Figure 2 shows that even though in all provinces the level of ageing is stronger than in Belgium as a whole, there is one province where the level is considerable higher than the others and is characterised by a stronger growth. In West-Flanders, the share of population aged 65 or above evolved from 18,3% in 2002 towards 23,0% in 2017. When looking into a lower spatial level and by visualizing the data per municipality (figure 3 & 4), we see again considerable differences. It becomes clear that especially at the seaside there is high level of ageing (already in 2002) as well as a relatively large growth in the period 2002 – 2017, while in other municipalities in the same province the share of people aged 65 or above even decreased during that period. This is not surprisingly since the seaside is traditionally an area which is characterised by retirement migration (e.g. Provincie West-Vlaanderen, 2017). The pattern becomes even more complex when looking into the more detailed and lower level of the statistical districts (not shown), where for example at the seaside it is noticeable that ageing is mainly located at the direct seaside and already more limited in the direct hinterland.

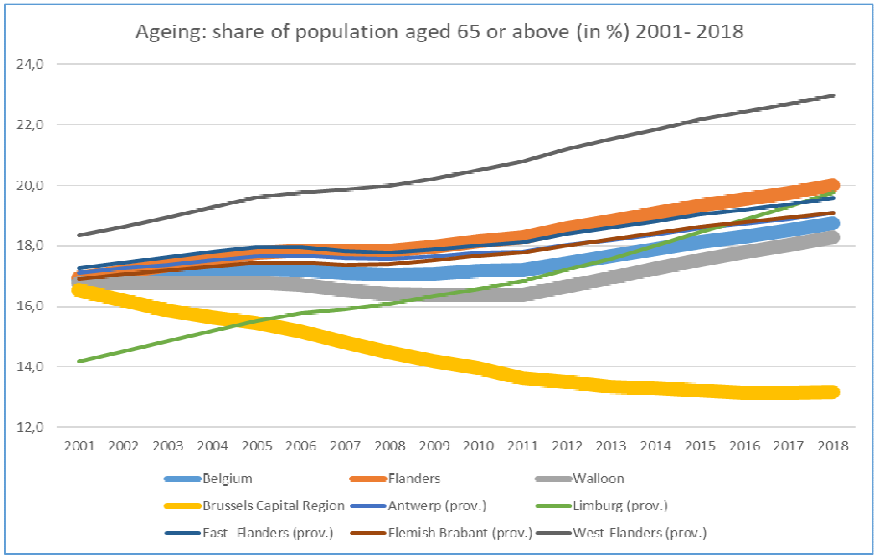

Figure 2: Ageing per region and province in Belgium, 2001 - 2018

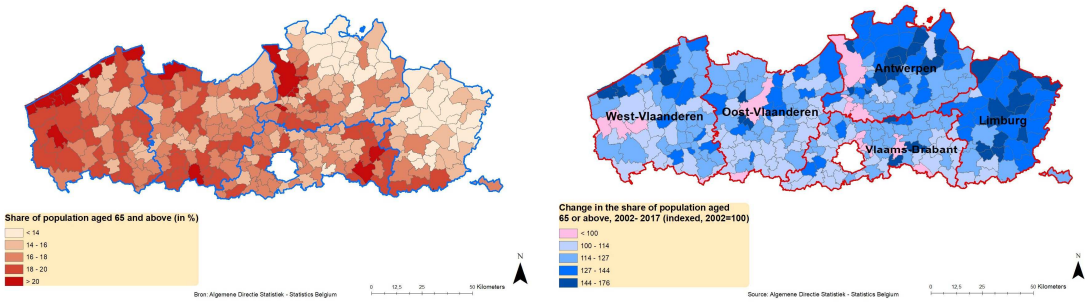

Figure 3: Ageing in Flanders, 2002, Figure 4: Indexed numbers ageing, 2017 compared to 2002, per municipality, Flanders

Figure 4 shows furthermore that especially the eastern parts of Flanders (especially in Limburg and some parts of Antwerp) are characterized by a relatively strong growth during the period 2002- 2017. This is partly the consequence of a catch-up since figure 3 shows that exactly these areas were characterized by a lower level of aging in 2002. Moreover, most of the municipalities in these regions are still being characterized by a lower level of ageing compared to average (not shown). This lower starting position in

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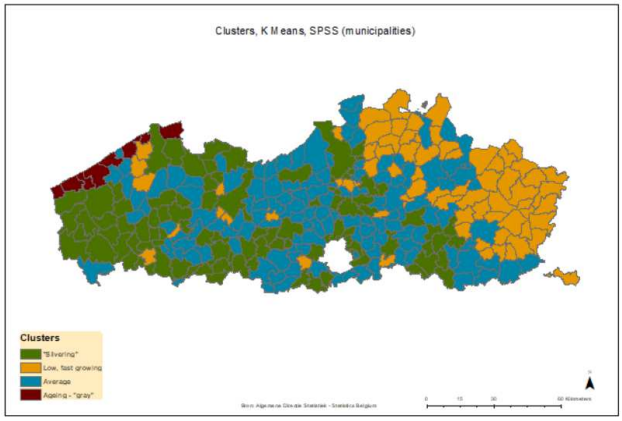
2002 can mainly be explained by labour migration in the period after World War II resulting in a younger population. The contrast between on the one hand the western part of Flanders and on the other hand the eastern part of Flanders, is something that is also reflected when we look into other ratios. In general, it can be mentioned that based on these visual interpretation of patterns some dynamics become visible as well as some indications of the existence of spatial clusters (e.g. based on a high level or a fast(er) growth). Although the figures above do only relate to ageing, it is interesting to reflect as well on for example the so-called family care ratio (population aged 80 or above compared to the population between 50- 59). Thereby it can be stated that also this ratio is higher in the western part of Flanders, while the eastern part is characterised by a strong(er) growth. However, also in this case patterns become more complex on a lower spatial level. We should furthermore not forget that the consequences of this ratio can differ between both urban and rural regions, but also between regions which already adjusted to this reality compared to regions who are characterised by a more recent growth (and decline in potential informal carers). This points to the need to get for example more insight in distances between parents and children and residential movements.



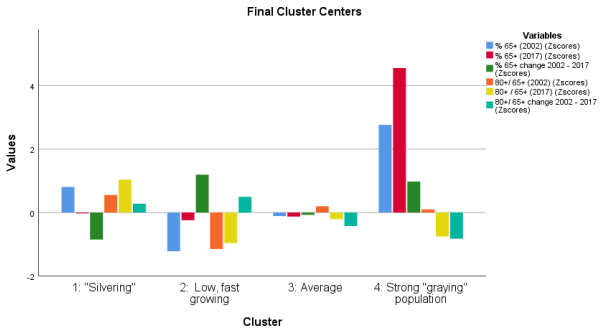


Figure 5: K-Means clustering (demographic ratios), municipalities, Flanders . Figure 6: Clusters (municipalities)

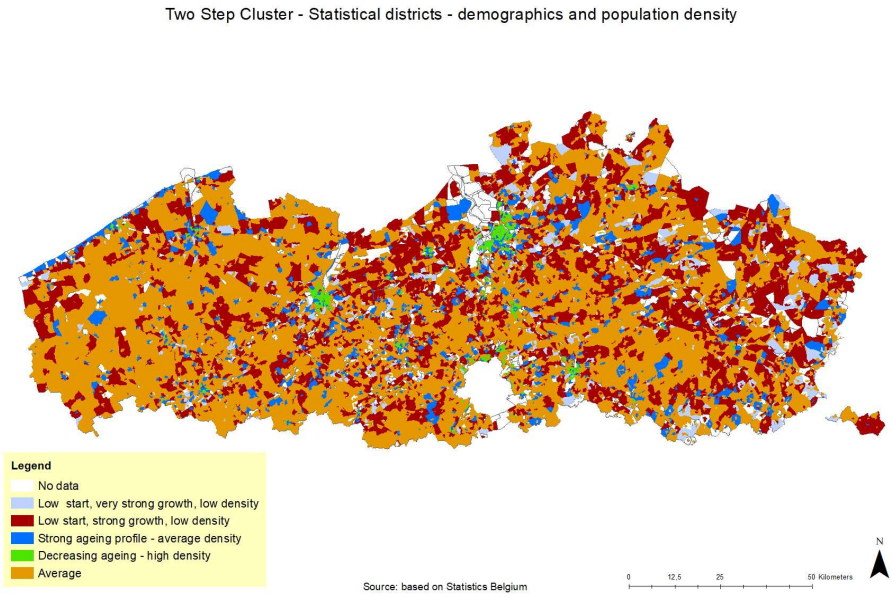


Figure 7: Two-step cluster approach relating to statistical districts and making use of demographics and population density

As a second step a K-means cluster approach was used to divide the municipalities (n=308) based on their ageing profile. Thereby we made use of the share of population older than 65 (in 2002, 2017 and the growth between 2002- 2017) and the share of the oldest old compared to the older population (in 2002, 2017 and the growth between 2002 – 2017). Thereby we identified four clusters, which partly relate to the results and insights described in the foregoing. First of all, a small cluster of municipalities at the seaside are identified as localities with a high level of ageing (n=8), while mainly in the eastern part of Flanders we see a concentration of municipalities who can be considered as being characterized by a relatively low level in 2002 but a fast growth level (n=71). However, most municipalities (n=131) can be characterized as having

an average ageing profile. The remaining ones (n=98) are characterized especially by a high level of inhabitants older than 80 years, while the level of ageing (65+) is decreasing. This is for example the case in large cities, which were traditionally characterised by an older population but have seen an influx of younger population and migrants. But also several rural municipalities show the same development. In other words, more insights are needed in for example the impact of population densities and levels of urbanization.

As an example of the third step, figure 7 shows a cluster approach whereby we took into account the population density, this time on the level of the neighbourhood (statistical district). Although figure 8 shows us that further refinements in terms of clusters are desirable, the results are nevertheless interesting. Except for a further subdivision, the demographic characteristics of the clusters itself are not that much different from the ones identified in figure 5. However, it is clearly visible that the pattern on a lower spatial level is much more complex. Furthermore, the (larger) urban areas (e.g. Antwerp, Ghent, Mechelen, Leuven) are clearly defined as a specific cluster characterized by a high population density and a level of ageing which decreased between 2002 and 2017.

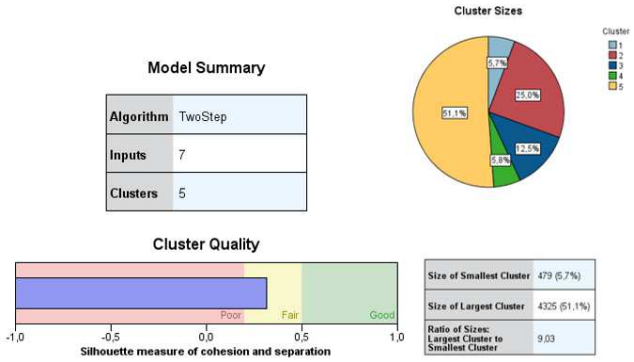


Figure 8: Model summary related to figure 7

6 DISCUSSION AND CONCLUSION: TOWARDS NEXT STEPS

This paper started with pointing towards the need to get more insight in geographies of ageing and care which are too often neglected or downplayed. More insight is needed to support ageing-in-place and better define the environmental characteristics that stimulate this. Although ageing-in-place is stimulated from a policy perspective it is often not clear if for example (potential) informal care is available in every region. The aim of the paper was to present a framework or starting point for research into these aspects and stimulate better integrated policy making, as well as research into informal care related to ageing-in-place. To realize this we used macrodata obtained from the statistical office to visualize several demographic ratios throughout the period 2002 – 2017. Based on these visualizations we could already confirm the existence of 'geographies of ageing' and differences across spatial scales. On a higher spatial scale differences in ageing are relatively easy to explain by migration patterns and residential movements, while on the level of the neighbourhood patterns are more complex and less straightforward. Therefore, we carried out several cluster analysis to emphasize more fine-grained and detailed ageing patterns at several spatial levels, in which we also took into account the population density.

Further research can for example compare and/or enrich the results with aspects such as formal care facilities, retail activities and mobilities and transport. Although macrodata (aggregated) can already give improved insight into geographies of ageing and care, there is need for making use of microdata to get more detailed patterns and insights in residential movements and distances. This is especially true in a context in which informal care is more and more emphasized. In Flanders there is a lack of information about for example distances between parents and children and if informal care can compensate for the (potential) decline in formal care. Microdata can be useful here, also to see regional differences in this respect, as well as how distances between family members evolve over time. It will also enable to us to look into gender differences when it comes to distances, as well as potential biases in clusters for which macrodata is not suitable. Furthermore, as informal care and distances are relative concepts, qualitative research can shed light on the negotiating of distances and informal care, and enhance our knowledge about ageing-in-place, also by complementing quantitative approaches to interpret patterns.

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🏆 *reviewed paper*

Grätzlrad Wien: Nutzerinnen- und Nutzerstruktur und Nutzungsverhalten in host-basiertem Lastenrad-Sharing

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1 ABSTRACT

Lastenräder, die insbesondere in urbanen Räumen eine umweltfreundliche Transportalternative zum motorisierten Individualverkehr gelten, sind bisher jedoch ein Nischenprodukt. Das Teilen (Sharing) von Transporträdern bietet die Chance, einige der Nutzungshürden zu überwinden. Neben der damit möglichen Umgehung der relativ hohen Anschaffungskosten wird damit auch eine Möglichkeit zum Ausprobieren von Transporträdern geschaffen. Die dadurch gesammelten Erfahrungen zu den Einsatzmöglichkeiten bilden eine wichtige Grundlage für die Intention zur künftigen Nutzung von Lastenrädern.

In host-basierten Systemen übernehmen in der Regel lokale Kleinbetriebe (z. B. Gastronomie, Einzelhandel) Wartung und Verleih der Räder. Beim Projekt Grätzlrad in Wien erhielten zehn Unternehmen bzw. Organisationen eine hohe Förderung für die Anschaffung eines Transportrades unter der Bedingung, dieses für mindestens zwei Jahre kostenfrei interessierten Nutzerinnen und Nutzern zur Verfügung zu stellen. Gegen Ende dieser zwei Jahre fand eine Evaluierung des Projekts statt, die unter anderem eine Auswertung von Reservierungsdaten und eine Befragung der Nutzerinnen und Nutzer umfasste.

Im Betrachtungszeitraum der ersten 18 Monate des Bestehens des Grätzlrad-Angebots fanden rund 1600 Ausleihen statt. Umweltfreundlichkeit, Fahrspaß und das Ausprobieren neuer Transportmittel stellen wesentliche Gründe für die Nutzung von Transporträdern dar. Die Struktur der Nutzerinnen und Nutzer weicht von der Gesamtbevölkerung deutlich ab, was sich insbesondere in einem sehr hohen Bildungsgrad und einer großen Bedeutung von Fahrrädern für die persönliche Mobilität äußert. Dennoch nutzte der überwiegende Teil zum ersten Mal ein Lastenrad, was den Stellenwert derartiger Programme zum Kennenlernen dieser Transportoption unterstreicht. Im Beitrag werden Erkenntnisse zu (1) räumlicher und zeitlicher Verteilung der Ausleihen, (2) Einsatzzwecken der Lastenräder und (3) verkehrliche Wirkungen des Angebots vorgestellt sowie Implikationen für die Förderung von deren weiteren Verbreitung diskutiert.

Keywords: Evaluierung, Sharing, Lastenrad, host-basiert, Verkehr

2 LASTENRÄDER

Lastenräder (auch Transporträder) sind Fahrräder, deren Bauform für den Transport größerer Lasten und Volumina optimiert ist. Viele Modelle sind auch für Personentransporte (insbesondere Kinder) geeignet. Die Nutzlast beträgt bist zu 500 Kilogramm, wobei Transporträder für die Privatnutzung üblicherweise Transporte von bis zu 100 Kilogramm aufnehmen können (Becker & Rudolf, 2018a; Hagen, Lobo & Mendonça, 2013; IRALA, 2017; Masterson, 2017; Riehle, 2012; Riggs & Schwartz, 2018; Weirich, 2012) Der Übergang zwischen herkömmlichen Fahrrädern und Lastenrädern ist fließend. Für eine klare Abgrenzung werden in der Regel nur Fahrräder mit mindestens 50 Kilogramm Nutzlast zu den Lastenrädern gezählt (Riehle, 2012).

Lastenräder gibt es in einer Vielzahl verschiedener Bauformen, die noch durch ein Zahl von Sonderanfertigungen sowie Rädern mit experimentellem Charakter ergänzt werden. Wesentliche Unterscheidungsmerkmale sind die Anzahl der Räder und die Position der Ladefläche im Verhältnis zu dem/der Fahrerin oder Fahrer. Obwohl es grundsätzlich eine große Zahl an Bauweisen gibt, kommen für die nicht-gewerbliche Nutzung im Wesentlichen nur vier Typen zum Einsatz: (1) Bäckerrad, (2) Longtail, (3) Long John und (4) Bakfiets (nicht zu Verwechseln mit dem gleichnamigen Hersteller) (Ghebrezgiabiher & Poscher-Mika, 2018). Die einzelnen Modelltypen sind schematisch in Abbildung 1 dargestellt. Die einzelnen Bauformen sind mit Stärken und Schwächen in Bezug auf Nutzungseigenschaften wie Fahrverhalten, Nutzlast, Leergewicht, Höhe des Schwerpunktes oder Stehenbleiben und Abstellen verbunden. Die Eignung der einzelnen Typen ist deshalb insbesondere im Kontext des Einsatzbereiches zu sehen (Becker & Rudolf, 2018b; Ghebrezgiabiher & Poscher-Mika, 2018; Gruber & Rudolph, 2016; Rüdiger, Kopka Jan-Philip & Hohaus, 2016).

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Zu den typischen Ausstattungsmerkmalen von Transporträdern zählt die elektrische Antriebsunterstützung, die bei den meisten Modellen optional angeboten wird. Zudem kann man insbesondere bei Long John- und Bakfiets-Modellen zwischen verschiedenen Transportaufbauten wählen, zu denen in der Regel eine für den Kindertransport optimierte Kiste und eine verschließbare Box für Gütertransporte zählen (Ghebrezgiabiher & Poscher-Mika, 2018; Riehle, 2012).

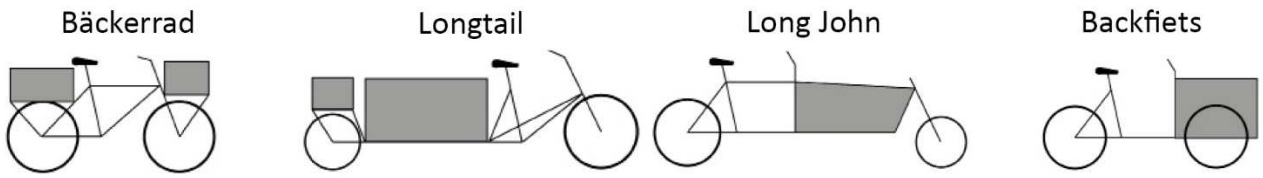

Abbildung 1: Überblick über weit verbreitete Bauweisen von Lastenrädern anhand gängiger Klassifizierungsmerkmale

3 LASTENRAD-SHARING

Durch die Möglichkeit größere Gegenstände bzw. Mengen sowie Kinder zu transportieren, bieten sich Lastenräder als Alternative zum motorisierten Individualverkehr an. Damit können sie einen erheblichen Beitrag zur Reduktion von Luftschadstoff- und Treibhausgasemissionen leisten. Dennoch stellen Transporträder bisher ein Nischenprodukt dar. Zu den wesentlichen Nutzungsbarrieren zählen die geringe Bekanntheit und die hohen Anschaffungskosten.

Lastenrad-Sharing ermöglicht die Verwendung von Transporträdern ohne dass eine Eigentumsübertragung stattfindet. Daraus ergeben sich auf drei Weisen verkehrliche und damit auch ökologische Wirkungen: (1) durch die niederschwellige Verfügbarkeit werden Fahrten mit anderen Verkehrsmitteln ersetzt und (2) Interessierte erhalten die Möglichkeit sich damit vertraut zu machen, was Basis für wiederholte Nutzungen oder eine Anschaffung sein kann. (3) Letztlich sind Transporträder dadurch vermehrt im Öffentlichen Raum sichtbar (entweder an den Verleihorten oder wenn diese genutzt werden), was zur Verankerung dieses Verkehrsmittels im Bewusstsein beiträgt.

3.1 Angebotsformen

Das Angebot im Bereich Lastenrad-Sharing ist derzeit durch eine große Zahl relativ kleiner Initiativen geprägt. Neben Angeboten, die nur einem geschlossenen Nutzendenkreis zur Verfügung stehen (z. B. geschlossenes Lastenrad-Sharing in Wohnausanlagen, Testnutzungsprogramme für Unternehmen, Leih-Lastenräder von Handelsketten), gibt es auch verschiedene Varianten von Lastenrad-Sharing, die der Allgemeinheit offen stehen.

Bei Öffentlichen Lastenradverleihsystemen erfolgt die Ausleihe an fixen Stationen im Selbstbedienungsbetrieb, die Rückgabe ist in der Regel an jeder anderen Station im System möglich. Obwohl dieses Modell bei Bikesharing in Städten weit verbreitet ist, spielt es beim Teilen von Lastenrädern nur eine untergeordnete Rolle (Becker & Rudolf, 2018b). Beispiele für öffentliche Lastenradverleihsysteme sind das Pilotprojekt TINK das zu Forschungszwecken in den deutschen Städten Konstanz und Norderstedt etabliert wurde und die SeestadtFLOTTE im Wiener Stadtentwicklungsgebiet Seestadt aspern, bei der auch herkömmliche Fahrräder angeboten werden (TINK; Wien 3420 aspern Development AG, 2019). Vereinzelt ist der Verleih von Transporträdern Teil des Angebots an Mobilitätsstationen.

Bei Peer-to-Peer Lastenrad-Sharing treten Privatpersonen als Verleihende auf, die ihr privates Lastenrad anderen Personen zur Verfügung stellen. Die Vermittlung erfolgt meist über internetbasierte Sharing-Plattformen (Becker & Rudolf, 2018b; Scholl, 2019). Im deutschsprachigen Raum gibt es mit das-lastenrad.at nur eine derartige Plattform, die auf Lastenräder spezialisiert ist. Dort können registrierte Nutzerinnen und Nutzer alle verfügbaren Transporträder ausleihen und selbst welche anbieten.

Host-basiertes Lastenrad-Sharing greift auf Kleinbetriebe und andere lokale Organisationen als Verwalterinnen und Verwalter der geteilten Lastenräder zurück. Diese übernehmen die Abwicklung von Ausleihen und meist auch kleinere Wartungsarbeiten. Zudem fungieren die Hosts als Mulitplikatorinnen und Multiplikatoren im Stadtviertel, die das Sharing-Angebot an Ihre Kundinnen und Kunden weitertragen. Im Gegenzug erhalten sie Vorteile wie die kostenfreie Nutzung der Räder oder eine erhöhte Förderung für deren

Anschaffung (Becker & Rudolf, 2018b). Auch ergeben sich häufig zusätzliche Vorteile wie eine erhöhte Kundenfrequenz und die Möglichkeit den eigenen Betrieb auf dem Lastenrad zu bewerben. Ein Beispiel für ein derartiges System ist Carvelo2Go in der Schweiz, das mit rund 300 Transporträdern gegenwärtig auch das größte derartige Angebot darstellt (Becker & Rudolf, 2018b; Suter, Stawicki & Schmid, 2017).

Freie Lastenräder sind Transporträder, die von zivilgesellschaftlichen Initiativen angeboten werden und in der Regel gegen freie Spende genutzt werden können. Die Abwicklung des Verleihs variiert stark mit den einzelnen Initiativen. In einigen Städten werden beispielsweise lokale Betriebe als Verwalterinnen und Verwalter der Lastenräder eingebunden (Becker & Rudolf, 2018a), wodurch es Überschneidungen mit host-basierten Systemen gibt.

3.2 Nutzung

Befragungen unter Nutzenden von Freien Lastenrädern sowie der Initiativen TINK und Carvelo2Go zeigen, dass deren Merkmalsausprägungen erheblich von den Werten der Gesamtbevölkerung abweichen. So sind 63% der befragten Nutzerinnen und Nutzer freier Lastenräder männlich, während der Anteil männlicher Nutzer bei Carvelo2Go bei 67% und bei TINK bei 68% (Konstanz) bzw. 70% (Norderstedt) liegt. Mit 77% Akademikeranteil und einer durchschnittlichen Haushaltsgröße von 2,68 weisen zudem befragte Carvelo2Go-Nutzende in Basel auch in Bezug auf diese Merkmale überdurchschnittliche Werte auf. Beim Alter der Befragten liegt der Mittelwert bei 38 (freie Lastenräder und TINK Konstanz) bzw. 42 Jahren (TINK Norderstedt). Eine schweizweite Analyse der Carvelo2Go-Nutzenden zeigt, dass 50% davon in der Altersgruppe zwischen 25 und 44 sind (Suter et al., 2017). In Bezug auf die Mobilität zeichnet sich diese Gruppe durch eine häufige Nutzung des Fahrrads für die Alltagsmobilität aus (Becker & Rudolf, 2018a; Hess & Schubert, 2019; Scheffler & Bleh, 2018).

Geteilte Lastenräder werden überwiegend für private Erledigungen wie dem Transport von Einkäufen bzw. Lebensmitteln oder Möbeln genutzt. Auch der Kindertransport spielt bei den betrachteten Lastenrad-Sharing Angeboten eine wesentliche Rolle, häufig im Zusammenhang mit Ausflügen. Bei rund 58% der Ausleihen von freien Lastenrädern wurden weniger als zehn Kilometer zurückgelegt. Die durchschnittliche Distanz liegt bei 14,5 Kilometern, wobei einige Ausreißer nach oben das Ergebnis verzerren (Becker & Rudolf, 2018a).

3.3 Projekt Grätzlrad

Im Frühjahr 2017 schüttete die Stadt Wien eine Förderung für die Anschaffung von Lastenrädern aus. Ein Teil des Förderbudgets war für zehn Betriebe oder ähnliche Organisationen mit fixem Standort und Öffnungszeiten vorgesehen, die eine volle Kostenübernahme von bis zu 3000 Euro erhalten konnten. Bedingung für die Inanspruchnahme der Förderung war, dass das damit angeschaffte Lastenrad zumindest für 24 Monate kostenfrei zum Verleih angeboten wird (Mobilitätsagentur Wien). Dieses Angebot wird unter dem Namen Grätzlrad beworben (Grätzl ist Wienerisch für Stadtviertel oder Quartier). Die mit der Abwicklung der Förderung beauftragte Mobilitätsagentur Wien stellte dafür eine eigene Website mit Reservierungsfunktion[1] zur Verfügung. Die Reservierungsseite stand auch anderen Lastenrad-Sharing-Initiativen offen, wodurch fünf weitere Transporträder an vier Standorten über die Seite reserviert werden können. Diese Lastenräder wurden von Bezirken, Gebietsbetreuungen und Stadtteilmanagements finanziert. Die bereitstellenden Organisationen werden als „Grätzlrad-Partner“ bezeichnet (Mobilitätsagentur Wien). Nach 18 Monaten wurde das Projekt evaluiert um eine Wissensbasis für die weitere Vorgehensweise zu schaffen. In diesem Beitrag werden Erkenntnisse aus der Evaluierung in Bezug auf die Zusammensetzung der Nutzerinnen und Nutzer, deren Nutzungsverhalten sowie die Zufriedenheit mit dem Angebot zusammengefasst.

4 METHODIK

4.1 Auswertung Reservierungsdaten

Aus den Reservierungsvorgängen der Lastenräder über die von der Mobilitätsagentur Wien bereitgestellte Buchungsplattform wurde ein Datensatz generiert, der Informationen zu Alter und Geschlecht der Ausleihenden, dem Verleihzeitraum sowie dem Standort enthält, an dem die Ausleihe stattfand. Insgesamt

[1] aufrufbar unter www.graetzlrad.wien

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besteht der Datensatz auch 1348 Fällen, was zugleich auch der Zahl der Reservierungsanfragen über die Online-Reservierungsseite im Zeitraum März 2017 bis November 2018 entspricht. Da angenommen werden musste, dass ein Teil der Befragungen abseits des Reservierungssystems (also telefonisch oder persönlich) stattfanden, wurden die Verleihenden nach einer Einschätzung nach der Anzahl solcher Anfragen gebeten. Damit war einerseits eine Abschätzung der Gesamtzahl der Ausleihen möglich und andererseits konnte damit auch die Aussagekraft der Reservierungsdaten beurteilt werden. Die Reservierungsdaten bilden die Grundlage für die Analyse zeitlicher und räumlicher Verleihmuster.

4.2 Befragung von Nutzerinnen und Nutzern

Um vertiefende Einblicke in die Zusammensetzung der Ausleiherinnen und Ausleiher und verschiedene Aspekte der Ausleihe zu erhalten, wurde ergänzend zur Auswertung der Reservierungsdaten eine quantitative Befragung durchgeführt. Dazu wurde ein über das Internet abrufbarer Fragebogen erstellt und der Zugangslink allen Personen, die über die Grätzlrad-Website eine Reservierung tätigten, per E-Mail zugeschickt. Insgesamt erhielten damit rund 700 Personen die Einladung zur Teilnahme an der Befragung. Der Rücklauf umfasste 284 vollständig ausgefüllte Fragebogen, die für die weitere Analyse verwendet werden konnten.

Neben Fragen zu personen- und haushaltsbezogenen Merkmalen, waren Verwendungszwecke der Lastenräder und der damit einhergehenden im Zuge der Ausleihen gefahrenen Distanzen, Gründe und Motive für die Lastenrad-Nutzung sowie zur Zufriedenheit mit dem Angebot wesentliche Inhalte des Fragebogens.

5 ERGEBNISSE

5.1 Nutzerinnen- und Nutzerstruktur

Unter den Nutzenden, welche die Reservierungsfunktion auf der Grätzlrad-Seite nutzten, waren 62% männlich. Unter den Befragten gaben 59% als Geschlecht männlich an, 27% weiblich und weitere 4% anderes. Die Verteilung nach Altersgruppen ist in Tabelle 1 dargestellt. Der überwiegende Teil der Personen, die ein Transportrad ausliehen, sind zwischen 25 und 45 Jahren alt, auf sie entfallen rund 75% der Ausleihen. Der Vergleich mit der Verteilung der Altersgruppen in der Wiener Gesamtbevölkerung zeigt deutliche Abweichungen. Weibliche Nutzende sind mit einem Durchschnittsalter von 38,2 Jahren etwas jünger als Männer mit 38,9 Jahren, die Unterschiede sind jedoch nicht signifikant, wie ein Kruskal-Wallis Test zeigt (Chi-Quadrat (2) =1,903, p = 0,386).

	Weiblich			Männlich			Gesamt		
Altersgruppen	Anzahl	Anteil	Verteilung Bevölkerung Wien	Anzahl	Anteil	Verteilung Bevölkerung Wien	Anzahl	Anteil	Verteilung Bevölkerung Wien
unter 20	0	0,0%	16,3%	4	0,5%	18,3%	4	0,3%	19,3%
20 bis unter 25	40	7,8%	2,0%	51	6,2%	2,2%	91	6,8%	7,1%
25 bis unter 30	95	18,5%	6,9%	126	15,4%	7,3%	221	16,6%	8,6%
30 bis unter 35	95	18,5%	8,3%	151	18,4%	8,8%	246	18,5%	8,2%
35 bis unter 40	146	28,5%	7,9%	169	20,6%	8,5%	315	23,6%	7,5%
40 bis unter 45	71	13,8%	7,2%	151	18,4%	7,7%	222	16,7%	6,8%
45 bis unter 50	37	7,2%	6,7%	86	10,5%	6,9%	123	9,2%	7,2%
50 bis unter 55	11	2,1%	7,2%	44	5,4%	7,3%	55	4,1%	7,4%
55 bis unter 60	11	2,1%	7,2%	24	2,9%	7,6%	35	2,6%	6,4%
60 bis unter 65	3	0,6%	6,3%	6	0,7%	6,5%	9	0,7%	5,1%
über 65	4	0,8%	5,2%	7	0,9%	4,9%	11	0,8%	16,5%

Tabelle 1: Nutzerinnen und Nutzer des Grätzlrads nach Geschlecht und Altersgruppen

Der Bildungsgrad der Teilnehmenden an der Befragung liegt deutlich über dem Durchschnitt der Wiener Bevölkerung: während in Wien 26% über einen akademischen Abschluss verfügen, sind es unter den Befragten 74%. Weitere 17% der Befragten verfügen über eine Matura. Diese Erkenntnis deckt sich im

Wesentlichen mit Untersuchungen zu den Nutzenden anderer Lastenrad-Sharing-Angebote (Becker & Rudolf, 2018a; Hess & Schubert, 2019; Scheffler & Bleh, 2018).

Die Mittelwerte zur Gesamtanzahl der Personen als auch zur Anzahl der Kinder und Jugendlichen im Haushalt sind deutlich höher als die entsprechenden Werte für die Gesamtbevölkerung Wiens. Dies ist ein Hinweis darauf, dass überproportional viele Familien das Angebot in Anspruch nehmen. In Bezug auf die Mobilitätsausstattung liegt die Zahl der Fahrräder im Haushalt deutlich über dem Durchschnitt, während die Zahl der Pkw wesentlich geringer ist.

	Mittelwert Befragte	Mittelwert Bevölkerung Wien
Haushaltsgröße	2,70	2,07[1]
Haushaltsmitglieder unter 18 Jahren	0,72	0,36[1]
Anzahl Fahrräder im Haushalt	3,81	1,62[2]
Anzahl Pkw im Haushalt	0,31	0,97[2]

[1] Daten: Statistik Austria 2018

[2] Daten: österreichweite Mobilitätsbefragung Österreich unterwegs 2013/2014

Tabelle 2: Mittelwerte Haushaltsgröße und Mobilitätsausstattung der Haushalte im Vergleich zur Wiener Gesamtbevölkerung

Die überdurchschnittliche Fahrradverfügbarkeit in den Haushalten der Befragten äußert sich auch in einer starken Nutzung dieses Verkehrsmittels in der Alltagsmobilität. Wie Tabelle 3 zeigt, nutzen 93% der Befragten das Fahrrad in der warmen Jahreszeit zumindest wöchentlich, davon rund drei Viertel täglich. Im Winter nimmt dieser Wert etwas ab, 79% der Befragten fahren zu dieser Zeit zumindest wöchentlich mit dem Fahrrad. Damit heben sich die Nutzerinnen und Nutzer des Grätzlrads auch in Bezug auf die Verkehrsmittelwahl deutlich von der Wiener Gesamtbevölkerung ab, wo nur 7% der Wege mit dem Fahrrad zurückgelegt werden.

	Warme Jahreszeit		Kalte Jahreszeit	
Antwortmöglichkeiten	Anzahl	Anteil	Anzahl	Anteil
(fast) täglich	204	72%	124	44%
mehrmals wöchentlich	54	19%	71	25%
ca. einmal wöchentlich	8	3%	26	9%
ein- bis mehrmals monatlich	8	3%	21	7%
seltener	10	4%	41	14%
weiß nicht	0	0%	1	0%

Tabelle 3: Häufigkeit der Fahrradnutzung der Befragten in Abhängigkeit von der Jahreszeit

5.2 Ausleihen

Über die Grätzlrad-Reservierungsplattform wurden im Zeitraum von 20 Monaten 1348 Reservierungen getätigt. Angaben der Verleihenden von Grätzlrädern zufolge wurden zusätzlich 260 Ausleihen telefonisch, per E-Mail oder persönlich angefragt. Dadurch kamen insgesamt 1608 Ausleihvorgänge von Transporträdern zustande. Der durchschnittliche Reservierungszeitraum betrug 4,25 Stunden. Mit 41% fallen die meisten Ausleihen in die Kategorie 2,5 bis 5 Stunden. Jeweils 10% der Ausleihen waren kürzer als 2,5 Stunden bzw. länger als 10 Stunden. Bei diesen Daten ist zu berücksichtigen, dass es sich um Reservierungszeiträume handelt. Die tatsächliche Nutzungsdauer dürfte aufgrund der von Nutzerinnen und Nutzern eingeplanter Zeitpuffer kürzer sein.

Auf die Wochentage bezogen ist zum Ende der Arbeitswoche hin eine Zunahme von 149 Ausleihen an Montagen auf 349 Nutzungen an Freitagen hin zu beobachten. Auf Samstage entfielen 210 Ausleihen, auf Sonntage 31. Die geringe Zahl an Verleihvorgängen an Sonntagen erklärt sich dadurch, dass die Verleihbetriebe an Sonntagen in der Regel geschlossen sind. Für die Betrachtung des saisonalen Nachfrageverlaufs wurde der Beobachtungszeitraum auf 12 Monate reduziert (Juli 2017 bis Juni 2018) um Verzerrungen durch doppelt gezählte Monate zu vermeiden. Auf die Sommermonate Juli und August entfielen jeweils etwas mehr als 200 Ausleihen, während im Jänner nur 20-mal ein Grätzlrad ausgeliehen wurde. Die saisonalen Nachfrageschwankungen sind also deutlich.

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Aus räumlicher Perspektive lag der Schwerpunkt der Ausleihen auf den innenstadtnahen Bezirken, die einen Ring um den zentralen Bezirk Innere Stadt bilden. Auf die flächenmäßig großen Außenbezirke entfielen hingegen, trotz deutlich höherer Zahl an dort lebenden Menschen, weniger Ausleihen. Deutlich erkennbar ist dabei, dass jene Bezirke, die über ein oder mehrere Grätzlrad-Standorte verfügen, eine höhere Zahl an Ausleihen verzeichnen (s. Abbildung 2). Durchschnittlich liegt der Ausleihstandort 2,32 Kilometer vom Wohnort der Nutzerinnen und Nutzer entfernt. Dies liegt unter anderem daran, dass nicht immer der Grätzlrad-Betrieb für die Ausleihe gewählt wurde, der am nächsten zum Wohnort liegt, sondern auch andere Gründe in die Entscheidung einflossen, wie beispielsweise die Nähe zum Arbeitsort, die Bauweise des verfügbaren Lastenrads oder die Öffnungszeiten des verleihenden Betriebs. Zudem verzerren einige Ausreißer nach oben, das Gesamtbild. Der Median der Distanz zwischen Wohn- und Ausleihort liegt dementsprechend auch deutlich niedriger bei 1,25 Kilometern.

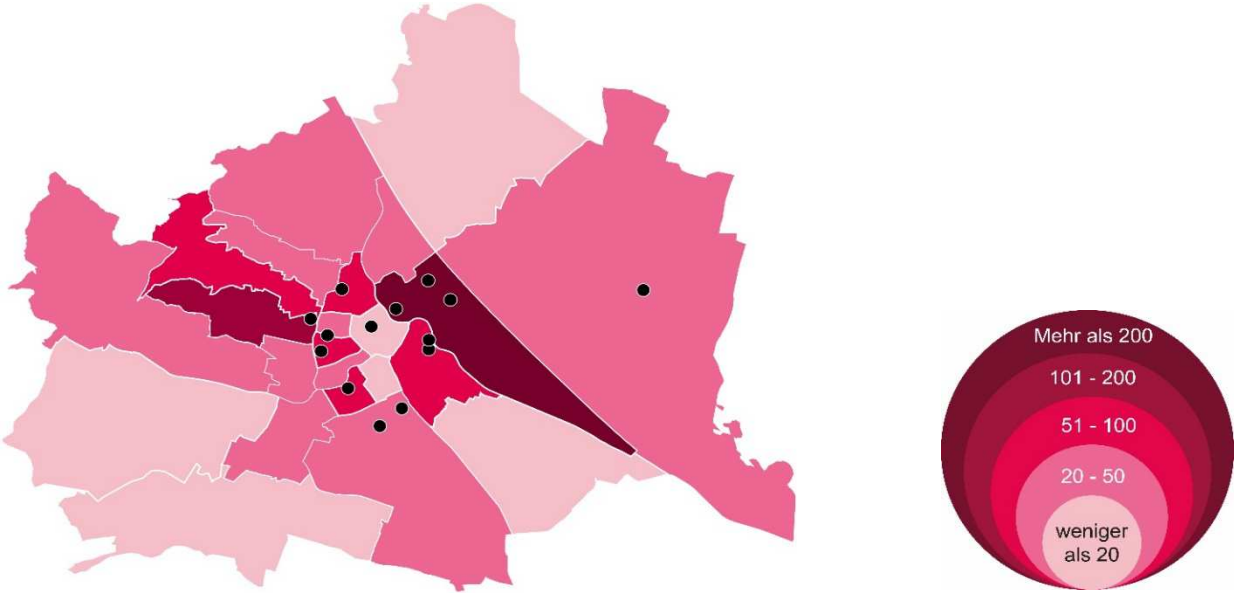

Abbildung 2: Räumliche Verteilung der Ausleihen von Grätzlrad-Lastenrädern

5.3 Einsatzzwecke

82% der Befragten gaben an, dass Transportrad für private Zwecke genutzt zu haben, 9% nutzten aus beruflichen Gründen. Weitere 9% verwendeten es sowohl privat als auch beruflich. Tabelle 4 zeigt, dass die Beförderung von Personen der wichtigste Transportzweck ist. Darüber hinaus werden die Lastenräder für den Transport schwerer Haushaltsgegenstände, Lebensmitteln und Arbeitsmaterialien genutzt. Ausflugs- bzw. Entsorgungsfahrten sind weitere relevante Gründe für die Ausleihe eines Transportrads.

Was wurde transportiert?	Anzahl Nennungen	Anteil an den Nutzenden gesamt
Kinder und Erwachsene	121	42,6%
schwere Gegenstände (z. B. Möbel, Haushaltsgeräte)	91	32,0%
Lebensmittel	76	26,8%
Arbeitsmaterialien	58	20,4%
Sachen für Ausflug	54	19,0%
Dinge zum Entsorgen	52	18,3%
Einkäufe mittelfristigen Bedarfs (z. B. Elektronik, Kleidung)	35	12,3%
Sportausrüstung	18	6,3%
Musikinstrument	10	3,5%
Haustier	6	2,1%
Sonstiges	37	13,0%
weiß nicht	0	0,0%

Tabelle 4: Von den Befragten mit dem Lastenrad durchgeführte Transporte (Mehrfachantworten möglich)

5.4 Zufriedenheit

Die Zufriedenheit der Nutzenden wurde mit der Frage gemessen, ob sie das Angebot ihren Bekannten weiterempfehlen würden, wobei für die Antwort eine zehnstufige Skala zur Verfügung stand. Der Wert von 1 bedeutet dabei, dass man das Angebot keinesfalls weiterempfehlen würde, während 10 stellvertretend dafür steht, dass das Angebot jedenfalls weiterempfohlen wird. Der Mittelwert von 9,51 deutet somit auf eine sehr hohe Zufriedenheit hin. 78,0% der Befragten wählten auf der Skala den Wert für die höchste Zufriedenheit. Tabelle 5 zeigt die Zufriedenheit mit den einzelnen Aspekten des Angebots im Detail. Vergleichsweise die höchste Zufriedenheit konnten dabei die Betriebe und Hosts verzeichnen, die als Hosts fungieren. Der Mittelwert der Beurteilung liegt bei 5,36, theoretisch maximal möglich wäre ein Wert von 6,0. Insbesondere jene Schritte in der Nutzung, Herausgabe und Rücknahme des Lastenrads, die mit persönlichem Kontakt verbunden sind, wurden von den Nutzerinnen und Nutzern positiv wahrgenommen. Auch die Zufriedenheit mit den Transporträdern ist mit einem Mittelwert von 5,27 gut. Die vergleichsweise schlechteste Bewertung erhielt die Reservierungsplattform, hier wird insbesondere der Reservierungsprozess als wenig nutzerfreundlich empfunden. Eine Auswertung der Kommentare zur Bewertung der Reservierungsplattform zeigt einige wesentliche Kritikpunkte der Befragten. Kritisiert wurde vor allem, dass die Reservierungen für maximal einen Tag getätigt werden können, die Bestätigung der Reservierung mit (teils großer) Zeitverzögerung erfolgt und dass es keine Übersicht der verfügbaren Räder zu einem bestimmten Wunschdatum gibt.

Beurteilungskriterien Zufriedenheit		N	Mittelwert	Std.-Abweichung	Mittelwert übergeordnet	Korrelation (Spearman)	Signifikanz
Bewertung Reservierungs-plattform	Übersichtlichkeit	270	1,181	4,66	4,65	0,122	0,049
	Informationen zu den verfügbaren Transporträdern und Verleihstandorten	268	1,156	4,89		0,167	0,007
	Reservierungs-prozess	272	1,531	4,40		0,137	0,026
Bewertung Grätzlrad-Verleih-standorte	Reaktion auf Reservierungs-anfrage und weitere Fragen	275	1,433	4,98	5,36	0,176	0,004
	Herausgabe des Transportrades und Erläuterung Funktionsweise	270	,990	5,50		0,355	0,000
	Abwicklung Rückgabe des Transportrades	271	,921	5,60		0,293	0,000
Bewertung der Transporträder	Zustand	272	,942	5,42	5,27	0,276	0,000
	Eignung für den durchgeführten Transport	272	,921	5,37		0,301	0,000
	Fahrverhalten	272	1,079	5,05		0,341	0,000
	Abstellen und Abschließen	273	,928	5,23		0,304	0,000

Tabelle 5: Zufriedenheit mit dem Grätzlrad-Angebot in Bezug auf verschiedene Aspekte

Von den erwähnten Bewertungskriterien lässt sich ein Zusammenhang mit der globalen Zufriedenheit mit Angebot (Bereitschaft das Angebot an Bekannte weiterzuempfehlen) erkennen. Die Effektstärke der Korrelationen liegt im Bereich zwischen 0,122 und 0,355 was einem schwachen bis mittleren Effekt entspricht.

Aspekte im Zusammenhang mit der Betreuung durch die Hosts sowie Zustand und Eigenschaften der Transporträder weisen dabei stärkere Zusammenhänge mit der Gesamtzufriedenheit auf. Einen schwächeren Zusammenhang gibt es mit der Beurteilung der Reservierungsplattform. Eine geringe Zufriedenheit mit der

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Buchungsfunktion schlägt sich also weniger stark in einer schlechteren Gesamtbewertung nieder. Bei den Transporträdern sind insbesondere die Aspekte Fahrverhalten, die Praktikabilität des Abstellens und Abschließens sowie deren Eignung für die durchgeführten Transporte in höherem Zusammenhang mit der hohen Gesamtzufriedenheit. Bei den Verleihstandorten scheint insbesondere der positiv wahrgenommene persönliche Kontakt mit den Hosts einen wesentlichen Beitrag zur guten Beurteilung des Gesamtsystems beizutragen.

5.5 Wirkung

Im Rahmen der Befragung wurden Wirkungen in Bezug auf die direkte Substitution anderer Verkehrsmittel durch die Verwendung eines Lastenrades sowie indirekte Effekte in Bezug auf die zukünftige Nutzung bzw. Anschaffung eines Transportrads adressiert. Der Beitrag des Projekts zur Verankerung von Lastenrädern im Bewusstsein der Bevölkerung konnte mit der gegebenen Methodik nicht abgebildet werden. 33,9% der Fahrten mit dem Transportrad ersetzten eine Pkw-Fahrt: entweder mit dem eigenen Auto, einem geliehenen Auto von Bekannten oder mittels Carsharing. Im Vergleich zu den freien Lastenrädern ist damit der Anteil der substituierten Pkw-Fahrten gering (Becker & Rudolf, 2018a). Auf der anderen Seite wurden auch zusätzliche Wege induziert, 16,1% der Befragten gaben an, dass der Transport sonst nicht durchgeführt worden wäre. 29,2% der Nutzerinnen und Nutzer hätten stattdessen ein herkömmliches Fahrrad oder ein anderes Transportrad verwendet.

Zur Abschätzung der indirekten Effekte sind einerseits der Anteil der Personen, die im Zuge der Grätzlrad-Ausleihe erstmals ein Lastenrad verwenden, von Interesse sowie die Absichten in Bezug auf die zukünftige Nutzung. 70% der Befragten waren Erstnutzerinnen und Erstnutzer, weitere 16% hatten zuvor erst ein- oder zweimal ein Lastenrad verwendet. Das zeigt, dass mittels Transportrad-Sharing Menschen zum Ausprobieren von Lastenrädern animiert werden können. Tabelle 6 stellt die Häufigkeit der Transportrad-Nutzung vor der ersten Ausleihe eines Grätzlrades in Beziehung zur geplanten künftigen Verwendung. 99,3% der Befragten möchten in Zukunft zumindest gelegentlich ein Transportrad nutzen. Personen, die schon häufiger ein Transportrad genutzt haben, tendieren dazu, sich das auch für die Zukunft öfter vorzunehmen (Spearman-Rangkorrelation: rs = 0,275, p = 0,000, n = 269). Insgesamt ist der Anteil der Personen, die eine wiederholte Nutzung beabsichtigen auch unter bisherigen Nicht-Nutzerinnen und Nicht-Nutzer sehr hoch, weshalb eine starke, verkehrlichen Wirkung des Angebots erwartet werden kann.

Häufigkeit Lastenrad-Verwendung vor erster Ausleihe	geplante zukünftige Häufigkeit Lastenrad-Nutzung										
	nie		ja, aber weniger als einmal pro Jahr		ja, mehrmals pro Jahr		ja, mehrmals pro Monat		ja, wöchentlich oder häufiger		Gesamt
	Anzahl	Anteil	Anzahl	Anteil	Anzahl	Anteil	Anzahl	Anteil	Anzahl	Anteil	Anzahl
nie	2	1,1%	24	12,8%	140	74,9%	12	6,4%	9	4,8%	187
1-2 mal	0	0,0%	2	4,7%	31	72,1%	4	9,3%	6	14,0%	43
3-5 mal	0	0,0%	1	4,8%	17	81,0%	2	9,5%	1	4,8%	21
6-10 mal	0	0,0%	0	0,0%	2	50,0%	1	25,0%	1	25,0%	4
> 10 mal	0	0,0%	0	0,0%	5	35,7%	4	28,6%	5	35,7%	14
Gesamt	2	0,7%	27	10,0%	195	72,5%	23	8,6%	22	8,2%	269

Tabelle 6: Kreuztabelle Häufigkeit Lastenrad-Nutzung vor erster Ausleihe und geplante künftige Nutzung

8,2% der Grätzlrad-Nutzerinnen und Grätzlrad-Nutzer planen die Anschaffung eines Transportrads, weitere 37,5% ziehen es zumindest in Betracht und 5,4% haben sich schon eines gekauft. Auch hier besteht eine signifikante Korrelation zur vorhergehenden Häufigkeit der Transportrad-Nutzung (Spearman-Rangkorrelation rs = 0,281, p = 0,000, n = 280). Im Vergleich zu den Nutzerinnen und Nutzer freier Lastenräder, bei denen 20,2% angeben, in Zukunft ein Transportrad anschaffen zu wollen (Becker & Rudolf, 2018a), ist dieser Wert sehr niedrig. Andererseits zeigt das Ergebnis auch, dass knapp 10% der Erstnutzerinnen und Erstnutzer ein Transportrad angeschafft haben oder eine Anschaffung planen. Da der Erstkontakt mit Transporträdern über das Sharing-Angebot zustande kam, ist davon auszugehen, dass dieses einen entscheidenden Impuls dargestellt hat. Je geringer die Zahl der vorhergehenden Nutzungen von Transporträdern, desto stärker dürfte der Einfluss des Grätzlrad-Nutzung auf die Entscheidung, ein Lastenrad anzuschaffen, sein.

Häufigkeit Lastenrad-Verwendung vor erster Ausleihe	geplante Anschaffung eigenes Transportrad							
	nein		vielleicht		ja		ich habe schon ein eigenes Transportrad angeschafft	
	Anzahl	Anteil	Anzahl	Anteil	Anzahl	Anteil	Anzahl	Anteil
nie	113	57,70%	64	32,70%	12	6,10%	7	3,60%
1-2 mal	13	28,90%	24	53,30%	5	11,10%	3	6,70%
3-5 mal	6	28,60%	11	52,40%	3	14,30%	1	4,80%
6-10 mal	1	25,00%	2	50,00%	1	25,00%	0	0,00%
mehr als 10 mal	4	28,60%	4	28,60%	2	14,30%	4	28,60%
Gesamt	137	48,90%	105	37,50%	23	8,20%	15	5,40%

Tabelle 7: Kreuztabelle Häufigkeit Lastenrad-Nutzung vor erster Ausleihe und (geplante) Anschaffung eines Lastenrads

6 DISKUSSION

Die Nutzerinnen- und Nutzerstruktur von Lastenrad-Sharing besteht derzeit im Wesentlichen aus Personen, die für ihre Alltagswege Fahrräder nutzen und über eine hohen Bildung verfügen. Eine Diversifizierung dieser Gruppe ist, nicht nur wegen der Vergrößerung des Nutzerinnen- und Nutzerkreis, sinnvoll. Insbesondere wenn Personen mit einem hohen Anteil an Wegen, die mit dem Auto zurückgelegt werden, als Nutzerinnen und Nutzer gewonnen werden können, führt zu einer größeren Einsparung an umweltschädlichen Emissionen. Zudem könnte das Lastenrad im Bewusstsein einer breiteren Masse verankert und die Auslastung der Räder durch eine größere Zahl potenzieller Nachfragenden verbessert werden. Neben entsprechender Bewerbungsstrategien, bietet auch die Wahl der Verleihstandorte in Bezug auf Lage und Zusammensetzung der Kundinnen und Kunden einen Ansatzpunkt zur Erweiterung der Zielgruppe.

Die räumliche und zeitliche Verteilung von Ausleihen ist noch sehr ungleich. Aus zeitlicher Perspektive könnten Maßnahmen zur Steigerung der Nachfrage in der kalten Jahreszeit sowie zu Wochenbeginn angedacht werden. Um die Nachfrage auch in weniger zentral gelegenen Bezirken zu steigern, müsste dort das Angebot erweitert werden. Aufgrund der längeren Wege als im Stadtzentrum (z. B. für Einkäufe) könnten Transporträder gerade dort einen Beitrag zur Reduktion des Pkw-Verkehrs leisten.

Der persönliche Kontakt mit den Grätzlrad-Hosts wird aus Perspektive der Befragten positiv wahrgenommen und hat zugleich auch Relevanz für die positive Gesamtbewertung des Angebots. Insbesondere für Erstnutzerinnen und Erstnutzer dürfte wichtig sein, eine Ansprechpartnerin oder einen Ansprechpartner für Fragen in Bezug auf das Lastenrad zu haben. Das dürfte auch den bisherigen Erfolg host-basierter Systeme im Bereich des Transportrad-Sharing erklären, da hier, im Gegensatz zu bspw. Bikesharing, der Anteil unerfahrerenen Nutzenden sehr hoch ist. Bei der Auswahl der Hosts ist jedoch zu berücksichtigen, dass diese für die Abwicklung der Ausleihen und Erklärung der Funktionsweise die notwendigen Zeit- bzw. Personalressourcen zur Verfügung stellen können. Vorteilhaft ist zudem, wenn diese auch kleine Wartungs- und Reparaturarbeiten an den Transporträdern durchführen können.

Die Ergebnisse zeigen deutlich, dass Lastenrad-Sharing zu einem direkten Ersatz von Fahrten im motorisierten Individualverkehr führt. Als wesentlich bedeutender werden jedoch die indirekten Effekte eingeschätzt. Knapp 99% der Erstnutzerinnen und Erstnutzer wollen in Zukunft wieder ein Transportrad verwenden, was die Bedeutung von der Ausleihmöglichkeit für die Erprobbarkeit unterstreicht. Diese Erkenntnis unterstreicht, dass die Etablierung von Sharing-Angeboten eine geeignete Maßnahme ist, um eine noch wenig bekannte Mobilitätsoptionen einem breiten Publikum zugänglich zu machen, deren Anwendbarkeit im Alltag erfahrbar zu machen und stärker im Bewusstsein zu verankern.

Die präsentierten Ergebnisse bieten einen ersten Einblick zur Zusammensetzung der Nutzerinnen und Nutzer von Lastenrad-Sharing sowie darüber wie die Transporträder verwendet werden. Auch zur Wirkung des Angebots konnte auf Basis der Ergebnisse eine erste Einschätzung getroffen werden. Insgesamt bleiben die Erkenntnisse an der Oberfläche und sind daher als Ausgangspunkt für weitere Forschungsarbeiten, die sich vertiefend mit den angesprochenen Aspekten auseinandersetzen, zu sehen. Im Zusammenhang mit (potenziellen) Nutzerinnen- und Nutzergruppen könnten durch bevölkerungsrepräsentative Befragungen weitere Gruppen identifiziert werden, die mit solchen Angeboten angesprochen werden können. Um die

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direkten verkehrlichen Wirkungen genauer abzubilden, bedarf es weiterer Untersuchungen, die sich vertiefend mit Mobilitätsverhalten der Nutzerinnen und Nutzer und dessen Veränderung durch die Verfügbarkeit von Lastenrädern befassen. Mittels Längsschnittuntersuchungen könnten auch die langfristigen Änderungen des Mobilitätsverhaltens, die sich beispielsweise durch eine Anschaffung und/oder regelmäßige Nutzung von Lastenrädern ergeben, beleuchtet werden.

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🏆 *reviewed paper*

Größere Discounter, kleinere Verbrauchermärkte und Onlineshops: Welche Rolle spielen die aktuellen Trends im Lebensmitteleinzelhandel für die Nahversorgung im ländlichen Raum?

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1 ABSTRACT

In den letzten Jahren sind im deutschen Lebensmitteleinzelhandel mehrere Entwicklungen hinsichtlich der Betriebsformen- und Standortstruktur festzustellen: Bestehende Discounterfilialen werden erweitert und neue Filialen werden mit Verkaufsflächengrößen weit oberhalb der in Deutschland geltenden planerischen Grenze des großflächigen Einzelhandels eröffnet; Discounter werden daher auch immer häufiger Gegenstand von Verträglichkeitsbeurteilungen in Planungsverfahren. Gleichzeitig sinkt die Marktbedeutung von großen Verbrauchermärkten bzw. SB-Warenhäusern und mehrere Supermarktketten bzw. -kooperativen treiben ein kleinflächiges Citymarkt-Konzept voran. Während Amazon und Rewe in ausgewählten Großstadtregionen einen Online-Lieferdienst für Lebensmittel aufgebaut haben, erweitern etablierte Supermarktketten ihr stationäres Angebot um einen online-gestützten Abholservice (Click and collect). Anhand eines regionalen Fallbeispiels aus dem ländlichen Raum (Südniedersachsen) untersucht dieser Beitrag, inwiefern diese Entwicklungen – konvergierende Marktgrößen und Cross-Channel-Einbindung im LEH – mit dem tatsächlichen Einkaufsverhalten der Bevölkerung in Einklang zu bringen sind. Denn die planerischen Ideale zielen auf eine intakte Nahversorgung ab, die in erster Linie als gute Erreichbarkeit übersetzt wird. Sprechen also „große“ Discounter oder Supermärkte mit einem Onlineshop überhaupt die Verbraucher an? Und: Relativieren diese Entwicklungen die hohe Relevanz, die der Erreichbarkeit in Nahversorgungsfragen zugesprochen wird? Konkret wird daher untersucht, welche Rolle die (betriebsformenspezifische) Verkaufsflächengröße und die Click-and-collect-Option – unter Berücksichtigung der Erreichbarkeit – für die Einkaufsstättenwahl im LEH spielen. Hierzu wird ein quantitatives Modell der Einkaufsstättenwahl aufgestellt und die Einflüsse anhand von empirischen Echtdaten zum Einkaufsverhalten überprüft. Interessanterweise zeigt sich, dass das Angebot eines online-gestützten Abholservices (bisher) keinerlei Effekt auf die Einkaufsentscheidungen der Kunden hat. Es lässt sich allerdings belegen, dass Verkaufsflächenerweiterungen bei Discountern die Kundenzuflüsse erhöhen, wobei dieser Effekt stärker ist als bei allen anderen Betriebsformen. Als wichtigste Determinante des Einkaufsverhaltens im LEH zeigt sich jedoch wieder einmal die Erreichbarkeit der Anbieter. Die Ergebnisse leisten einen Beitrag zu der Frage, wie Neuansiedlungen und Erweiterungen von LM-Märkten in Planungsverfahren ggf. differenzierter beurteilt werden können.

Keywords: Modell der Einkaufsstättenwahl, Einkaufsverhalten, Lebensmitteleinzelhandel, Nahversorgung, Click and collect

2 EINFÜHRUNG

Von rd. 513,3 Mrd. EUR an gesamtem Einzelhandelsumsatz in Deutschland (2017) entfallen rd. 187 Mrd. EUR auf den Lebensmitteleinzelhandel (LEH) (IfH, 2018). Abseits dieses hohen Umsatzanteils hat der LEH aber auch eine wichtige gesellschaftliche Funktion, nämlich die Bereitstellung von Grundbedarfsgütern bzw. Gütern des täglichen Bedarfs für die gesamte Bevölkerung. Die Verfügbarkeit bzw. Erreichbarkeit von LEH-Einkaufsmöglichkeiten ist ein wesentlicher Faktor der Lebensqualität, weshalb die Nahversorgung – deren zentraler Baustein der LEH ist – auch eine normative Zielvorstellung in der räumlichen Planung der Bundesrepublik Deutschland darstellt (Einig, 2015; siehe z.B. Raumordnungsgesetz: §2 Abs. 2 Satz 3 ROG). Regelmäßig wissenschaftlich begleitet wird diese Entwicklung durch Untersuchungen zu den Strukturen von Versorgung bzw. Erreichbarkeit im LEH sowie der Definition ausreichender oder „qualifizierter“ Nahversorgung, alles vor dem Hintergrund stetiger Strukturveränderungen auf der Betriebsseite. Grundsätzlich wird Nahversorgung i.d.R. mit der kleinräumigen Verfügbarkeit bzw. Erreichbarkeit der relevanten Betriebe übersetzt (Überblick z.B. Krüger et al., 2013; Kokorsch/Küpper, 2019; Wieland, 2018).

Seit etwa 2010 sind im deutschen LEH (mindestens) vier Entwicklungen hinsichtlich der Betriebsformen- und Standortstruktur festzustellen, die sich notwendigerweise auch auf die Nahversorgung auswirken müssen: Erstens findet im Bereich der Lebensmitteldiscounter eine deutliche Maßstabsvergrößerung statt. Die landesweit präsenten Discount-Filialunternehmen – insbesondere Aldi und Lidl – erweitern bestehende

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Filialen und eröffnen neue Verkaufsstellen mit Verkaufsflächengrößen weit oberhalb der in Deutschland geltenden planerischen Grenze des großflächigen Einzelhandels (800 qm). Viele moderne Filialstandorte von LM-Discountern erreichen Größen von deutlich über 1.000 qm Verkaufsfläche und werden daher auch immer häufiger Gegenstand von Verträglichkeitsbeurteilungen in Planungsverfahren (siehe z.B. LebensmittelZeitung online, 2014). Zweitens sinkt gleichzeitig die Marktbedeutung von großen Verbrauchermärkten bzw. SB-Warenhäusern. Den Standortschließungen stehen nur wenige Neueröffnungen gegenüber. Bestehende Märkte dieser Betriebsform werden z.T. sogar verkleinert (siehe z.B. Handelsblatt, 2019). Drittens treiben einige Supermarktketten bzw. -kooperativen ein kleinflächiges Konzept insbesondere für hochfrequentierte Innenstadtstandorte voran (z.B. Rewe City, Edeka xpress). Diese Entwicklungen – Discounter werden „größer“, Vollsortimenter wieder „kleiner“ – spiegeln sich auch in den Marktdaten zur betriebsformenspezifischen Entwicklung des LEH in Deutschland wider (z.B. bulwiengesa AG, 2017).

Die vierte Entwicklung betrifft die Etablierung des Onlinehandels im deutschen LEH: Beispielsweise ist Amazon in den Lebensmitteleinzelhandel eingestiegen, wobei ein Online-Vollsortiment (AmazonFresh) bisher nur in ausgewählten Großstädten mit einer hohen Kundendichte (Berlin/Potsdam, Hamburg, München) verfügbar ist (Amazon, 2020). Parallel haben etablierte Supermarktfilialisten bzw. -kooperativen ihr Angebot um einen online-gestützten Liefer- und/oder Abholservice erweitert: Während der Online-Lieferdienst von Rewe nur in einigen Großstadtregionen verfügbar ist, wird ein online-gestützter Abholservice (d.h. „Click and collect“ für Lebensmittelkäufe) auch von einzelnen Anbietern im ländlichen Raum angeboten, die als eigenständige Kaufleute der jeweiligen Kooperative angeschlossen sind. Beispielsweise ist bei den teilnehmenden Rewe-Märkten ein vollständiges Supermarkt-Sortiment von 10.640 Artikeln (inkl. Non-Food-Artikel; Abfragedatum: 17.01.2020) über den Onlineshop verfügbar. Aus diesem Angebot stellt der Kunde seinen individuellen Warenkorb zusammen und gibt im Anschluss ein Abholzeitfenster an; die Abholung erfolgt im Markt und ist dementsprechend an dessen Öffnungszeiten gekoppelt. Es existiert aktuell (Abfragedatum: 08.01.2020) kein Mindestbestellwert, allerdings wird eine Servicepauschale von 2,00 EUR erhoben (Rewe, 2020). Ein weiteres Beispiel sind mehrere eigenständige Märkte unter dem Dach der Edeka Südwest, die „Click and collect“ für Lebensmittel und teilweise auch einen (regional begrenzten) online-gestützten Lieferservice anbieten (Edeka Südwest, 2020).

Diese skizzierten Entwicklungen betreffen im Kern die Marktgrößen sowie die Cross-Channel-Einbindung von Lebensmittelmärkten. Sprechen aber „große“ Discounter oder Supermärkte mit Onlineshop die Verbraucher überhaupt an? Und: Relativiert sich dadurch die Rolle der räumlichen Nähe, der im Kontext der Nahversorgung die höchste Relevanz zugesprochen wird? Der vorliegende Beitrag behandelt die Frage, welche Rolle die (betriebsformenspezifische) Verkaufsflächengröße und die Click-and-collect-Option – unter Berücksichtigung der Erreichbarkeit und anderer Erklärungsgrößen – für die Einkaufsstättenwahl im LEH spielen. Hierzu wird ein quantitatives Modell der Einkaufsstättenwahl aufgestellt, wobei anhand empirischer Daten zu realem Einkaufsverhalten im ländlichen Raum (Südniedersachsen) die Einflüsse der genannten Erklärungsgrößen identifiziert werden. Im folgenden Kapitel werden zunächst die (standort-) theoretischen Grundlagen zur Einordnung dieser Aspekte dargestellt und im Anschluss Hypothesen formuliert sowie die Analysemethodik und das Untersuchungsgebiet vorgestellt. Daraufhin werden zunächst deskriptive Teilergebnisse zur erfassten Angebots- und Nachfragesituation dargestellt und im Anschluss die Modellergebnisse besprochen. Der Beitrag schließt mit den Schlussfolgerungen aus den Ergebnissen für den Planungskontext.

3 THEORETISCHE VORÜBERLEGUNGEN UND METHODISCHER ANSATZ

3.1 Das Huff-Modell

Ein etabliertes Modell zur Darstellung und Erklärung des räumlichen Wettbewerbs im Einzelhandel ist das Marktgebietsmodell von Huff (1962, 1964). Ungeachtet vieler Kritikpunkte ist dieses quantitative Modell zugleich auch häufig die Grundlage von Auswirkungsanalysen bzw. Verträglichkeitsgutachten in Planungsverfahren bei Einzelhandelsgroßprojekten (Khawaldah et al., 2012; Wolf, 2012). Das Huff-Modell ist aber vor allem ein theoretisches Modell, das Aussagen zur Wirkung von Marktgrößen und der Erreichbarkeit von Standorten trifft, und daher eine sinnvolle Grundlage für die o.g. Fragestellungen.

Huff (1962) definiert den Nutzen eines Angebotsstandortes *j* für die Nachfrager in Wohnort *i*, U_{ij}, durch zwei Erklärungsgrößen (Teilnutzen): Die Größe des Angebotsstandortes, A_j, wirkt als Attraktivitätsmerkmal,

wobei als Größenindikator typischerweise die Verkaufsfläche herangezogen wird. Die hinterliegende ökonomische Begründung dieser Modellformulierung bezieht sich auf das Informationsniveau der Nachfrager: Den (potenziellen oder tatsächlichen) Einzelhandelskunden wird – realistischerweise – unterstellt, dass sie ihre Einkaufsentscheidungen unter Unsicherheit treffen und daher nicht genau wissen, ob sie die von ihnen nachgefragten Güter auch tatsächlich am jeweiligen Angebotsstandort bekommen. Je größer jedoch der Angebotsstandort ist, desto höher ist aber die Wahrscheinlichkeit eines „erfolgreichen" Einkaufs; die Verkaufsfläche ist also – sofern Angebotsstandorte derselben Branche mit vergleichbarer Sortimentsbreite betrachtet werden – lediglich eine Proxyvariable für die Sortimentstiefe (Auswahl) bzw. Sortimentshöhe (Vorrätige Artikelzahlen). Da mit steigendem Sortimentsumfang auch die Such- und Entscheidungskosten der Nachfrager steigen (Stichworte: „tyranny of freedom of choice", „choice overload", „customer confusion"), wirkt dessen Anstieg nicht proportional auf den Konsumentennutzen, sondern es wird von abnehmendem Grenznutzen ausgegangen.

Die zweite Erklärungsgröße ist die Erreichbarkeit der Angebotsstandorte, d_{ij}, die ausdrücklich keine physische Raumüberwindung i.e.S. darstellt, sondern eine Wegezeit. Um die Opportunitätskosten der Raumüberwindung (Einkaufsfahrt mit dem Auto, Fahrrad, ÖPNV etc.) auszudrücken, wird davon ausgegangen, dass die „investierte" Zeit überproportional wahrgenommen wird.

Die konsumentenseitige Einkaufsentscheidung wird als probabilistisch angesehen, d.h. die „Zuordnung" des Nachfrageortes *i* zu einem Angebotsstandort *j* ist eine Wahrscheinlichkeit (p_{ij}, wobei: $0 < p_{ij} < 1$), die von der Ausprägung des Nutzens aller zur Verfügung stehenden Alternativen abhängt:

$$p_{ij} = \frac{U_{ij}}{\sum_{j=1}^{n} U_{ij}} = \frac{A_j^{\gamma} {d_{ij}}^{-\lambda}}{\sum_{j=1}^{n} A_j^{\gamma} {d_{ij}}^{-\lambda}}$$

Die Gewichtungsparameter (γ, λ) spiegeln die Wirkung der beiden Einflussfaktoren wider ($0 < \gamma < 1$, $|\lambda| > 1$).

Mit Hilfe ökonometrischer Abwandlungen des Huff-Modells oder anderer Modellvarianten wurden die beiden Kernaussagen des Huff-Modells im Kontext des Lebensmitteleinkaufs bereits häufig bestätigt: Die Verkaufsfläche (die ja eigentlich das Sortiment symbolisiert) wirkt sich unterlinear positiv auf die Kundenzuflüsse aus, während eine steigende Fahrtzeit die Kundenzuflüsse überproportional senkt (siehe z.B. Lademann, 2007; Orpana/Lampinen, 2003; Tihi/Oruc 2012; Suárez-Vega et al., 2015; Wieland 2015, 2018, 2019a). In einigen Fällen konnte auch über Sensitivitätsanalysen (Lademann, 2007; Wieland, 2019a) oder standardisierte Parameter (Wieland, 2015) gezeigt werden, dass bei Lebensmitteleinkäufen die Erreichbarkeit den wichtigsten Einflussfaktor bei der Einkaufsentscheidung darstellt.

3.2 Forschungshypothesen

Da die im Huff-Modell angenommene positiv-degressive Wirkung der Verkaufsfläche (als Proxy für das Sortiment) unzählige Male bestätigt wurde, wird auch hier vom selben Effekt *über alle Betriebsformen hinweg* ausgegangen. Allerdings steht hier die betriebsformenspezifische Wirkung im Vordergrund: Da LM-Discounter erweitert bzw. mit größeren Verkaufsflächen (VKF) neu eröffnet werden, große LM-Vollsortimenter (insb. Große Verbrauchermärkte bzw. SB-Warenhäuser) hingegen an Marktrelevanz verlieren, werden diesbezüglich folgende Hypothesen zum Effekt der VKF-Größe formuliert:

$H1_a$: Bei LM-Discountern ist der positive Effekt der VKF auf die Einkaufsentscheidung von allen LEH-Betriebsformen am größten

$H1_b$: Bei großen Verbrauchermärkten ist der positive Effekt der VKF auf die Einkaufsentscheidung von allen LEH-Betriebsformen am geringsten

Da die Erreichbarkeit von Lebensmittelmärkten regelmäßig als signifikanter (und wichtigster) Einfluss auf deren Marktgebiete identifiziert wurde (siehe Kap. 3.1), ist dieser Indikator natürlich in einer modellgestützten Analyse des Einkaufsverhaltens zu berücksichtigen (auch wenn sich die Forschungsfragen hier nicht auf diesen Aspekt beziehen). Es sind für die vorliegende Untersuchung daher zwei Hypothesen zu formulieren, die sich aus dem Huff-Modell und den genannten empirischen Untersuchungen ableiten:

$H2_a$: Die Wegezeit zum Lebensmittelmarkt hat einen negativen Einfluss auf die Einkaufsentscheidung

$H2_b$: Der Einfluss der Wegezeit auf die Einkaufsentscheidung ist überproportional

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Etwas schwieriger gestaltet sich allerdings die Verknüpfung des Click-and-collect-Angebotes mit den bisherigen Überlegungen, die aus der Standorttheorie des (stationären) Einzelhandels stammen, die – aufgrund ihrer Datierung und ihres raumwissenschaftlichen Charakters – keinen Bezug zum Onlinehandel nimmt. Zunächst ist festzustellen, dass im Hinblick auf die Erreichbarkeit von Lebensmittelmärkten kein Unterschied besteht, ob der eigentliche Einkauf im Markt oder mit Hilfe eines online-gestützten Abholservices vollzogen wird; in beiden Fällen muss der Kunde den Anbieter selbst aufsuchen, da ein Lieferservice (in dem Sinne wie in Kap. 2 beschrieben) im hiesigen Untersuchungsgebiet nicht verfügbar ist.

Allerdings steht ein online-gestützter Abholservice in Bezug zu einem anderen Aspekt des hier zu Grunde gelegten Einkaufsstättenwahlmodells, selbst wenn die physischen Eigenschaften der Einkaufsstätte bzw. ihres Standortes durch die virtuelle Anbindung nicht verändert werden: Für die Einkaufsentscheidungen wird angenommen, dass die Kunden keinen vollständigen Überblick über das Angebot von Handelsstandorten haben und ggf. nicht alle gewünschten Produkte beim ausgewählten Anbieter beziehen können; aus dieser Annahme heraus wird erst die Attraktivitätswirkung der „Größe“ hergeleitet. Mit steigender „Größe“ steigt aber auch der Suchaufwand *innerhalb* der Einkaufsstätte, womit u.a. der degressiv-positive Effekt begründet wird (siehe Kap. 3.1). Ein integrierter Onlineshop, über den der Warenkorb am Bildschirm zusammengestellt werden kann, hebt dieses Prinzip nahezu vollständig auf bzw. entkräftet den im Modell angenommenen „Größen“effekt, und zwar in zweierlei Hinsicht: Über den Onlineshop besteht erstens die Möglichkeit, sich eine vollständige Information über das Sortiment des Marktes und die Verfügbarkeit der Produkte (sowie Preise, weitere Produktinformationen etc.) zu verschaffen, ohne den Markt selbst zu besuchen. Zweitens: Es entfällt der Suchaufwand im Markt (und mit ihm weitere Einzelbausteine des Einkaufs, z.B. Wartezeit an der Kasse). Ein (Lebensmittel-)Markt mit Click-and-collect-Option senkt also insbesondere die Unsicherheit der Einkaufsentscheidung sowie die Suchkosten, was bei Erfahrungsgütern wie Lebensmitteln ausgehend von den o.g. standorttheoretischen Überlegungen ein Wettbewerbsvorteil sein *muss*. In Bezug auf die Cross-Channel-Integration von LM-Märkten wird also die folgende zu prüfende Hypothese formuliert:

H3: Das Angebot eines online-gestützten Abholservices („click and collect“) durch einen Lebensmittelmarkt hat einen positiven Einfluss auf die Einkaufsentscheidung

3.3 Modellierung des Einkaufsverhaltens

3.3.1 Das Modell

Zur Überprüfung der Hypothesen wird ein Modell für beschränkte abhängige Variablen verwendet, das auf Mullahy (1986) zurückgehende Hürdenmodell. Eine spezielle Abstimmung dieses allgemein formulierten mikroökonometrischen Modells auf die Erklärung der Einkaufsstättenwahl bzw. auf Kundenzuflüsse im Einzelhandel wurde bereits vorgenommen (Wieland, 2019a). Sinn des Modelleinsatzes ist, wie auch bei anderen ökonometrischen Modellen der Einkaufstättenwahl (z.B. Multiplicative Competitive Interaction Model [MCI], Discrete Choice Model) auf der Grundlage empirisch erfasster Einkäufe bzw. Einkaufssummen von befragten Individuen auf die Wirkung einzelner Teilnutzen zu schließen.

Ein besonderer Vorteil dieses Modells ist die Möglichkeit der Zerlegung des räumlichen Einkaufsverhaltens in zwei Aspekte, und zwar die Entscheidung *ob* bei einem bestimmten Anbieter eingekauft wird (oder eben nicht), und, *wenn ja*, wie „intensiv“ diese Einkaufsinteraktion ist, d.h. wieviele Einkäufe vollzogen werden oder wie hoch die Einkaufssummen sind. Dahinter steht die implizite Annahme eines zweistufigen Entscheidungsprozesses: Im ersten Schritt erfolgt die Entscheidung, *ob* etwas getan wird; danach wird in einem zweiten Schritt entschieden, *wie* etwas gemacht wird, wobei diese Entscheidung durchaus von ganz anderen Faktoren – oder von denselben Faktoren mit umgekehrter Kausalität – abhängig sein kann als die erste. Anders als das Huff-Modell und dessen Erweiterungen ist das Hürdenmodell für Individualdaten konzipiert und akzeptiert – nicht wie z.B. das MCI-Modell – (viele) empirische Ausprägungen der abhängigen Variable gleich null (was die mathematische Motivation der Modellkonstruktion ist).

Das Konzept lässt sich wie folgt zusammenfassen (die Darstellung orientiert sich an der in Wieland, 2019a):

Der Nutzen der Einkaufsstätte j für den Kunden i, U_{ij}, lässt sich in einer Nutzenfunktion mit einem „erklärten“ Teil V_{ij} (repräsentativer Nutzen) und einem nicht erklärten Teil ε_{ij} (Fehlerterm) ausdrücken:

$$U_{ij} = V_{ij} + \varepsilon_{ij}$$

Der repräsentative Nutzen besteht aus einer bestimmten Menge erklärender Variablen (Teilnutzen) in einer linearen Funktion:

$$V_{ij} = \boldsymbol{x_{ij}}'\boldsymbol{\beta}$$

Das Hürdenmodell besteht aus zwei Gleichungen, wobei die erste ein binäres Logit-Modell darstellt, dass die Wahlentscheidung modelliert (Kunde *i* kauft bei Anbieter *j* oder nicht). Die Zielgröße dieses Modells ist die Wahrscheinlichkeit, dass Kunde *i* Anbieter *j* aufsucht (p_{ij}), d.h. dass die Zahl der empirisch erfassten Einkaufsinteraktionen (Einkäufe oder Einkaufssummen), S_{ij}, größer als null ist. Diese Wahrscheinlichkeit wird durch den repräsentativen Nutzen erklärt:

$$p_{ij} = Pr\left[S_{ij} > 0 | V_{ij}\right] = \frac{e^{V_{ij}}}{1 + e^{V_{ij}}}$$

Eine lineare Interpretation des repräsentativen Nutzens ergibt sich durch die Betrachtung der Logits (Logarithmiertes Verhältnis der Wahrscheinlichkeiten des Eintretens und des Nichteintretens):

$$\ln \frac{p_{ij}}{1 - p_{ij}} = V_{ij}$$

Der zweite Teil des Modells behandelt die Intenstität der tatsächlich stattfindenden Einkaufsinteraktionen, d.h. alle Werte von S_{ij}, die größer null sind. Hierfür wird ein linkstrunkiertes Poisson-Modell verwendet, wobei der Poisson-Parameter λ_{ij} dem Mittelwert von S_{ij} entspricht:

$$E\left(S_{ij}, S_{ij} > 0 \middle| V_{ij}\right) = \frac{\lambda_{ij}}{1 - e^{-\lambda_{ij}}}$$

Die Linkfunktion des Poisson-Parameters λ_{ij} stellt durch eine loglineare Form einen linearen Zusammenhang mit dem repräsentativen Nutzen her:

$$\ln \lambda_{ij} = V_{ij}$$

Der Erwartungswert des Hürdenmodells ist das Produkt aus der Auswahlwahrscheinlichkeit und dem Erwartungswert aus der Intensitätsgleichung:

$$E\left(S_{ij} \middle| V_{ij}\right) = \left(Pr\left[S_{ij} > 0 | V_{ij}\right]\right)\left(E\left[S_{ij}, S_{ij} > 0 | V_{ij}\right]\right)$$

Beide Modellteile werden zunächst separat betrachtet, da sowohl die Effektstärke als auch die Richtung des Zusammenhangs keinesfalls gleichartig sein müssen (was i.d.R. plausibel durch die hinterliegenden Kausalzusammenhänge erklärt werden kann). Für Simulationen bzw. Prognosen wird dann das integrierte Modell verwendet. Die Berechnung des Hürdenmodells im vorliegenden Fall erfolgte in R (R Core Team, 2019) mit dem Paket pscl (Zeileis et al., 2008).

3.3.2 Erklärende Variablen und Nutzenfunktion

Im repräsentativen Nutzen sind diejenigen Variablen aufgeführt, auf die sich die Hypothesen beziehen, sowie etwaige Kontrollvariablen. Die Hypothesen $H1_a$ und $H1_b$ beziehen sich auf die Verkaufsfläche der Anbieter, weshalb dieser Indikator (A_j: Verkaufsfläche des LM-Marktes *j*) natürlich Teil der Nutzenfunktion ist. Um allerdings die betriebsformenspezifischen Effekte analysieren zu können, ist eine Differenzierung innerhalb des Modells notwendig, die über Dummy-Variablen (1/0) und Interaktionsterme hergestellt wird. Die LM-Märkte werden über Dummies als zugehörig zu den Betriebsformen (DG_j: Großer Verbrauchermarkt bzw. DD_j: LM-Discounter) gekennzeichnet. Für beide Dummies wird noch eine Interaktion mit der Verkaufsfläche integriert; die Koeffizienten der Interaktionsterme zeigen dann die Abweichung des VKF-Effektes der großen Verbrauchermärkte bzw. Discounter vom Effekt bei allen anderen Betriebsformen.

Die Wegezeit, auf die sich die Hypothesen $H2_a$ und $H2_b$ beziehen, findet sich ebenso als kontinuierliche Variable im Modell (d_{ij}). Da im Huff-Modell für beide Fälle (Verkaufsfläche und Wegezeit) ein nichtlinearer Einfluss angenommen wird (der sich auch immer wieder bestätigt hat, siehe Kap. 3.3.1), gehen die Verkaufsfläche und die Wegezeit in logarithmierter Form (ln) in die Gleichung ein. Die Koeffizienten der kontinuierlichen Variablen in beiden Teilmodellen können dann als Elastizitäten interpretiert werden, d.h. die prozentuale Veränderung der abhängigen Variable *Y* (odds ratio bzw. Erwartungswert der Intensität) unter der Bedingung, dass sich die betrachtete abhängige Variable *X* um 1% verändert.

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Die Hypothese H3 (Positive Wirkung der Click-and-collect-Option) wird mit Hilfe einer weiteren Dummy-Variable (DC_j) in der Nutzenfunktion überprüft, die anzeigt, ob der jeweilige LM-Markt einen online-gestützten Abholservice anbietet (1) oder nicht (0). Um einen etwaigen verzerrenden Effekt durch große Unterschiede im Preisniveau abzubilden, wird eine zusätzliche Kontrollvariable integriert, die ebenso in Dummy-Form anzeigt, ob der betreffende Markt ein Bio-Supermarkt ist (DB_j). In die Intensitätsgleichungen wird weiterhin noch der Gesamtwert der Einkäufe bzw. Einkaufssummen je Kunde aufgenommen, um den zu erwartenden Unterschieden zwischen den einzelnen Käufern gerecht zu werden (z.B. einmalige große Ausgaben, Unterschiede in der Zahl der angegebenen Käufe).

Die Funktion des repräsentativen Nutzens (unter Aussparung der letztgenannten Kontrollvariablen, die nur im zweiten Teil der Modelle auftauchen) lässt sich dann wie folgt formulieren:

$$V_{ij} = \beta_0 + \beta_1 \ln d_{ij} + \beta_2 \ln A_j + \beta_3 DC_j + \beta_4 DB_j + \beta_5 DG_j + \beta_6 DD_j + \beta_7 \left(\ln A_j * DG_j\right) + \beta_8 \left(\ln A_j * DD_j\right)$$

3.3.3 Untersuchungsraum und Datenerhebung/-nachbearbeitung

Das Untersuchungsgebiet der vorliegenden Studie ist das südliche Niedersachsen, hier abgegrenzt durch die Landkreise Göttingen (inkl. Altkreis Osterode am Harz), Northeim und Holzminden. Das Gebiet wird in der BBSR-Gebietstypisierung weit überwiegend dem ländlichen Raum zugeordnet (Landkreise Northeim und Holzminden sowie der Altkreis Osterode entsprechen in der Klassifikation von 2015 dem siedlungsstrukturellen Kreistyp „Dünn besiedelte ländliche Kreise“; BBSR, 2017). Die drei Kreise haben gemeinsam 531.814 Einwohner (Stand: 31.12.2018; Statistische Ämter des Bundes und der Länder, 2020).

Die notwendige Datenerhebung gliederte sich in zwei Teile: Zunächst wurden im 1. Quartal 2019 sämtliche Lebensmittelmärkte des Untersuchungsraumes nach der Defintion von AC Nielsen (The Nielsen Company, 2017) erfasst, d.h. Supermärkte, Verbrauchermärkte und LM-Discounter. Die Standorte wurden für die späteren Modellschritte georeferenziert. Die aktuellen Verkaufsflächengrößen der Betriebe wurden i.d.R. bei den jeweiligen LEH-Unternehmen erfragt; in den übrigen Fällen wurden diese Daten öffentlich verfügbaren Quellen (z.B. Medienberichte, Bebauungspläne, Einzelhandelsgutachten) entnommen oder manuell abgeschätzt. Zudem wurde protokolliert, ob im Fall von rechtlich eigenständigen Märkten innerhalb einer Kooperative ein online-gestützter Abholservice angeboten wird.

Die Erfassung des Konsumentenverhaltens erfolgte im Zeitraum von März bis Juni 2019 mit Hilfe einer schriftlich-postalischen Befragung. Hierbei wurde eine Zufallsstichprobe aus dem amtlichen Melderegister per Brief kontaktiert und um Teilnahme gebeten, wobei eine einmalige Nachfassung stattfand. Die kontaktierten Personen konnten den ausgefüllten Fragebogen mit einem portofreien Umschlag zurücksenden oder ihre Antworten stattdessen in ein Online-Formular beim Dienst q-set (www.q-set.de) eingeben. Als Erhebungsinstrument fungierte ein standardisierter Fragebogen, bei dem das Einkaufsverhalten in mehreren Sortimentsbereichen sowie Einstellungsmerkmale und sozio-demographische Daten abgefragt wurden. Die Erfassung der Einkäufe erfolgte analog zu Vorgängerstudien (Wieland, 2015; 2019a) über die Abfrage der drei zuletzt getätigten Einkäufe und der zugehörigen ungefähren Einkaufssummen. Für die vorliegende Untersuchung wurden nur die erfassten Lebensmitteleinkäufe verwendet. Im Untersuchungsgebiet wurde eine Stichprobe von n = 297 Befragten realisiert, hiervon 265 auf dem schriftlichen Weg und 32 über das Online-Formular. Die Dateneingabe sowie Nachbearbeitung erfolgte mittels SPSS (IBM Corp, 2016). Die angegebenen LM-Märkte wurden entsprechend der vorherigen Angebotserfassung codiert.

Aus den Rohdaten wurden Interaktionsmatrizen (i befragte Personen * j erfasste Lebensmittelmärkte) erstellt und für alle möglichen Kombinationen Wegezeiten durch die Abfrage von PKW-Fahrtzeiten aus dem OSRM-Dienst (Open Source Routing Machine) ermittelt. Diese beiden letzten Schritte, die unmittelbare Vorarbeiten für die Berechnung der Hürdenmodelle darstellen, erfolgten in R (R Core Team, 2019) mit dem Paket MCI2 (Wieland, 2019b).

4 ERGEBNISSE

4.1 Deskriptive Statistiken

4.1.1 Angebotssituation im Untersuchungsgebiet

Tabelle 1 zeigt das Angebot an Lebensmittelmärkten im Untersuchungsgebiet zum Zeitpunkt der Datenerfassung, aufgeschlüsselt nach LEH-Betriebsformen nach der Nielsen-Definition. Ingesamt wurden 195 Lebensmittelmärkte mit einer Gesamtverkaufsfläche von 254.646 qm erfasst. Es zeigt sich hierbei z.B. auch, dass die durchschnittliche Verkaufsflächengröße der LM-Discounter mit rd. 857 qm oberhalb der Grenze des großflächigen Einzelhandels (800 qm) liegt. Ein online-gestützter Abholdienst (Click and collect) wurde zum Erfassungszeitpunkt von fünf Lebensmittelmärkten – allesamt selbständige Verbrauchermärkte unter dem Dach der Rewe Group – angeboten.

Betriebsform (Nielsen-Typologie)	Anzahl (davon mit Click & Collect)	VKF [qm], Summe	VKF [qm], Mittelwert
Supermärkte, klein (bis 399 qm) [+]	11 (0)	2.180	198,18
Supermärkte, groß (400-999 qm) [++]	19 (0)	11.404	600,21
Verbrauchermärkte, klein (1.000-2.499 qm)	58 (5)	88.269	1.521,88
Verbrauchermärkte, groß (ab 2.500 qm)	18 (0)	76.558	4.253,22
LM-Discounter	89 (0)	76.235	856,57
Gesamt [+++]	195 (5)	254.646	1.305,88

[+] darunter 4 subventionierte Betriebsformen (Dorfläden) mit einer durchschnittlichen VKF von 94 qm
[++] darunter 4 Bio-Supermärkte mit einer durchschnittlichen VKF von 519 qm
[+++] In der Tabelle nicht inkludiert: 2 Märkte außerhalb des Untersuchungsgebietes (1x kleiner VM, 1x großer VM; Summe VKF: 6.560 qm)

Tabelle 1: Lebensmittelmärkte im Untersuchungsgebiet nach Betriebsformen (Quelle: Eigene Erhebungen und Berechnungen).

Diese Aufstellung entspricht nicht exakt der Angebotssituation, die in der weiteren Modellanalyse berücksichtigt wurde: Es wurden noch zwei Verbrauchermärkte außerhalb des Untersuchungsgebietes (Stadt Höxter, Nordrhein-Westfalen) mit einer Gesamtverkaufsfläche von 6.560 qm ins Modell aufgenommen, da diese in der Haushaltsbefragung aus mindestens zwei Gemeinden als Einkaufsquelle angegeben wurden.

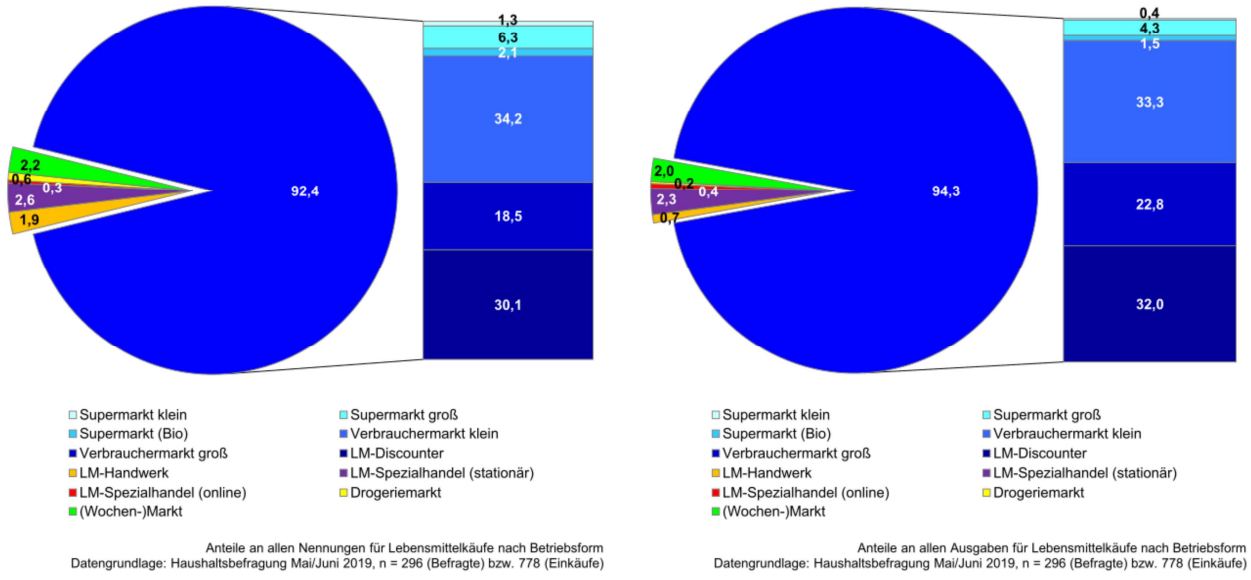

Abbildung 1: Anteile der Nennungen bzw. Einkaufssummen (Quelle: Eigene Erhebungen und Berechnungen).

4.1.2 Erfasste Marktanteile nach Betriebsformen bzw. Vertriebskanälen

Die in der repräsentativen Haushaltsbefragung erfassten Lebensmitteleinkäufe wurden für eine deskriptive Übersichtsdarstellung nach Betriebsformen klassifiziert (siehe Abb. 1), wobei hier auch Angebotsformen berücksichtigt sind, die für die Modellanalyse extrahiert wurden (z.B. Einkäufe im Lebensmittelhandwerk). Separat ausgewiesen werden hier auch die Bio-Supermärkte, die in der Nielsen-Kategorisierung zu den

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„großen Supermärkten“ gezählt werden. Es zeigt sich hier, dass 92,4 % aller Einkäufe bzw. 94,3 % aller Ausgaben im Lebensmittelbereich auch in Lebensmittelmärkten getätigt werden. Die Marktanteile von kleinen Verbrauchermärkten (1.000-2.499 qm VKF) und LM-Discountern sind nahezu gleich (34,2 % aller Einkäufe bzw. 33,3 % aller Ausgaben vs. 30,1 % und 32,0 %). Einige wenige Online-Lebensmittelkäufe bei Spezialanbietern spielen keine nennenswerte Rolle (0,3 % der Käufe bzw. 0,4 % der Ausgaben).

Am Vergleich der Einkaufs- und Ausgabenanteile zeigen sich auch die funktionalen Unterschiede zwischen den LEH-Betriebsformen: Bei den kleinsten Betriebsformen (kleine und große Supermärkte) liegen die Anteile der Einkäufe deutlich höher als die Anteile der Ausgaben; im Fall von großen Verbrauchermärkten oder Discountern ist dieses Verhältnis umgekehrt. Dies weist auf deutlich geringere Durchschnittsausgaben bei den kleinen Betriebsformen hin, die eher für häufig durchgeführte Ergänzungskäufe genutzt werden. Discounter und insbesondere große Verbrauchermärkte sind dagegen überwiegend die Einkaufsquelle für Großeinkäufe, die zwar regelmäßig, jedoch insgesamt seltener stattfinden (Reutterer/Teller, 2009).

4.2 Modellergebnisse

Tabelle 2 zeigt die Ergebnisse der Berechnung der Hürdenmodelle für die Einkäufe und die Ausgaben bei den Lebensmittelmärkten. Das erste Teilmodell, dessen Zielgröße die Auswahlwahrscheinlichkeit der zur Verfügung stehenden Alternativen ist (binäres Logit-Modell), ist für beide Modellvarianten identisch, da hier nur die Information zu Grunde gelegt wird, *ob* bei einem bestimmten Anbieter eingekauft bzw. Geld ausgegeben wird. Die dritte und vierte Spalte der Tabelle zeigen jeweils den zweiten Teil des Hürdenmodells für die Einkäufe bzw. die Ausgaben. Die Koeffizienten (β) der kontinuierlichen Variablen sind aufgrund der Logarithmierung als Elastizitäten (prozentuale Veränderung von Y bei einer 1-%-Änderung von X) zu interpretieren, die Koeffizienten der Dummy-Variablen als Semi-Elastizitäten (β*100 gibt an, um wieviel Prozent sich Y erhöht oder senkt, wenn sich der Wert der Dummy-Variable X von 0 auf 1 ändert).

Erklärende Variablen	Null-Hürden-Modell (binäres Logit-Modell) $Einkäufe_{ij}$ / $Ausgaben_{ij}$	Zähldatenmodell (zens. Poisson-Modell, Logit-Verknüpfung)	
		$Einkäufe_{ij}$	$Ausgaben_{ij}$
Fahrtzeit (ln d_{ij})	-2,644*** (0,064)	-0,424*** (0,140)	-0,047*** (0,009)
Verkaufsfläche (ln A_j)	1,113*** (0,148)	0,132 (0,234)	0,175*** (0,022)
Dummy Click and collect (DC_j)	-0,059 (0,330)	-0,030 (0,585)	-0,040 (0,047)
Dummy Bio-Supermarkt (DB_j)	0,873*** (0,335)	0,488 (0,647)	0,122** (0,055)
Dummy Großer Verbrauchermarkt (DG_j)	6,523*** (2,160)	-8,044* (4,237)	-0,532* (0,280)
Dummy LM-Discounter (DD_j)	-1,172 (2,823)	-7,278 (5,683)	-2,613*** (0,366)
Verkaufsfläche x Dummy Großer Verbrauchermarkt (ln A_j x DG_j)	-0,784*** (0,268)	0,907* (0,507)	0,059* (0,035)
Verkaufsfläche x Dummy LM-Discounter (ln A_j x DD_j)	0,204* (0,414)	1,002 (0,830)	0,404*** (0,053)
Alle Einkäufe (C_i^E)		1,230** (0,530)	
Alle Ausgaben (C_i^A)			0,005*** (0,00004)
Konstante	-4,906*** (1,058)	-4,771** (2,252)	1,950*** (0,158)
Anzahl Beobachtungen		56.520	56.520
Log-likelihood		-2.028,878	-7.426,207
			*p < 0,1; **p < 0,05; ***p < 0,01

Tabelle 2: Ergebnisse der Hürdenmodelle für die LM-Einkäufe und -Ausgaben (Quelle: Eigene Erhebungen und Berechnungen).

Der Verkaufsflächeneffekt für die Referenzgruppe (Alle Supermärkte und kleine Verbrauchermärkte) ist entgegen der a-priori-Annahme überproportional positiv: Eine Erweiterung der Verkaufsfläche um 1% erhöht die Chance, für einen Einkauf ausgewählt zu werden, um rd. 1,11 %. Ist der Lebensmittelmarkt bereits ausgewählt, steigert eine 1-%-Erhöhung der VKF die dort getätigten Ausgaben um rd. 0,18 %. Allerdings liegt der Fokus an dieser Stelle auf den Abweichungen von diesem Wert, die durch die Koeffizienten der Interaktionsterme angezeigt werden: Bei großen Verbrauchermärkten hat eine Erweiterung der Verkaufsfläche um 1% einen um 0,78 Prozentpunkte geringeren Effekt als bei der Referenzgruppe: Eine solche Erhöhung steigert demnach die Auswahlwahrscheinlichkeit um nur rd. 0,33% (1,113 - 0,784 = 0,329). Wird der jeweilige Markt allerdings besucht, steigert die Verkaufsfläche die Kunden- und Ausgabenzuflüsse

dieser Anbieter. Bei LM-Discountern ist der positive Effekt der VKF-Größe um rd. 0,20 Prozentpunkte höher als bei der Referenzgruppe; tatsächlich steigert also die VKF-Erhöhung eines Discounters um 1 % die Auswahlchance um rd. 1,32 % (1,113 + 0,204 = 1,317). Auch die Bonsummen bei bereits ausgewählten Märkten steigen mit der Verkaufsfläche. Offensichtlich zeigt sich also eine wie in den Hypothesen $H1_a$ und $H1_b$ formulierte Wirkung: Lebensmitteldiscounter profitieren von Verkaufsflächenerweiterungen am stärksten, während große Verbrauchermärkte hierdurch nur unterproportionale Kundenzuflüsse erwarten können. Dass bei Besuchen von Discountern im Mittel geringere Summen ausgegeben werden, wie der Koeffizient der Dummy-Variable DD_j anzeigt, verwundert aufgrund des geringeren Preisniveaus dieser Betriebsform (DISQ, 2017) nicht.

Auffällig ist das Ergebnis zur Prüfung der Hypothese H3: Die Click-and-collect-Option hat keinen signifikanten Einfluss auf die Auswahlwahrscheinlichkeit und erhöht auch nicht die Intensität der Einkaufsbeziehungen. Die insgesamt fünf Verbrauchermärkte können *im Mittel* also keine zusätzlichen Kunden- oder Kaufkraftzuflüsse durch das Angebot eines online-gestützten Abholservices generieren. Die Hypothese einer Attraktivitätssteigerung durch die Cross-Channel-Integration der LM-Märkte muss damit zumindest im vorliegenden Fall verworfen werden.

Zudem zeigt sich ein signifikant negativer Effekt der Wegezeit sowohl auf die Auswahlwahrscheinlichkeit als auch auf die Zahl der Einkäufe und die zugehörigen Ausgaben. Ein Anstieg der Fahrtzeit um 1% resultiert in einer Reduzierung der Besuchschance um rd. 2,6 %, was einen stark überproportionalen Effekt bedeutet und vollkommen konsistent mit früheren Ergebnissen zum Einkaufsverhalten im LEH ist (siehe Kap. 3.1). Dies führt zur Bestätigung der formulierten Hypothesen $H2_a$ und $H2_b$. Weiterhin sind die Effekte der Wegezeit sowohl im Entscheidungsmodell als auch beim Zählmodell für die Einkäufe deutlich höher als die der Verkaufsfläche und des – ohnehin niemals signifikanten – Cross-Channel-Angebotes. Es bestätigt sich also auch hier, dass die Erreichbarkeit von Lebensmittelmärkten die wichtigste Einflussgröße beim LEH-Einkauf darstellt und Betriebsformen- und Verkaufsflächeneffekte sowie ergänzende Online-Angebote in ihrer Relevanz deutlich überschattet.

5 SCHLUSSFOLGERUNGEN

Die Entwicklungen im LEH der letzten Jahre zeigen einerseits eine Tendenz konvergierender Marktgrößen – Discounter werden „größer“, Vollsortimenter „kleiner“ – und andererseits eine wachsende Online-Anbindung auch traditioneller LEH-Ketten und -Kooperativen. Tatsächlich zeigt sich der erstgenannte Effekt im Kundenverhalten: Discounter profitieren aufgrund ihres spezifischen Betriebsformenkonzeptes wesentlich stärker von größeren Verkaufsflächen als Vollsortimenter (was sich auch in den weitgehend höheren durchschnittlichen Flächenproduktivitäten der Discounterfilialen bemerkbar macht; siehe z.B. Hahn Gruppe, 2019); bei großen Vollsortimentern ist der Effekt gegenteilig. Dies führt unweigerlich zu der Frage, ob die Beurteilung der Zulässigkeit bzw. Schädlichkeit von betrieblichen Neuansiedlungen oder Erweiterungen, die planungsrechtlich zunächst nur an der Verkaufsfläche festgemacht wird, möglicherweise ausdifferenziert werden müsste. Ab einer Verkaufsfläche von 800 qm (bzw. 1.200 qm Geschossfläche) gilt nach § 11 BauNVO die Vermutungsregel, dass negative Auswirkungen von Einzelhandelsprojekten nicht ausgeschlossen sind; in Bayern gelten in der Landesraumordnung Ausnahmen dieser Regelungen für Lebensmittelmärkte bis 1.200 qm (LEP Bayern, Ziel 5.3.1). Unabhängig davon, welche Grenze in welchem Fall angewendet wird, zeigt sich aber, dass etwaige Auswirkungen in jedem Fall betriebsformenspezifisch sein *müssen*, denn die Effekte der VKF-Größen auf die Kundenzuflüsse sind es auch. Dieses Argument wurde bereits in der deutschlandweiten Studie „Qualifizierte Nahversorgung“ (u.a. Anders, 2015; Krüger et al., 2013) diskutiert, da sich hier zeigte, dass zwischen Discountern und (durchschnittlich größeren) Verbrauchermärkten (800-1.500 qm) keine Unterschiede im Hinblick auf deren Einzugsgebiete sowie induzierte Verkehrseffekte bestehen.

Ein weiterer Untersuchungsgegenstand lag im Effekt der Cross-Channel-Einbindung von LM-Märkten. Es war hier zu erwarten, dass diese einen Wettbewerbsvorteil darstellt und möglicherweise den Attraktivitätseffekt der Marktgröße abschwächt. Allerdings konnte diese Hypothese hier ausdrücklich nicht bestätigt werden. Dies ist allerdings möglicherweise auf eine noch zu geringe Bekanntheit bzw. Etablierung online-gestützter Abholdienste zurückzuführen. Im vorliegenden Fallbeispiel haben die – insgesamt nur fünf – Verbrauchermärkte im Untersuchungsgebiet dieses Angebot erst vergleichsweise kurz eingeführt (der erste

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dieser Märkte war ein Rewe-Markt in Göttingen, dessen online-gestützter Abholservice seit Februar 2017 besteht). Es ist hier jedenfalls dringend geboten, diese Hypothese in späterer Zeit nochmals zu prüfen.

Tatsächlich zeigen die Ergebnisse aber auch, dass die hier diskutierten Veränderungen im LEH-Markt nichts am eigentlichen Nahversorgungscharakter des Lebensmitteleinzelhandels geändert haben: Nichts spielt in der konsumentenseitigen gedanklichen Abwägung bei der Auswahl der Einkaufsstätte eine größere Rolle als die Erreichbarkeit der Lebensmittelmärkte. Das wissenschaftliche Monitoring der Nahversorgungsstrukturen sollte, ebenso wie die planerische Steuerung der räumlichen Einzelhandelsentwicklung, auch weiterhin eben diesen Aspekt fokussieren.

6 FÖRDERUNGSHINWEIS UND DANKSAGUNG

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🏆 *reviewed paper*

How to Attract the Right Economic Activities in a Certain Spatial Environment?

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1 ABSTRACT

During the past few years, our research has examined and described the spatial patterns and organisation of economic activities. In order to link these findings to policy, we introduced the concepts of demand and supply segments, and applied them on the scale of an area or a certain spatial environment.

Considering the business needs of companies on a certain location, we identified 16 demand parameters of companies, that are spatially relevant on the scale of an area: the size of good flows, the alternative freight transport, the nearness to the market,… Literature, interviews and observations offer supporting evidence for the parameters. We linked them to 24 other parameters that reflect the characteristics of the area where a company is located. These include amongst others mobility, level of foot fall, the presence of green infrastructure, other companies (or mix of companies), density, parking possibilities,… The combination of this information with our typology of economic area's (Giaretta, Pennincx, De Mulder, Zaman, 2019) resulted into 24 main segments, that show the relation between demand of companies and supply of spatial characteristics on the scale of an area. The segments are ideally grouped according to the characteristics, and in this sense they differ from typology of economic areas, that is based on the observed location preferences of companies.

This way of grouping into segments generates new questions, that enable us to spatially differentiate economic environments, and to make decisions regarding the location of economic activities. We aim at getting concrete answers to three main questions:

(1) Is my company located in the right place? Does this area spatially deliver what my company needs?

(2) Does the area deliver the right services, that the companies in this area need?

(3) If we want to transform an area, which area characteristics do we need to change in order to attract the wanted companies?

We subdivide these three main questions into sub questions.

The first question considers the demand side and uses the micro-economic considerations, made by a company, in order to choice a certain segment. Several questions succeed each other and deal with the demand of companies regarding the effects of agglomeration, economic and environmental spatial use, freight transport, price per square meter,…

The second question can lead to the segment that is the closest to the actual situation, based on the typology of economic areas. Indeed, there is usually a gap between the actual situation and the best fitting segment. Using the typology and the segments on an actual situation uncovers information about visibility, land price value, good flows, land use plan.

The third and last question deals with areas that are in a process of transformation. After finding out the desirable segment, it is possible to evaluate which companies belong to this segment, which need to adapt or to disappear. In addition, the transition in terms of services that the area delivers (which is implied when transforming from one segment to another), can be determined.

Keywords: upgrading areas, future of mixed use areas, urban economy, economic space, segmentation

2 INTRODUCTION

During the first decade of the 21st century, spatial planning for economic space was focussing on two questions: (1) What are the characteristics of a preferred location of companies that are looking for a place to start or that are in the process of leaving their current location? and (2) How much space (new developped businessparks) is needed to accommodate the growth of the economy in Flanders? The first question was adressed in the 'strategic plan for regional economy' (SPRE) (Cabus et al, 2004) and was based on a

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questionnaire filled out by more than 5.500 companies in Flanders. In the context of desindustrialisation and suburbanisation, with an oversupply of cheap available green field development for offices and light industry, company owners where asked to stated their preferences for a future location. These are 'stated preferences'. However, when combined with a dominant view of modernist planning, the way the questions were asked implied a social set of values that can be best described as a 'constructed preference'. The second question was answered by making forecasts based on macroeconomic data such as the current number of employees per hectare per sector, trend analysis of workforce growth in these sectors, investment,… In order to decide whether these parameters were good for these forecast purposes, a sensitivity analysis was done (Jacobs et al, 2003). Without much surprise, the results had a big variance, and the Flemish Government decided that, in order to be on the safe side (and not limiting economic growth), they would go for the moderate scenario, while providing extension possibilities towards the high demand scenario.

By 2012 first signs appeared that the public was no longer happy with the ever expanding businessparks that popped up everywhere in the countryside (Pisman et al. 2018, p 73)

In 2014, the government agency Flanders Innovation and Entrepreneurship (VLAIO) presented a research (Idea consult, 2014) where they tried to recalculate the need for additional industrial land and the net land take. In this project they had to find a way to measure whether a company really needed to occupy industrial land, or if it could also thrive in a mixed urban context.

Soon after this project, we started the research project called 'segmentation of economic locations', (van Dinteren, 2015) where we aimed to reframe the questions, both from the perspective of a business owner and of a local spatial/economic policy maker. The central position is that economy is everywhere, and that we (as spatial planners) do not fully understand how this functions. We asked ourselves how this understanding can be improved, for audiences such as the businesses, workers, and the public in general. In order to graps how economy functions, we have to know where specific activities take place, in what circumstances, and also try to understand what were implicit business related decisions that a company made in different phases of its history.

We complemented the stated preference from SPRE, with an observed choice of companies by mapping all activities present in different areas in Flanders and Brussels. From 2016 until 2019, we mapped almost 45.000 individual economic units in a 375 km² territory. We interpret the observed choice as a 'revealed preference' (Varian (2005), Samuelson (1938, 1948)) for micro economic site location choices of individual companies. As discussed in Huybrechts et al (2019), companies not only make a location choice when they first settle in a specific space: the law of minimizing costs obliges them to make a recurring evaluation of the location cost. The cost of moving a company is high and doing so has many uncertainties, which result in the statement that companies do not change location unless absolutely necessary.

We therefore assume that the best way of understanding location choice is to look at existing complex environments or economic ecotopes. This concept means that we focus on economic activities that are located on one or more parcels, taking into account their business models, and that we look into the area surrounding the economic activities. These economic area's have certain (spatial) characteristics that can be seen as economic ecotopes.

As discussed by Giaretta et al (2018, 2019), the revealed preference from the comprehensive mapping of economic activities had to be transformed into 'types' or economic ecotopes? An iterative inductive method was used to define the 16 economic types. For some small areas we produced a first proposal. This proposal was used by a group of people involved in spatial planning, urbanism, economics and real estate development. All of them have a good understanding of the field and have an in depth knowledge of that specific territory. The users discussed the nature of the types, the specific subdivision and how to use it in spatial and economic transformation of the territory. From these discussions, a new set of rules was derived for a new version of the types. This was done in different areas in and around Brussels and in Flemish cities, Kortrijk, Roeselare and Herentals.

3 FROM ECONOMIC ECOTOPES TO MARKET SEGMENTS

In 2018, we proposed a first version of the economic types (Giaretta et al, 2018), that we later used in discussions about transformation of areas, area specific development en regional economic planning. By november 2019 we applied an improved version of the method for the complete mapped area of 37.558ha in

Flanders and Brussels (Fig), allowing a more in depth study of the implicit parameters of each ecotope. The extend of the mapping (almost 45.000 economic units) resulted in the definition of 3.300 areas in 16 types (update of the 2018 version), ordered into 'continous', 'close', 'discontinous' and 'solitary' categories, and into several mixes of activities. From this mapping of units we were able to deduce a 'fingerprint' of each type (Fig 1).

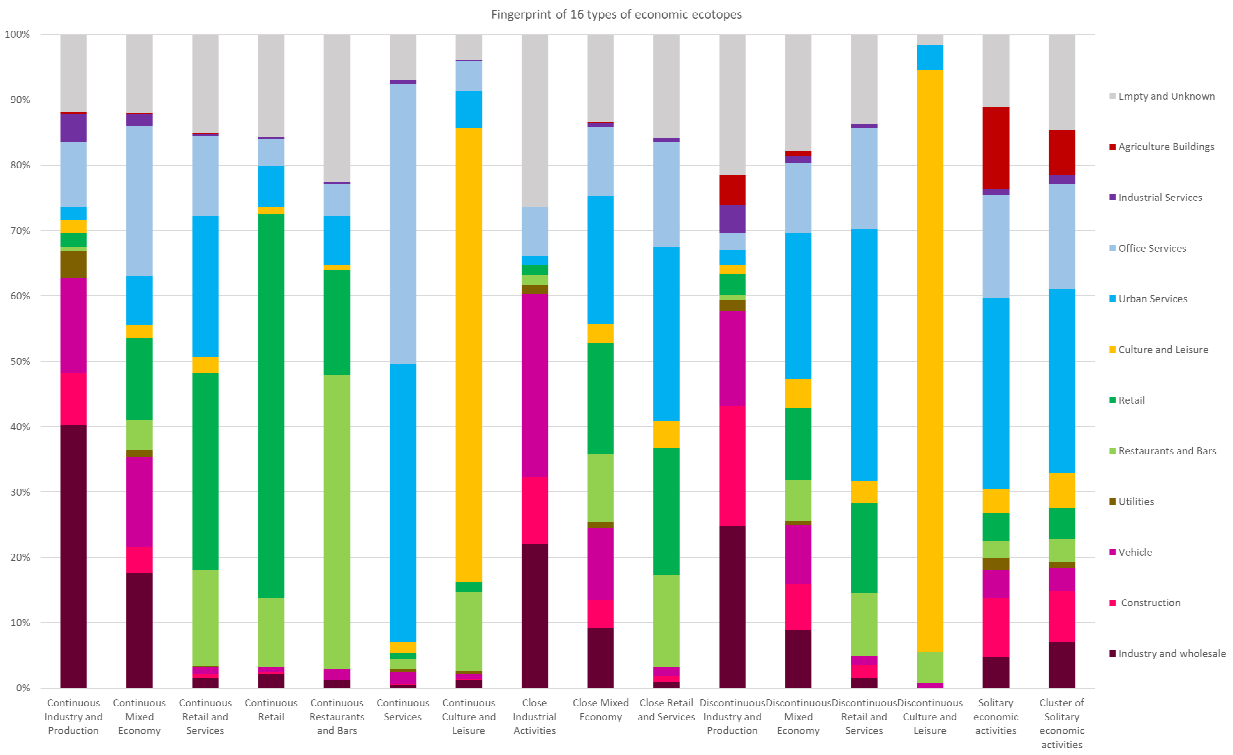

Fig. 1: Characteristic presence of different economic activities in each type or economic ecotope, based on the amount of units of the different economic activities.

As discussed in previous papers, it is expected that some types have a very similar composition because the main difference is not the type of activities but the distance between the economic activities in that type of ecotope. This is most striking between 'Continuous Culture and Leisure' and 'Discontinuous Culture and Leisure', and off course both types with solitary economic activities. In general, one can say that every economic activity can be present in every economic ecotope. So we can also use the data to calculate the probability that a company active in a specific sector will locate itself in any of the 16 types. Figure 2 shows this for a manufacturing company. As you would expect, a manufacturing company will most likely locate itself in a 'Continuous Industry and Production' type. However, the huge variety of manufacture and the different scales of these companies, make that the second observed choice is 'Discontinuous Mixed Economy'. Not all producing companies need the infrastructure provided in an industrial zone, nor do they have the necessary size and scale to be eligible for such sites. These graphs give a first glimpse of how individual companies might behave.

While site location choice is a discrete choice, the constant proces whether to stay in the same location or move to a new one, has more in common with a spatial planning 'Wicked Problem' (Rittel, 1972) than with a rationalisation of consumer choice. For wicked problems, no explicit basis exists for the termination of a problem solving activity; any time a solution is proposed, it can be developed still further (Rowe, 1987). This means that location choice is a recurrent problem. The interviews conducted by Huybrechts et al. (2019) with companies that remained in their original site, clearly show this proces. Every new event, acquisitions, hostile take over, new investment, environmental disputes with neighbours,… can suddenly revive the wicked problem of questioning the location of the firm. Changes in the value chain, e.g. outsourcing of material stock and logistics, can also influence the optimal location of a company.

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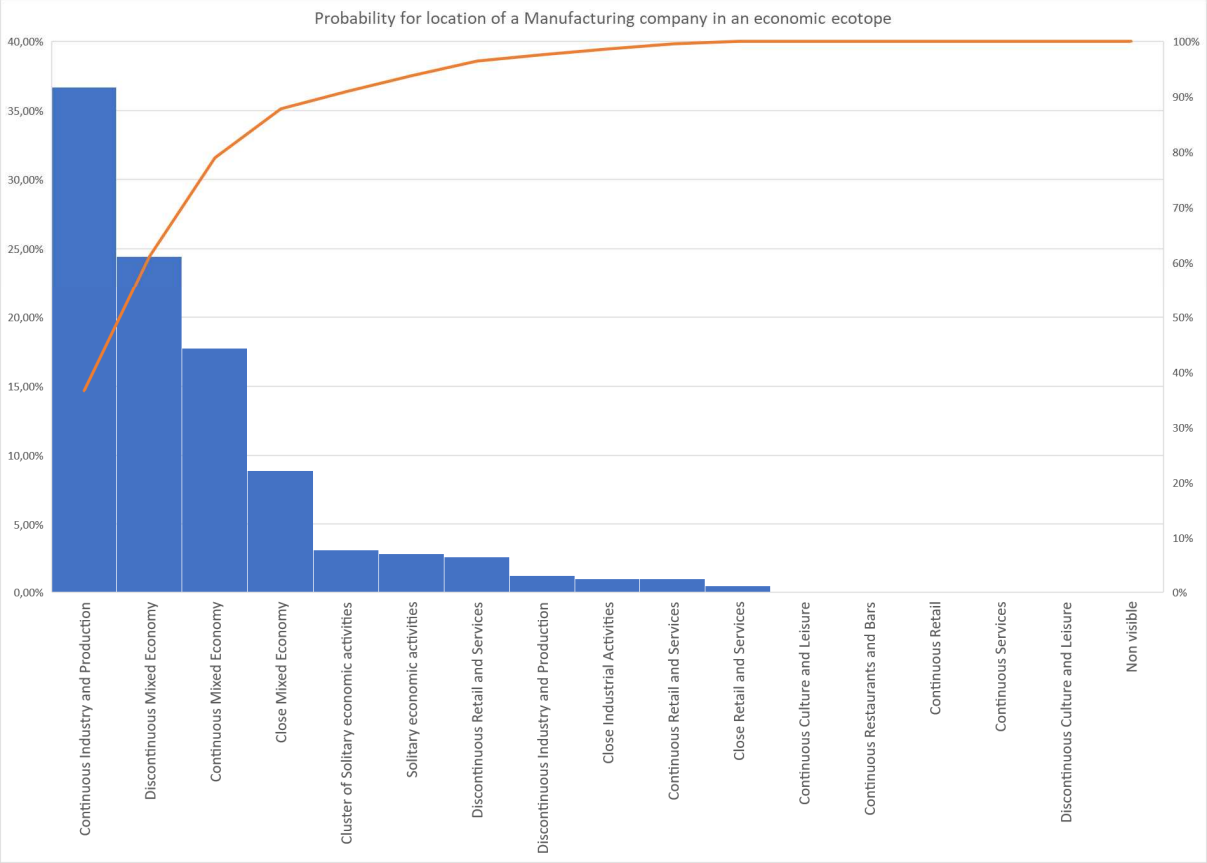

Fig. 2: probability of location of a manufacturing company in a Type of economic ecotope.

Different interdependent parameters play a role in the location decision making proces. In order to understand which parameters are relevant in making this discrete choice (demand side) we listed the parameters in site location that are differentiated territorially and are relevant on the scale of the economic ecotopes.

Starting with Alfred Weber's 'Theory on the location of Industries' (Weber, 1929), combined with industry and retail sales annual reports (JLL, 2019), and discussions with local stakeholders in the area of Buda in Brussels, we selected 16 relevant parameters for the demand side, and 26 for the product stratification (DeLisle, 2019).[1] The first stable version was tested for the Buda area in a workshop (29 August 2019), and later with the Province of Flemish Brabant (15 October 2019). Based on the comments and reviews, an adjustment was made to the proposed market segmentation. To keep a direct link with the economic ecotopes, we decided to slightly adjust the method, so types of ecotopes are either grouped or subdivided, but not spread around in different market segments.

A confrontation between the ecotope types and the territorial demand and product stratification parameters brings forward these findings:

[1] Territorial relevant parameters for the demand side and for the product stratification:
Demand: (D01) mix of activities in the area, (D02) size of units, (D03) cost of space, (D04) operational cost (environmental restrictions), (D05) population density in the area, (D06) population in the wider region, (D07) proximity to public services, (D08) image of the area, (D09) footfall, (D10) visibility from cars, (D11) number of cars passing, (D12) accessibility by public transport, (D13) accessibility by alternative goods transport, (D14) number of deliveries per week, (D15) type of goods vehicles, (D16) parking needs;
Product stratification: (P01) type of economic ecotope, (P02) proximity to economic activities, (P03) size of units, (P04) land use plan, (P05) combination with housing, (P06) environmental restrictions, (P07) external risk and hazard allowance, (P08) Floor Area Ratio, (P09) population density, (P10) average rent, (P11) land price, (P12) safe walking and cycling, (P13) large sidewalk, (P14) public transport service level, (P15) altenative goods transport infrastructure, (P16) direct access from the road, (P17) accessibility restrictions, (P18) parking availability, (P19) organization of loading and unloading, (P20) busy walking route between attraction points, (P21) footfall, (P22) visibility from a car, (P23) number of cars passing, (P24) availability of green spaces, (P25) public accessible green areas in the wider surroundings, (P26) collective water management.

(A) When the distance between economic activities increases, the potential relationship (Tobler, 1970) deminishes. Slight differences in distance between economic units are not distinctive when seen from the demand side. Three categories of proximity remain relevant: Continuous, Close (combining Close and Discontinuous), and Solitary.

(B) Where the mix of economic activities provides positive agglomeration effects and shared infrastructure in the Continuous economic ecotopes, this is no longer the case when economic activities are dispersed. The dominant presence of other activities (housing, farmland, forest,…) is more important for site location choice than the observed differences in mix of economic activities. The analytical subdivision of 'Close' and 'Discontinuous' types based on economic activity mix is not distinctive.

(C) The demand side parameters that are most relevant on this territorial scale are (1) footfall, (2) visibility from a main road, (3) potential clients in the area (= density), (4) shared infrastructure, and (5) organisation of loading and unloading. These parameters also explain the price of the accomodation. Areas will be subdivided in different segments where these parameters are considered important.

(D) The product stratification approach adds the (1) built form, (2) floor area ratio, (3) indoor/outdoor activities, (4) environmental restrictions and the (5) combination with housing as important parameters. As for the demand side, market segments will be subdivided accordingly.

Table 1 shows the resulting relation between the types and market segments. Not all parameters are equally relevant, and most are linked to one another. This is also reflected in the description of the market segments. The Type 'Continuous Industry and Production' exists both with and without a strong presence of housing. For the market segments, we propose a clear split between 'Urban Industry and Production', which includes substantial amounts of housing, and has a high Floor Area Ratio, and the other market segments, where there is no or very limited housing included in the area. When analyzing existing areas, an economic ecotope 'Continuous Industry and Production', that also contains a large proportion of housing, is associated with the 'Urban Industry and Production' market segment. Similarly, the 'Modern Industry and Production' segment refers to the absence of outdoor activities and storage, and 'Logistics and Wholesale' implies a very good freight transport accessibility and a dominance of Wholesale, Transport and Storage activities.

Type of economic ecotope	**Market Segment**
Continuous Industry and Production	Urban Industry and Production
	Industry and Production along a Main Road
	Modern Industry and Production
	Standard Industry and Production
	Logistics and Wholesale
Continuous Mixed Economy	Mixed Economic Activities along a Main Road
	Standard Mixed Economic Activities
Continuous Retail and Services	Retail and Services High Street
	Retail and Services Area
Continuous Retail	Shopping Street
	Shopping Mall
	Car Based Retail
Continuous Restaurants and Bars	Restaurants and Bars
Continuous Services	Office Services
	Urban and Public Services
Continuous Culture and Leisure	Culture
	Sports and Leisure
Close Industrial Activities; Close Mixed Economy; Close Retail and Services; Discontinuous Industry and Production; Discontinuous Mixed Economy; Discontinuous Retail and Services; Discontinuous Culture and Leisure	Close Economic Activities along a Main Road
	Close Economic Activities in Urban Areas
	Close Economic Activities in Low Density Areas
Solitary economic activities; Cluster of Solitary economic activities	Solitary Economic Activities in Built Areas
	Solitary Economic Activities in Agricultural Areas
	Solitary Economic Activities in Green Areas
	Areas without visible economic activities

Table 1: relationship between 16 types of economic ecotopes and 24 market segments

As in every attempt to propose market segments, this does not erase the differences between the individual locations or products within a segment. Within a an economic ecotope, different plot sizes, building properties,… will be available while other characteristics will be common for the entire ecotope. For specific economic activities (e.g. huge environmental impact, need for very large space,…) more in depth market research will be necessary to find a suitable location.

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4 CASE: MARKET SEGMENTS IN BUDA (FLANDERS, NORTH OF BRUSSELS)

Buda (central in Figure 3) is a historic industrial cluster south of Vilvoorde. This area is located in Flanders, but strides the border between the Brussels Capital Region and Flanders. This administrative divide however is invisible on the field. The development of the area started from the 1920s and resulted into different economic ecotopes of industrial type, around major transportation axes that link Brussels to Antwerp. In the Types map (Figure 3) we see how the industrial and mixed activities developed around the Canal Brussels-Scheldt and the railway Brussels-Antwerp. This patchwork of continuous industrial ecotopes highlights the perception problems this old industrial zone faces. Due to the historic soil pollution and strategic location close to Brussels and the Orbital Motorway (left to right in the middle of the orthophoto), there is real estate speculation in Buda, as many ambitious transformation proposals are currently discussed.

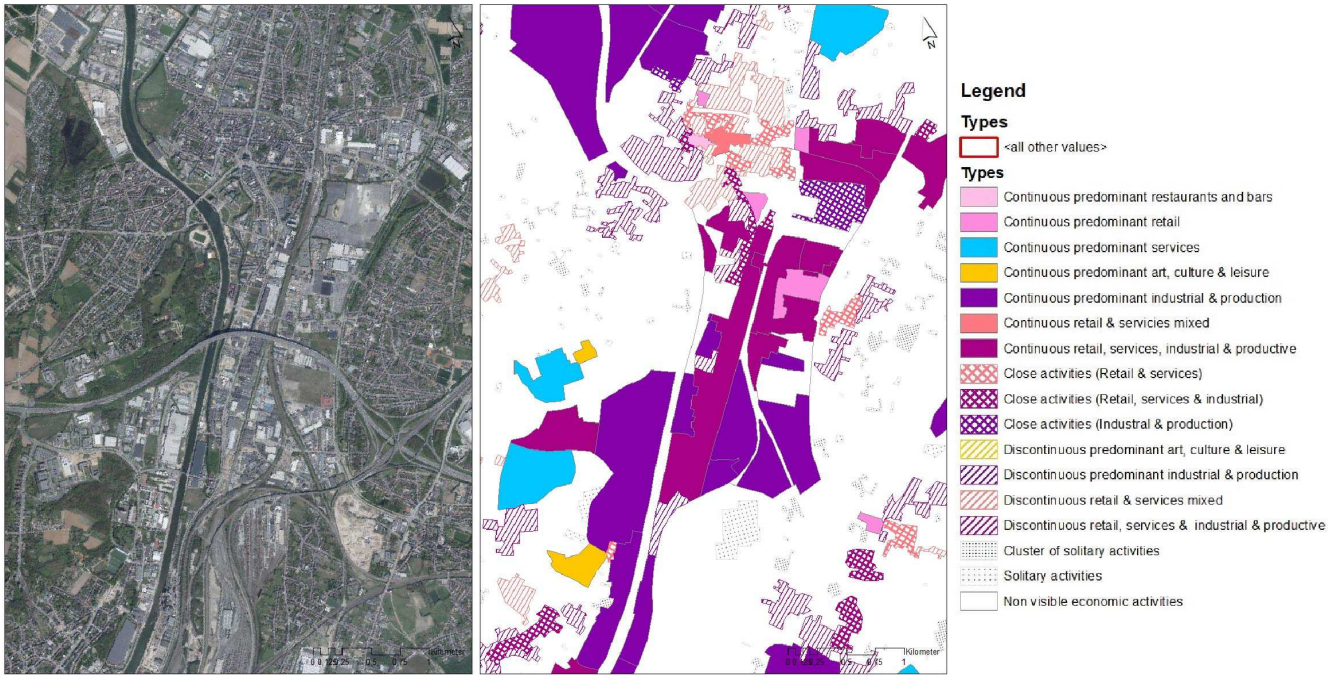

Fig. 3: Buda situation: orthophoto (left), Types of economic ecotopes in Buda (Central) and Type Legend (right)

Taking the step from types to segments in the Buda case, we attribute the most likely market segment to the existing areas. As both the set of demand parameters and of the product stratification are for a large part based on stated preferences of companies and policy makers, this does not necessarily correspond to a reality on the field. Everyone wants safe walking and cycling, but in real life this is not provided everywhere, especially not in industrial estates. As shown above in Table 1, the Segments map (Fig. 4) gives less detailed information for the non-continuous economic fabric, but highlights relevant site location factors such as visibility and accessibility. The Segments located along a main road or a high street are defined using local knowledge, additional data (such as population density) and network analysis. The morphological characteristics of areas surrounding solitary activities were used to create three different segments that focus on the interaction with either housing, agriculture or green areas.

In the following part of the paper we will show how this map of market segments can guide companies and policy makers to fully understand their decision making power. First, we will look through the eyes of a company that wants to move. Second, we will show how the segments can only be used to their full potential if all required services are provided, and last, we will demonstrate how market segments can contribute to the transformation of existing areas.

5 MINIMIZING COSTS BY CHOOSING THE RIGHT SEGMENT… AND A GOOD LOCATION

As shown in Figures 1 and 2, companies active in a specific type of activity could find a good location in almost any marked segment. Minimizing the cost of location depends on other factors than the trade or industry of a company. The 9 variables that describe the demand side of each market segment, can be used to help site location choice. As mentioned earlier, these variables are highly interdependent, meaning you only need to make a clear choice on three or four parameters to get a suggested type of ecotope. Furthermore, a

company may attach more importance to certain parameters than to others. We constructed several decision trees from the demand side.

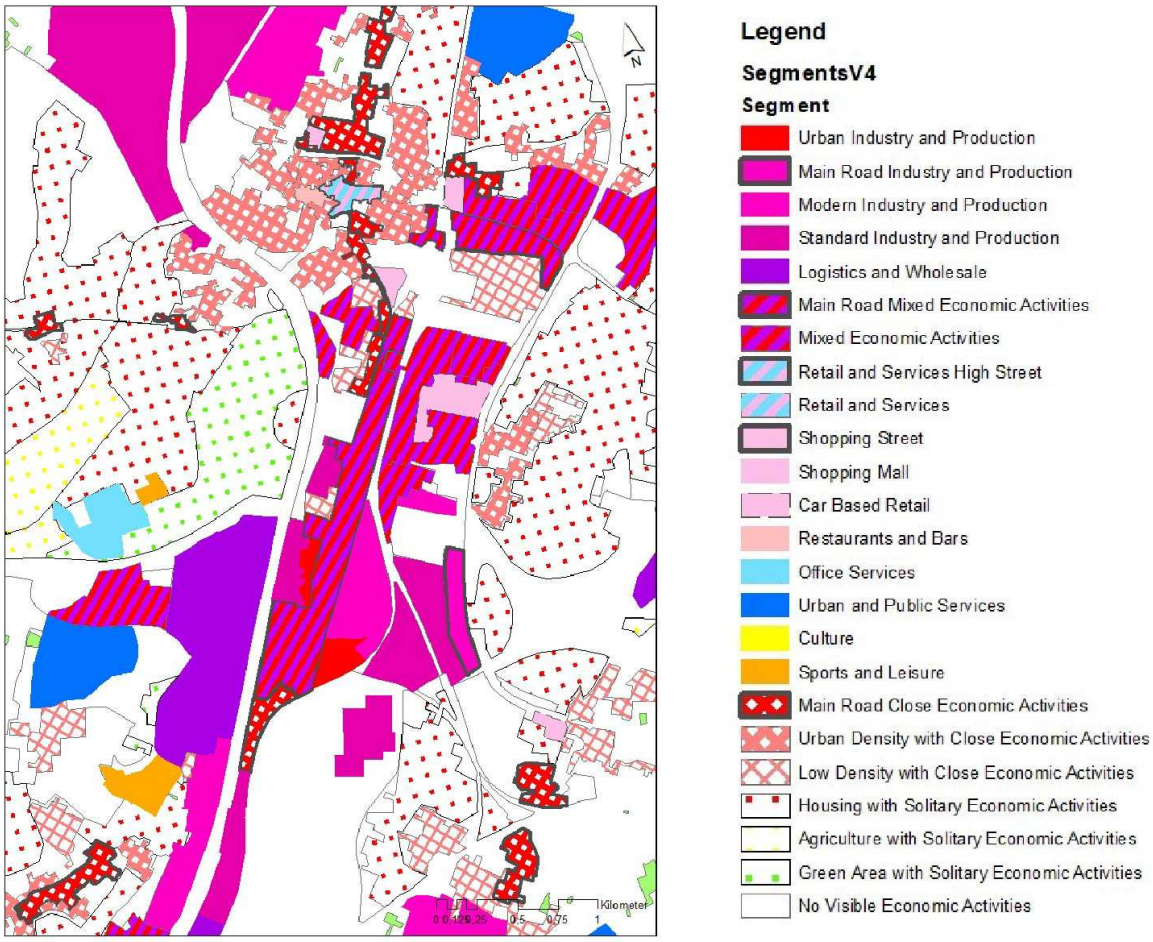

Fig. 4: Market Segments in Buda (Cross Border Brussels-Flanders)

In Fig. 5 you find a decision tree where the first question relates to rent price. This can easily be changed in a land purchase value (€/m² land) or building purchase value (€/m² floor). When we consider a furniture manufacturing company, it can use the decision tree depending on its specific activity characteristics. If it produces furniture on an industrial scale, the rent price, frequency of deliveries (1-5/day) and the indoor character would lead it to the 'Modern Industry and Production' segment. If is a highly specialised company that produces bespoke furniture and sells mainly through people seeing their products in their shop window, they may find it important to be visible on a high street and end up in the 'Retail and Services High Street' segment.

As the different parameters have a high interdependance, the scheme in Figure 5 is not the only way of getting to a suggestion for a market segment.

As mentioned above, the importance of certain parameters can vary according to the type of activity. That means that other decision trees will be developed, e.g. starting with the environmental impact of the activity, or with the characteristics of the area. An individual company can choose which cascade of questions seems more appropriate for its specific situation, or even use different decision trees in parallel in order to understand the nature of their 'Wicked Problem'.

6 OPTIMIZING THE COLLECTIVE BENEFITS /WELFARE MAXIMIZATION (VARIAN) BY PROVIDING THE RIGHT SERVICES

In the Buda case, we mentioned that the attribution of the 'most likely' Market Segment to an existing economic ecotope does not imply that all the requirements from the demand side are necessarily met. Most areas only approximate the 9 demand parameters and 26 product stratification characteristics.

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The market segments (Fig. 4) suggest that you could have similar loading and unloading conditions in the same segments (e.g. Modern Industry and Production). However, the current situation (Fig. 6) shows that there is no clear relationship between the most likely market segments and the actual organisation on the field. For policy makers this is a good opportunity to improve these areas according to market segment. This can lead to communicate to existing and new companies what behaviour is expected from them and what services (e.g. space for loading and unloading, public space, other activities in the neighbourhood,…) the local government will deliver to accommodate the economic activities. In this way, governments are taking steps to welfare maximization by providing the right services.

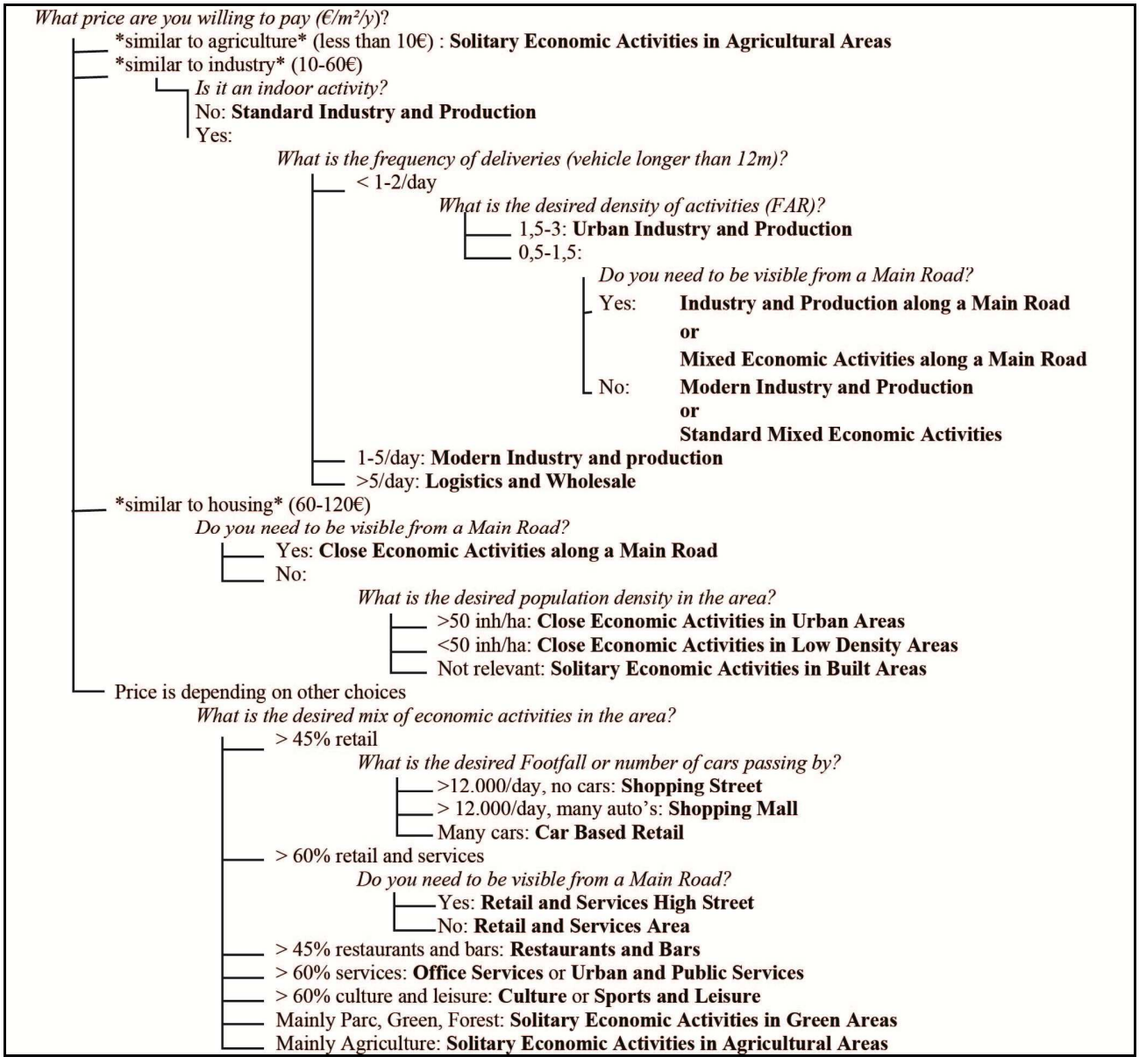

Fig. 5: Example of decision tree for site location choice between market segments

7 TRANSITIONS AND TRANSFORMATIONS

For policy makers, the creation of market segments based on an analysis of the current situation, is not sufficient. Especially in areas that are in a process of transformation at a high rate, such as Buda, the main objective is to redevelop large parts and therefore to change the existing segment into another segment. This will result in attracting new investments that are in line with the redevelopment goals, while existing companies will have to adapt to the new context or move to another location. For this purpose we will develop a different set of decision trees, with the 26 product stratifications parameters as a starting point. These trees guide policy makers through different main questions in order to get to a specific market segment. As a result, policy makers will get a clear idea about the most likely behouviour of companies in

this segment. Next to this, the trees will help them to get a clear understanding of what public services they have to provide.

Fig. 6: Current organisation of Loading and Unloading in Buda.

8 CONCLUSION

In this paper, we gave a brief overview of the spatial economic research we carried out and commisioned over the last 5 years. We started from the assumption that a new approach was needed to give economic planning an appropriate position within a spatial planning policy framework, in order to restrain green field development. The change from an urban expansion paradigm to a transformation of built up space paradigm necessitates a good understanding of the current economic functioning. By mapping economic activities on the field, and conducting many interviews and site visits, we got a good idea of territorial and spatial important parameters. The view point of micro economics and site location choice models gave crucial information. Thanks to this, we were able to move from an analytical tool to a decision support scheme for individual companies. In a final step we aim to transform the findings and maps into a policy making support tool, both for maximizing welfare and for the transformation of existing areas.

To get to a stable and fully developed spatial planning tool, more experiments and tests on the field are needed. We aim at combiing this with the elaboration of a separate set of decision trees.

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🏆 *reviewed paper*

Identifying Locations Suitable for Innovative Urban Public Transport Integration in Gauteng Province

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1 ABSTRACT

Globally, integrated urban public transport systems have been used as a solution to improve public transport services and reduce reliance on private cars which assists in reducing traffic congestion on the roads. In South Africa, Gauteng province is challenged daily with traffic congestion on the roads during certain peak hours. Therefore, the government of Gauteng province has developed innovative urban public transport systems - the BRT system and the Gautrain system - to improve the state of reliability and movement frequency of urban public transport. However, there is still a lack of reliability and of seamless travelling. This paper aims to explore locations where innovative urban public transport systems (BRT system and Gautrain system) can be further integrated in the province. The study adopted a qualitative research design that facilitated the gathering and analysis of spatial data and qualitative data from the innovative urban public transport officials, commuters and GIS data (BRT and Gautrain shapefiles). Results reveal that there are numerous locations that can be integrated where commuters can switch from one urban public transport system to another to improve travelling by public transport. The study concludes that this level of integration can create seamless travelling in the province and easy access to different modes of public transport. The study recommends that the identified locations need to receive attention as most commuters of these innovative UPT systems are located around these areas and to use the created model of the study to this effect.

Keywords: Urban Public Transport; Spatial Integration; GIS data; Reliability; Seamless travelling.

2 INTRODUCTION

Urban Public Transport (UPT) has become an increasing need to transport people from origin to destination. UPT is designed to reduce the various negative impacts on the roads. In developed countries UPT functions well with periodic improvements. In developing countries such as South Africa, UPT is not functioning at its best potential as planned, thus it struggles with attracting most of the private vehicle owners on the roads. Although Gauteng province has developed innovative UPT systems it still lacks public transport network connectivity within these systems. The objective of the study is to identify a way to attract more UPT users. Therefore, it aims to explore locations where more innovative urban public transport systems (BRT system and Gautrain system) can be integrated in the province. This is expected to improve the Gauteng province UPT network and hopefully attract many new UPT users.

3 LITERATURE REVIEW

Burt (2014), defines transportation planning as a cooperative process designed to foster involvement by all users of the system, such as the business community, community groups, environmental organisations, the traveling public, freight operators, and the general public, through a proactive public participation process conducted by the Metropolitan Planning Organisation (MPO), state Department of Transportation (state DOT), and transit operators. Transportation planning and design choices have a direct influence on development patterns, travel mode choices, infrastructure costs, redevelopment potential, the health of natural resources, and other community concerns. Transport planning/evolution and demand usually respond to how communities' function spatially (Redman et al., 2013) and, in some cases, transport planning can be used to force spatial change (Browning 2013). Further, transportation helps shape an area's economic health and quality of life. Not only does the transportation system provide for the mobility of people and goods, it also influences patterns of growth and economic activity by opening access to land. Transportation planning is more than listing highway and transit projects. It requires developing strategies for operating, managing, maintaining, and financing the area's transportation system to achieve the community's long-term transportation goals (Burt 2014).

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According to Hidalgo (2009), the public transport planning phase is critical as part of an overall planning system, while the design element is tied to a management plan as it will involve planning of routes and stops integrated with location and frequency of use. What needs to be considered at the strategic level of planning the public transport system is long-term stability of a high service quality for the public transport system to influence urban development and create more sustainable transport patterns (Moyo et al., 2018). Consequently, Mbatha and Gumbo (2019), state that planning a public transportation system is a multi-objective problem that includes among others line planning, timetabling, and vehicle scheduling. For each of these planning stages, there are known models and advanced solution techniques. Some of the models focus on spatial integration, others on commuter convenience. Devising a transportation system is usually done by optimising each of these stages sequentially.

In some instances, the challenge is physical connectivity, as some transport modes are not entering certain locations and, in some cases, the problem lies in the planning phases. For urban public transport to function well, there are certain elements that need to be considered. In the planning process, there is a need to find the current demand and the relationship of movement between different public transport modes and environmental demands. There is a need to formulate a plan which predicts future travel demand and makes recommendations on how to deal with challenges that might occur. The plan needs to assess whether the proposal will meet demand and provide maximum benefit to the community. This includes monitoring existing conditions, such as future population forecast and employment growth; assessing projected land uses in the region and identifying major growth corridors; identifying current and projected future transportation problems and needs; together with detailed planning studies to analyse various transportation improvement strategies to address those needs. Urban public transportation planning in South Africa has been improving over the years as more strategies from around the world are adopted by the Republic. Several transport modes have been implemented in order to improve the state of public transport in the country. Bus Rapid Transit & Speed train are implemented in order to boost quality, efficiency, effectiveness and reliability of the public transport network. Existence of these modes can be found in Gauteng province.

3.1 Integrated Transportation Approach

Transport systems are complex and multi-dimensional with many parts that compose the whole. The objective of integrated transport planning is to find a balance among these dimensions so that planning and investment decisions contribute optimally to the economic, social, cultural and physical potential of the transport system and society in general. Integration is a concern with the whole, with common objectives and agreed desired outcomes. The different options, goals and points of view must be integrated to identify realistic solutions to community problems. Integrated transport planning is more than coordinated transport planning. It integrates multiple and sometimes-conflicting objectives to reach more sustainable transport outcomes that contribute to community, industry and government priorities. Further, it is significant that the transportation network is well established from the beginning of the development, thus designs need to incorporate links between roads to link and foresee enough space for future vehicle movement and potential smart transportation development. In South Africa, Gauteng implemented smart UPT, such as the BRT system in the City of Tshwane (A Re Yeng bus), Ekurhuleni (Harambee bus) and City of Johannesburg (Rea Vaya bus). The development of these concepts played a positive role as it brought more alternatives to UPT; however, it reduced the width of the road used by other vehicles - both public and private transport- leading to traffic congestion at certain peak hours. Hence, environmental challenges and high human health risk are arising due to time spent on the roads where cars release noxious gases (Mbatha and Gumbo 2019).

3.2 Physical and Network Integration

Proximity to, and ease of access at mode interchanges are greatly enhancing public transport services. Hence, walkways must be carefully designed for passengers to change mode. Passengers must be within a short walking distance from their residences to a transit stop. Cities like Hong Kong and Singapore have been able to build mass transit stops in the heart of neighbourhoods, thereby providing proximity to residences, offices and retail outlets. Bus and rail systems should be an integrated network whereby these separate networks are complementing one another. Feeder services using buses, trams or light rail should be designed to maximise the patronage of the trunk routes (Liu and Ceder 2017). Network integration is closely linked to physical integration and both contribute towards the integration of infrastructure. For instance, it is relatively easy to change between different lines on the London Underground (tube) network as tube stations have been

designed with several interchange points between tube lines (Moyo and Musakwa 2016). Cities such as Hong Kong, Singapore and Kuala Lumpur have been able to redesign bus routes so that they feed into and support the mass transit/metro lines (Luk and Olszewski 2003). Similarly, London's underground and buses connect with the overground heavy rail network to take passengers to their final destinations. An essential part of network integration involves timetabling services so that intra-modal and inter-modal services connect efficiently and effectively.

3. STUDY AREA

The study area is Gauteng province which provides many economic opportunities in the Republic with a land cover area of 18 176 m2/ The province is the heart of economic activity.

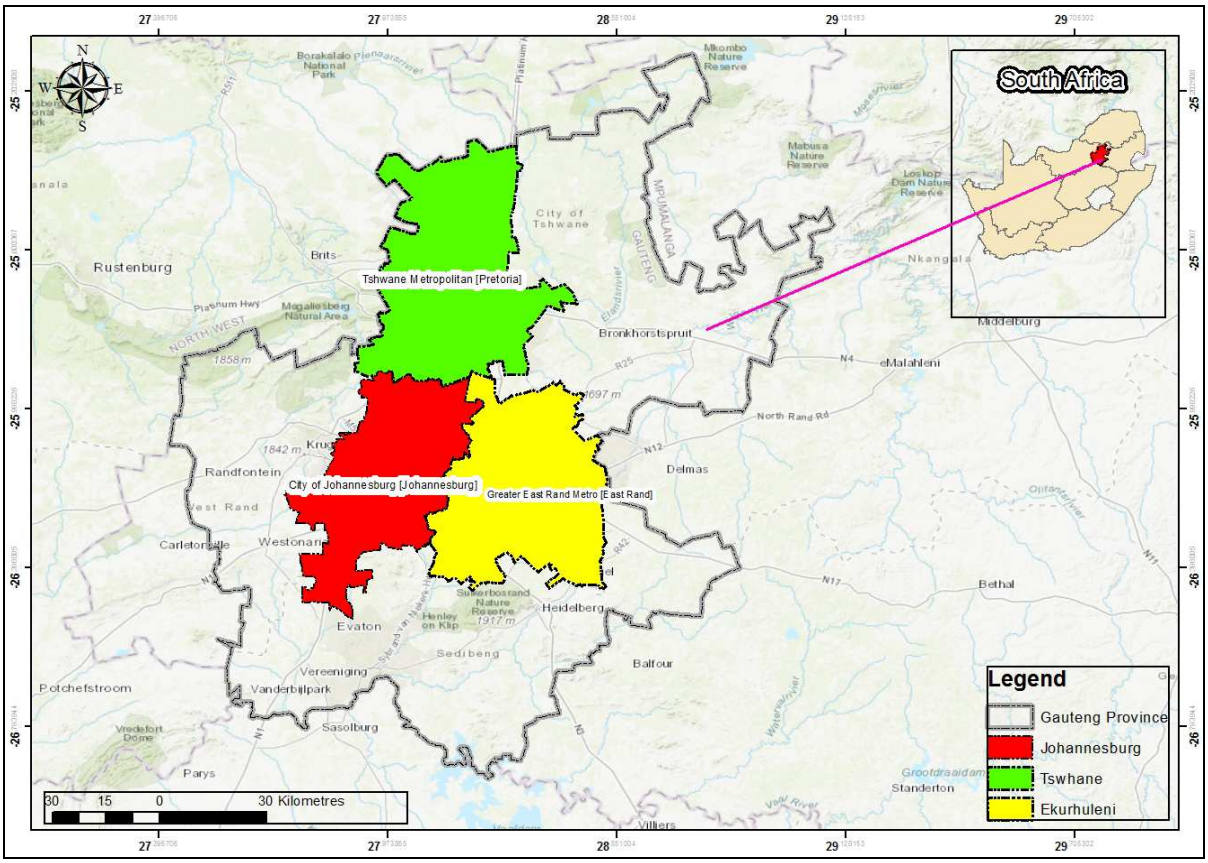

Figure1: Gauteng Province [Source: Author, 2020]

The depicted map (Fig 1) indicates the study area. According to Stats SA (2011), the population of Gauteng Province is 12,27 million. The study focuses on the formal urban public transportation system in the province, specifically Bus Rapid Transit (BRT) system and Gautrain system. The Gautrain system operates in selected locations in the province; however, it services all three metropolitan cities in the province which include the City of Johannesburg indicated in red, the City of Tshwane indicated in green and Ekurhuleni indicated in yellow. The BRT systems established in the province differ in names and work in the designated cities, and designated locations. In the City of Tshwane there is A Re Yeng bus, in the City of Johannesburg there is Rea Vaya bus and in Ekurhuleni there is the Harambee bus.

4 METHODOLOGY

A mixed method research design was adopted where qualitative data and spatial data analysis was used. Various research instruments were employed in the study. Ten interviews were carried out with officials from different departments, including the Johannesburg Road Agency, Department of Transport, Gautrain and BRT officials and Metropolitan Municipalities transport planners/ They assisted in providing insights for the study about the possibility of integrating the different public transport modes (bus and train) in general, and how to integrate the different entities of UPTs in the province. Accordingly, commuters were also interviewed to understand the commuter patterns and if there are any commuters who commute to and from one metropolitan city to another. 20 different daily commuters were interviewed who may have

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different experiences taking place daily. Purposive sampling was adopted as it was necessary to conduct interviews with informed officials and commuters. ArcGIS assisted with creating Gautrain rail tracks; BRT route maps were showing locations serviced, together with physical integration of the FUPT modes. BRT data (shapefiles), Gautrain data (shapefiles), interviews and documented studies relating to this study were the sources of data. Experimental analysis was conducted in order to develop a model through kriging interpolation that explains strategies of identifying suitable locations for integrating innovative Urban Public Transport in the province. Further, content analysis was employed to review previous documented studies. Secondary data used was obtained from larger data base such as Scopus, Science direct, Sage and Google scholar.

5 FINDINGS

The results obtained for this study were from both interviews and kriging interpolation. Interviews is one of the most important technique to collect data as researchers can gather views of some of the important role players involved. Interviews conducted with the officials in Gauteng province, indicated that there are various alternatives of urban public transport modes which include both informal and formal urban public transport. The use of taxis, bus and train services are in operation. Commuters using the City/Municipality bus services are currently subsidised, based on multi-journey ticket sales, by Gautrans in terms of an interim contracts. The subsidy funds originate from the budget of the National Department of Transport (NDoT) (Department of Transport 2007). The City of Johannesburg and the City of Tshwane have implemented the BRT system to improve the state of formal urban public transportation in the province for some time while Ekurhuleni BRT is still new. Further, there are also trains which include types such as Metrorail and Gautrain. Metrorail has schedules which are slow but very cheap. On the other hand, Gautrain is very quick in terms of operating schedules but expensive to use. Implementation of the Gautrain system was both to improve the state of urban public transport and to connect the three metropolitan municipalities in the province.

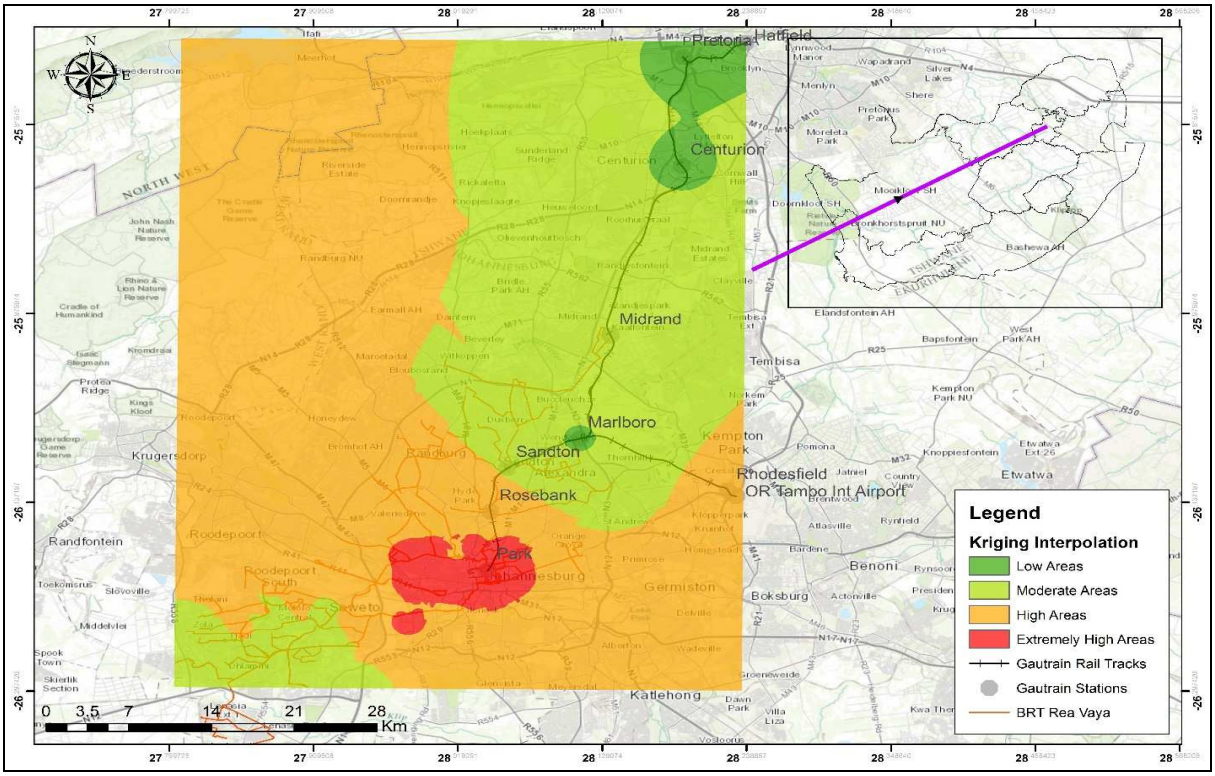

Figure 2: Gautrain and Rea Vaya Kriging Interpolation [Source: Author, 2020]

Officials highlighted that when these systems were developed plans put in place located these innovative UPT systems not far from one another. Gautrain was operating through all three metropolitan cities to act as a spine and connect with BRT systems in the three cities. It was found that the routes serviced by the BRT busses were mostly the busier routes. They were chosen for that purpose and could become potential route extensions planned to increase the BRT services to other locations in the province. Accordingly, this strategy

could lead to the physical integration of numerous routes in the province. Commuters indicated that there was also a need of spatial integration between the two systems as some of them travel between and within these three metropolitan cities and therefore an integrated system would be a positive asset for the overall UPT network of the province. Such integration would lead to seamless travelling which would less stressful for individuals who are travelling within the province.

5.1 Kriging Interpolation

When performing the analysis of UPT integration, this technique assists with creating a model that identifies the locations suitable for BRT and Gautrain integration in Gauteng province. This tool is important to identify hot spots and cold spots of locations concentration.

The map (Fig 2) indicates the suitable locations for physical integration in the City of Johannesburg between BRT Rea Vaya and Gautrain toward innovative UPT. In the index different colours are used to show different concentrations. All the areas overlaid by the location concentration indicate where there is a possibility for physical integration and/or a possibility for future expansions of these innovative UPT modes to develop an integrated UTP for Gauteng province.

Physically suitable integration locations	Percentage of suitable locations for integration%	Location Concentration
Red	15	Extremely high Concentration
Orange	40	High Concentration
Lime Green	30	Moderate Concentration
Green	15	Low Concentration

Table 1: Suitable locations for integration in COJ [Source: Author, 2020]

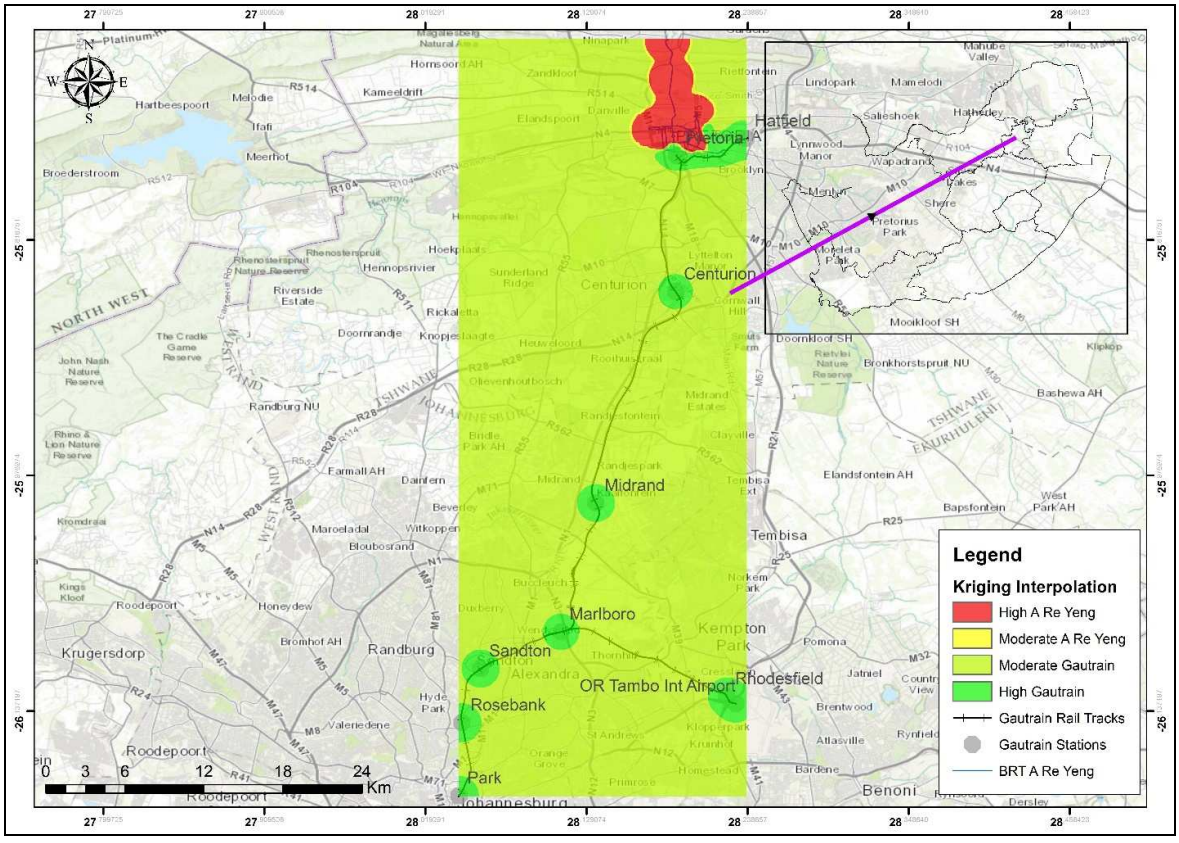

Figure 3: Gautrain and A Re Yeng Kriging Interpolation [Source: Author, 2020]

In the City of Johannesburg, Park station and its surrounding areas show extremely high concentration which is indicated in red. These locations indicated in red shows that it is suitable for physical integration in the city between Rea Vaya and Gautrain so that commuters can switch smoothly from bus to train. However, areas of 'extremely high concentration' in the city are very low in percentages and only identified in Park station and surrounding areas. 'High concentration areas' have a higher concentration percentage which is identified in

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many locations in Gauteng province, moving towards Roodepoort where future Gautrain stations are proposed. Moving towards Ekurhuleni close to Boksburg there are also opportunities for future expansion of the Gautrain station. Rea Vaya services occupy some other locations in Roodepoort. This indicates that when the Gautrain station is being developed in Roodepoort, this presents the possibility of future physical integration between Gautrain and Rea Vaya. Consequently, 'moderate concentrated areas' show a slightly possibility of integration as there is transport network of either Gautrain or Rea Vaya. This indicate that there is a possibility of whereby future stations of these innovate UPT systems could be developed. Further, low concentrated locations indicate that possibilities for physical integration of Rea Vaya and Gautrain are unlikely to happen. Below it is the map indicating suitable locations for physical locations in the City of Tshwane.

The map (Fig 3) shows Gautrain and A Re Yeng kriging interpolation. This analysis was conducted to identify locations that are suitable for physical integration in the City of Tshwane between A Re Yeng and Gautrain. Gautrain rail track, Gautrain stations and BRT A Re Yeng routes were all added to make sense of the suitable location areas for physical integration.

Physically suitable integration locations	**Percentage of suitable locationsfor integration%**	**Location Concentration**
Green	20	High Gautrain Concentration
Yellow	5	Moderate A Re Yeng Concentration
Red	20	High A Re Yeng Concentration
Lime green	55	Moderate Gautrain Concentration

Table 2: Suitable locations for integration in COT [Source: Author, 2020]

The above index of location concentration highlights that most of the areas that are concentrated are close to the Gautrain rail track, Gautrain stations, A Re Yeng bus routes and A Re Yeng bus stations. All the areas far from this have 0% of concentration where there could be a possibility of innovative UPT integration. However, if in the locations where there is concentration expansion of rail track, roads and stations could take place, there could be more concentration throughout Gauteng province and more areas could be identified for suitable physical integration. In the City of Tshwane, both a high A Re Yeng concentration area and high Gautrain concentration area are identified. Where these two-high innovative UPT concentrations connect indicates the suitable areas for physical integration in the City of Tshwane. Most of the locations with high concentration which include Gautrain stations and A Re Yeng station refer to the possibility of integration, as there are existing stations around those locations. Moderate Gautrain concentration also indicate a possibility of where more stations can be developed in the province and a possibility of physical integration could take place. The map (Figure 5) shows the integrated network for innovative UPT in the Gauteng province.

The map (Fig 4) indicates the integrated innovative UPT network of A Re Yeng bus in the City of Tshwane, Rea Vaya bus in the City of Johannesburg and Gautrain moving around all three metropolitan municipalities. As mentioned earlier, there is a possibility of integrating innovative UPT in Gauteng province as there is spatial integration on some locations in the province. This would lead to seamless travelling in Gauteng province. Rea Vaya bus in the City of Johannesburg connects physically with numerous Gautrain stations, A Re Yeng bus in the City of Tshwane physically connects with two Gautrain stations while the Harambee bus is still new and only connects physically with one station in Ekurhuleni. Integrating the BRT system with the Gautrain system will create reliability in UPT and easy access to different locations in the province. There are people travelling daily around the three metropolitan cities for different reasons, mostly work and school. Commuters travelling from the City of Tshwane to the City of Johannesburg can use the A Re Yeng bus from origin (home) and switch modes at a Gautrain station (Hatfield or Pretoria central) to a Gautrain to travel to the City of Johannesburg. Consequently, when commuters get to the City of Johannesburg, they can use Rea Vaya from the integrated areas between BRT and Gautrain to travel to their destination (work, school or place of interest). Further, Rea Vaya services a larger area in the City of Johannesburg including South Western Township (SOWETO), Tembisa, Rosebank etc. Therefore, there are commuters from other locations in SOWETO who travel to Ekurhuleni and the City of Tshwane. Commuters from Soweto, Tembisa can use Reya Vaya to travel to the City of Tshwane and Ekurhuleni by switching in between at Park station to a Gautrain and travel to Ekurhuleni and the City of Tshwane. When commuters reach the City of

Tswane they can switch to an A Re Yeng bus to their destination (work, school, home or place of interest) and on the other hand when commuters reach Ekurhuleni, they can switch to a Harambee bus to their destination.

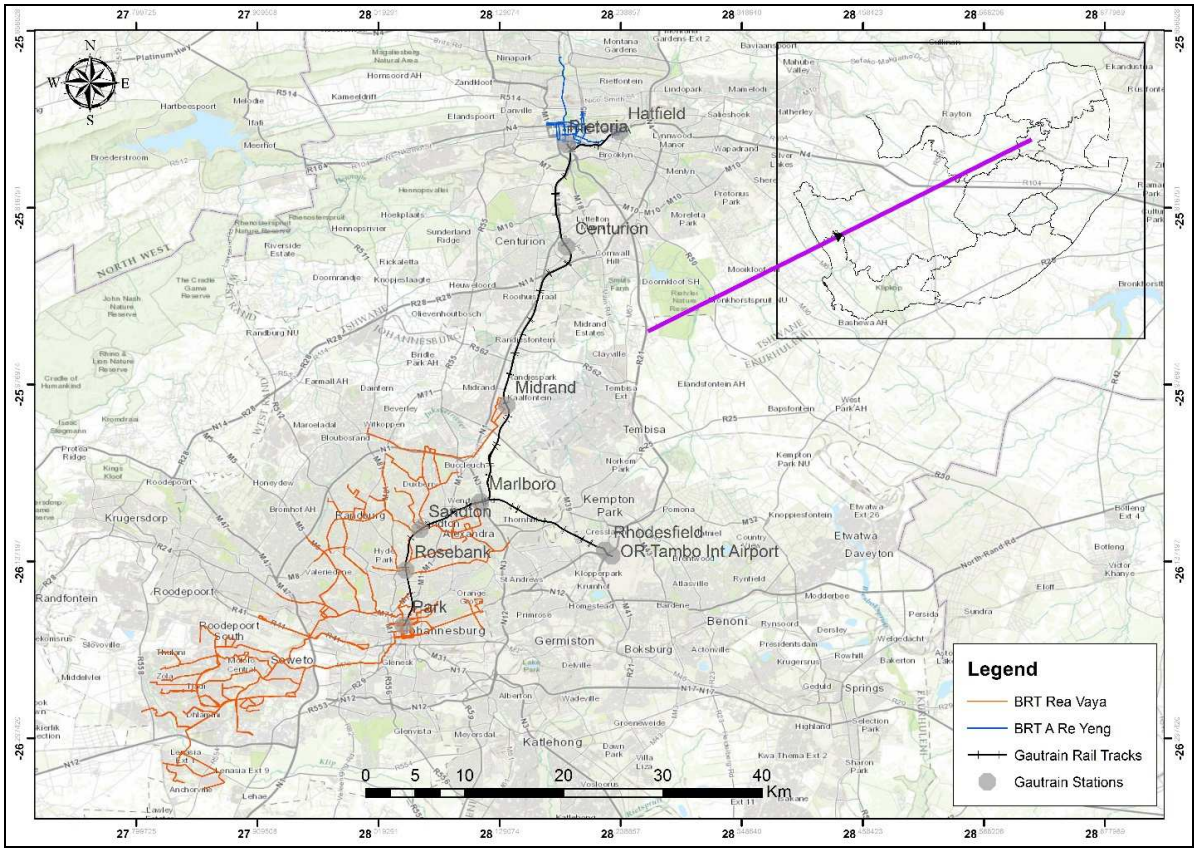

Figure 4: Integrated BRT and Gautrain Network [Source: Author, 2020]

6 CONCLUSION

South Africa is a developing country with good functioning UPT modes. Gauteng province has developed two of the world class UPT systems which are the BRT system and the Gauteng System. However, the study has indicated that these systems are currently not integrated which leaves a huge gap to commuters who use both UPT systems to reach desired destination. Therefore, an experimental analysis using kriging interpolation was performed to identify locations that can be suitable for physical integration in the Gauteng province. In the City of Tshwane, the results have shown a possibility for physical integration between A Re Yeng and Gautrain in Pretoria Central and Hatfield station. In Johannesburg the results have also shown a possibility for physical integration in Park station and other areas close by, and in Ekurhuleni Harambee is still small but over time it will increase and it will assist to connect Ekurhuleni metropolitan with the two metropolitan cities (COT and COJ). This shows that there is a possibility of bringing these services together and create one integrated transport network that will function across the province. Furthermore, the analysis also indicated areas which are possible for future expansion for implementation of stations to expand the transport network.

7 URBAN PUBLIC TRANSPORT INTEGRATION MODEL

Figure 5 explains the model regarding how to identify suitable locations for integration between the BRT system and the Gautrain system. Kriging interpolation was performed to designate suitable locations and help to identify current cold and hot spots of locations that need formal urban public transport services. When kriging interpolation was performed, first, Gautrain shapefiles and Rea Vaya shapefiles were combined to produce desired locations for integration in the City of Johannesburg. Second, Gautrain shapefiles and A Re Yeng shapefiles were combined also to produce desired locations for integration in the City of Tshwane. Kriging interpolation analysis was performed with an ARCGIS software. Lastly, the analysis also revealed locations that need services for the expansion of this UPT network. Accordingly, an

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integrated network map was designed to show the integration of BRT with Gautrain from the City of Johannesburg to the City of Tshwane in Figure 4.

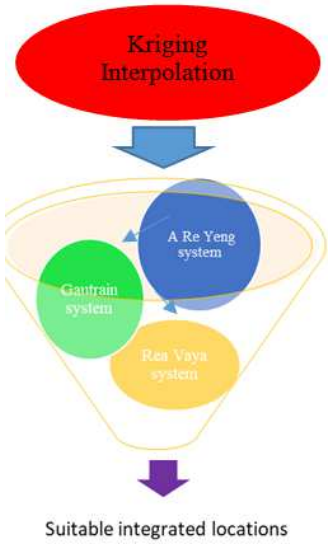

Figure 5: Spatial integration UPT model [Source: Author, 2020]

8 RECOMMENDATIONS

Adoption of integrated UPT network across the province is significant to attract more ridership of UPT and reduce private vehicle ownership and use on the roads resulting in less car accidents, less GHG emissions and producing smooth travelling from one city to the next. This is important, as in South Africa private car ownership increases regularly every year. The model used for the study can be adopted in order to identify suitable locations for UPT integration.

9 FUTURE STUDIES

Integrated UPT system allow for reliable, effective, convenient, safe, efficient and smart public transport in a certain place. The study focused on integrating spatially innovative UPT services in Gauteng province with the primary focus on both the BRT system and the Gautrain system. If there is a possibility of integrating these systems, the above-mentioned factors will take place. Therefore, there will be a need for such innovative UPT networks to connect all nine provinces in the country to create seamless travelling with well-functioning spatial integration. Future work will look at integrating UPT networks throughout South Africa.

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Identifying Policies and Legislative Frameworks to Create Integrated Innovative Public Transport in Gauteng Province

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1 ABSTRACT

Urban Public Transport (UPT) plays an imperative role in a society, it allows people to access different locations easily. Good urban public transport services attract more users reducing private vehicle on the roads and creating an environment with less gas emission produced. Key instruments used globally for good public transport service are policies and legislative frameworks. In South Africa, all three spheres of government National, Provincial and Local have implemented good urban public transport systems. However, in all the three spheres of government, there seems to be lack of connectivity of different systems of innovative urban public transport (Bus Rapid Transit (BRT) system and Gautrain system). Therefore, this paper aims to identify policies and legislative frameworks put in place to integrate innovative urban public transport in Gauteng province and what strategies can be implemented from these documents. The study adopted qualitative research approach were literature of previous documented studies, urban public transport drafted policies and legislative framework documents in South Africa, and interviews conducted with urban public transport officials. The results revealed that there are policies and legislative frameworks implemented, however, it is difficult to practice the strategies and ideas documented as these systems are owned by different entities. The study concluded that the provincial government need to identify ways of strengthening the available policies and legislative frameworks to integrate the different innovative public transport systems, by doing so, a common ground could be identified for integration leading to convenient public transport creating seamless travelling in the province. The study recommends that policies and legislative frameworks used in developed countries with good integrated urban public transport should be adopted and practiced in Gauteng province.

Keywords: Urban Public Transport; Integration; Policies and Legislative Frameworks; seamless travelling

2 INTRODUCTION

Globally, developed countries with good public transport system have good policies and legislative framework supporting sustainability, and integration to allow commuters easy access to UPT services. Urban public transport plays a significant role in the social and economic development of any country, and the National Government of the Republic of South Africa has recognised transport as one of its priority areas for socio-economic development. The effectiveness of the role played by urban public transport is to a large extent dictated by the soundness of the transport policy and the strategies utilised in implementing the policy (Chowdhury et al., 2018). Gauteng has developed innovative UPT in the past 10 years BRT system and Gautrain system. However, there is lack of integration in these systems. Therefore, the paper aims to identify policies and legislative frameworks put in place to integrate innovative urban public transport in Gauteng province and what strategies can be implemented from these documents for the province to have a world class functioning UPT.

3 LITERATURE REVIEW

Recently, integration of Pubic Transport (PT) systems has received attention from policy makers. Government authorities are investing in new infrastructure to improve the quality of PT services (Vassallo et al., 2012). Globally, regional plans are typically established to indicate amendments in the current system to alter it into a connected system. As most cities have an existing PT network, it can be difficult to create the changes that are required for integration. Implementation occurs in steps. For this reason, it is important to determine the key attractive features for the users (Chowdhury et al., 2018). The main purpose of an integrated transport system is to provide PT users with a “wide spectrum” of destination choices and with a convenient, accessible, comfortable, safe, speedy and affordable system (Ibrahim, 2003; Luk and Olszewski, 2003; Ulengin et al., 2007). Studies have shown that integrated systems can attract a greater number of users.

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Ibrahim (2003) discussed that in Singapore, where PT use is considerably high at 60% of mode share, the government aimed to increase the mode share to 75% through integration. Matas (2004) investigated the significant increase of PT use (>40%) in Madrid, Spain from 1986 to 2004 and found the reason to be the changes made for integration. The study discussed that integrated fare system and network integration had the most impact on ridership. Buehler (2011) conducted a comparison study between USA and Germany and showed the ridership of sustainable transport in Germany to be greater; 40% of German travelers used sustainable modes (8% for PT) while only 11% of American travelers used sustainable modes (2% for PT). One of the reasons given was better integration of PT services in Germany. Abrate et al. (2009) assessed the impact of fare integration on the ridership of services from 69 Italian operators. The effects of integrated fare systems on patronage were 2% in the short-run and 12% in the long–run (Chowdhury et al. 2018). These, countries managing to improve to higher ridership have well design policies and legislative frameworks focusing on supporting integration.

The provision and management of well-integrated, affordable and reliable modern public transportation systems in South African cities is critical in ensuring both smart cities and mobility within them. Notwithstanding the evident benefits of modern urban public transport systems, governments of the developing world at all levels, have been struggling to plan for, develop and manage public transport systems of acceptable standards (Musakwa & Gumbo, 2017). African governments have been struggling to provide well-coordinated, efficient, reliable and affordable public transport systems in their ever-growing cities spatially and demographically (Risimati & Gumbo, 2018). Consequently, there have been spirited efforts in South Africa to not only enact relevant urban transport legislative frameworks and policies but also their implementation to facilitate the development of efficient modern public transport systems. Notably, South Africa has adopted several enabling policies and legislative instruments to promote innovative urban public transport systems since the realisation of the democratic dispensation in 1994 (Risimati and Gumbo 2019).

4 METHODOLOGY

A qualitative study research design was adopted with most of the data drawn from the policies and legislative framework. Some of the data was drawn from the key informant interviews to understand why policies and legislative frameworks can't be implemented or used practically with 3 officials from the Department of Transport, 2 officials from City of Johannesburg Metropolitan Municipality and Larger database. Larger database used are Scopus, Science direct, Sage and Google scholar. Secondary data sources were used such as journal articles, Newspaper articles and documents from municipalities. The publication of authors featured on many journal articles in search results were studied for any relevant information to assist the study. For preparation of this study, 50 publications were reviewed, and only relevant publications were used. Further, Up-to-date conference proceedings were reviewed to assist with the current awareness, improvement from industry practitioners and researchers. Secondary data is important in supporting the study based on what other studies revealed. Purposive sampling was selected to assist this study with relevant data, only UPT journals articles and other materials were used. Journals as well as other materials selected only focused on integrated innovative UPT, Policies and Legislative frameworks. Journal articles focusing on UPT not relating to this study were excluded. Distillation of existing literature and documented analysis was used for the data analysis. Documented analysis highlighting ways of supporting integration of innovative UPT through drafted and approved policies and legislative frameworks was conducted.

5 FINDINGS

Interviews from different personnel have indicated that there are different modes of innovative UPT in Gauteng province which are owned by different entities with different visions. With these different innovative UPT modes developed in Gauteng, it has been agreed that there is lack of integration and it is not easy to connect all these modes due to different objectives. However, the study has identified numerous policies and legislative frameworks supporting integration of different modes of UPT. These policies and legislative frameworks are implemented to support the modal shift from private vehicles to UPT. This will minimize several challenges on the roads such as traffic congestion, GHG emission and drive less by reducing private vehicles and drive smart by using innovative UPT. Below are the policies and legislative frameworks identified;

5.1 National Development Plan (NDP) 2030

The National Development Plan offers a long-term perspective for the entire country. It aims to eliminate poverty and reduce inequality by 2030. The plan identifies the improvement of the quality of public services as critical to achieving transformation. This requires provinces to focus on identifying and overcoming the obstacles to achieving improved outcomes, including the need to strengthen the ability of local government to fulfil its developmental role. Transportation planning aims of the NDP 2030 are focused on the need to address inherited spatial divisions and call for a strategy that focuses on the space economy to address the legacy of the apartheid geography and create conditions for more humane and environmentally sustainable living and working environments by defining a spatially targeted approach.

The need for modal shift from private transport in the long term is highlighted. Behavioural change is critical in reducing environmental, social and economic cost, by shifting user and supplier decisions about movement, travel and sources of energy. While some forms of private transport, such as the car, will still be used in 2030, a marked change to PT will emerge through concerted effort, strong leadership, consistent messages and actions, and public system alternatives that work. By 2030, PT will be user-friendly, less environmentally damaging, cheaper and integrated or seamless.

5.2 Draft Revised White Paper on National Transport Policy 2017

Integrated transport planning has experienced limited success and difficulties in implementation, in that integrated transport planning is subservient to prioritised public transport and associated planning, and land use and transport integration is missing from current practices. An integrated transport planning framework should be established that integrates planning for infrastructure and operations across different modes, integrates the transport system with other sectors, and fosters integrated transport planning between the DoT and other departments, across and within the three spheres of government using shared data and information.

The part of the policy's mission in to provide integrated, well-managed, viable and sustainable transport planning and infrastructure meeting national and regional goals in the 21st century, in order to establish a coherent base to promote accessibility and the provision of safe, reliable, effective and efficient transport services. Accordingly, the strategic objectives for ITP are as follow:

- To establish sound integrated intermodal coordinating structures and promote the provision of seamless intermodal services;
- To promote seamless integration and harmonisation of standards with neighbouring member states; and to develop a comprehensive transport data and information system to inform integrated transport planning decisions;
- To find a practical and reasonable solution that leads to an equitable distribution of infrastructure capital, management, operating and maintenance costs across transport modes;
- To encourage more urban land use densification, correcting spatial imbalances and reducing travel distances and times for commuting to a limit of about 40 km or one hour in each direction;
- To promote a strong, diverse, efficient and competitive transport industry within the limits of sustainable transport infrastructure;
- To enhance the competitiveness of South African industry and the quality of life of its citizens by providing protection of consumers, safety and security, and meeting accessibility, reliability and mobility needs by providing transport infrastructure to serve the purpose;
- To ensure that the transport needs of persons with disabilities are considered when new infrastructure and operations are planned and designed;
- To advance human resource development in the provision of transportation infrastructure and management of operations (Department of Transport 2017).

5.3 Green Transport Strategy for South Africa: (2018- 2050)

South Africa has launched a Green Transport Strategy in June 2019 (GTS). Green Transport Strategy promote a transport system that is environmentally friendly and help boost economic growth and create jobs. This aims to minimize the adverse impact of transport on the environment, while addressing current and

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future transport demands, and encourages electric vehicle use and public transport enhancement. Fundamental to the greening of the transport sector is the seamlessly integrated functioning of the transport system. These integration policies and strategies have been defined in all transport sector planning, policy and strategy documents. Integration is the key principle on which all transport strategy rests for successful execution and functioning. In terms of the GTS, the modal shifts to rail and away from private vehicle use are premised on integrated transit and feeder systems that make far greater use of public transport and non-motorised transport.

GTS acknowledges the importance of advance technology in integrated transit systems as it notes that Intelligent Transport Systems have the potential to reduce GHG emissions and can be used through transport planning processes to provide advanced data via digital connectivity such as signal timing, real-time traveller information, incident management, etc. Transport planning and investment decisions can improve the operational efficiency of multi-modal transport networks and integrated transport and land use planning to reduce travel time. The DoT in consultation with National Treasury will provide a national team of experts to consult to all spheres of Government as infrastructure expands. The team of green transport integration experts will also consult to the Strategic Integrated Projects throughout their planning and execution.

5.4 National Land transport act of 2009

The national land transport act 5 of 2009 (“NLTA”) provides for the development and implementation of the Integrated Rapid Public Transport Network (“IRPTN”) plans by the metropolitan cities in order to provide uninterrupted public transport services to commuters. The Gauteng province consequently initiated the implementation of the IRPTN plan to improve the quality of lives of its commuters through facilitating an affordable and safe public transport services that will reduce the daily travel time between home and work. Bus travel time is naturally unstable since a small disturbance, such as a delay in boarding or alighting, can start a vicious cycle that results in bus unpunctuality. Further, buying a ticket for every public transport mode cost and take time. This reduce the attractiveness and the competitiveness of public transportation (Letaifa, 2015).

5.5 Gauteng 25-Year Integrated Transport Master Plan (2013)

The 25-year Integrated Transport Master Plan (ITMP25) contains a full Implementation Strategy for the transformation of the transport system in Gauteng over the next 25 years. However, given the current state of transport in the Gauteng City Region and the associated pressing problems and challenges, some urgent interventions are required. A number of various initiatives have been identified in order to integrate urban public transport in the Gauteng province. Regarding the study, integrated public transport ticketing and information are identified as one of the key importance initiatives.

5.5.1 Integrated Public transport tickets

In April 2011, Gauteng Department of Roads and Transport undertook the completion of Public Transport Systems Planning and Development of an Integrated and Interoperable Fare Management Framework. The objective of Integrated Fare Management (IFM) is to make it possible for seamless travel and transfer across an entire journey using a single fare media (and possibly a single fare) for different operators and modes of transportation. Furthermore, it is to promote an integrated fare collection system that will improve the transit experience and convenience for commuters. The IFM approach is to make public transportation systems more efficient by reducing the need for cash and cash management, and improving boarding times, which in turn reduces delays leading to better schedule adherence.

IFM relates to multiple operators (and multiple modes such as bus, rail, taxi) who deploy and accept the same fare collection mechanism for public transport services within a defined region. This type of system allows customers to travel throughout the region in a seamless manner. At a minimum, the use of a common fare media permits commuters to load individual Transit Products (e-Tickets or passes) from multiple operators as well as e- Money (electronic cash for fare payment) onto a single card. The purpose of the IFM Framework is to establish a common basis and vision from which to promote and execute Integrated Fare Management, towards establishing an integrated public transport system in Gauteng. The framework is being developed on a provincial level (to ensure consistency for strategic components), although operational components of the framework will be carried out primarily at a municipal level.

5.5.2 Integrated Public transport Information

The potential for collecting and integrating passenger travel information has always existed, but never realised because complex surveys were necessary to record this data. However, this problem has been resolved with the advent of Integrated Fare Management and the requirement for fare collection systems to comply with National AFC Regulations through the of use bank issued fare media. Many such electronic fare collection systems calculate and deduct a passenger's public transport fare through a "tap on tap-off" process. With the aid of vehicle satellite tracking systems this data translates into information on passenger travel patterns and volumes. A central data warehouse is required to be established in order to collect and collate this passenger travel data from different operators. The data can then be analysed to produce passenger travel information and real-time data for schedule information systems at stations and on-board busses. The advent of fast, reliable and affordable wireless/Internet communication has made it possible for travel information to be disseminated timeously and reliably via mobile phone (sms or social media), web sites and electronic signs. The use of an integrated, bank issued fare media must be established, through compliance with National AFC Regulations, followed by a Provincial Public Transport Data Warehouse. This will ensure the centralised collection of passenger data, to be disseminated as required once analysed. A Passenger Information Call Centre would be one means of co-ordinating the dissemination of such travel information.

5.6 Comprehensive Integrated Transport Plan 2015 - 2020

CITP 2015 to 2020 addresses all the chapters specified by the Department of Transport (DoT) CITP Minimum Requirements. The CITP is a statutory plan required by the National Land Transport Act No. 5 of 2009 (NLTA) and the Gauteng Transport Framework Revision Act. The CITP forms an integral component of the Integrated Development Plan (IDP). The CITP formulates City of Johannesburg, City of Tshwane and Ekurhuleni's vision, mission, policy and objectives for transport, consistent with the NLTA. The scope of the CITP has gone beyond what is required by the DoT in its minimum requirements, including aspects such as sustainable transport, aviation, road and public transport safety and security, intelligent transport systems, and micro-simulation of traffic in congested areas (Department of Transport 2007). The Gauteng province goals and objective are develop a transport system that improves accessibility and mobility whilst enhancing social inclusion, and provide a fully integrated public transport system. Consequently, develop a transport system that drives economic development, improve the safety and security of the transport system, and develop an efficient, effective, development orientated public transport system and integrates land use and public transport plans.

6 CONCLUSION

Improving the reliability of UPT services is a key priority and primary focus for the Gauteng Province Roads & Transport as stated in the Gauteng 25 - year Integrated Transport Master Plan. Consequently, National transport act 5 of 2009 ("NLTA") supports integrated UPT which provides for the development and implementation of the Integrated Rapid Public Transport Network ("IRPTN") plans. The City of Tshwane (A Re Yeng BRT), City of Johannesburg (Rea Vaya BRT) and Ekurhuleni (Harambee BRT) innovative FUPT services are the focus and Gauteng province is the primary unit of study. The aim of the study was to identify policies and legislative frameworks that supports the integration of innovative UPT. Therefore, policies and legislative frameworks have been identified. Accordingly, the province needs to initiate the implementation of the Integrated Rapid Public Transport Network policies in its Metropolitan cities to improve the quality of lives of its commuters through facilitating an affordable and safe public transport services that will reduce the daily travel time between home and work. Consequently, other policies and frameworks used in the province indicate strategies that could be used to strengthen and integrate different modes of UPT services, and this include integrated information dissemination, integrated payment system and spatial integration. With this, a common ground could be discussed, a working relationship for collaboration amongst public transport service providers with various entities to assist produce quality UPT services could be designed to benefit everyone. Non-integrated transport planning across various modes result in modes that are not sufficiently customer-focused and that are inefficient and have poor levels of reliability, predictability, comfort and safety. Such planning does not reflect the world-class aspiration of the NDP 2030. The fragmented nature of institutional governance over public transport is also not helpful. Therefore, there is a need for emergency solution to adopt and implement right policies and frameworks in the province.

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7 RECOMMENDATIONS

Policies and legislative frameworks in Gauteng province supports the integration of urban public transportation as their strategies of improving the public transport are focusing on integration. Therefore, the study recommends the adoption of the available policies and legislative frameworks in the province. Policies are available, however, the challenge they are not implemented practically. This is due to that, some entities are private and the others are public. Cooperation of public and private entities will strengthen the province's public transport. Therefore, policies and legislative frameworks need to support the relationship between the two (private and public) as they bring different perspective in UPT services. Further, countries with developed UPT make private and public entities relationship workable this include fare collection, information dissemination that is inline with one mode to the next and spatial integration with good transport networks. If such can be implemented at a global level, Gauteng province is capable as there is availability of innovative UPT. South Africa, Gauteng province, could adopt strategies used by these countries providing good UPT services.

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Improving Urban Regulations to Raise the City's Green Area Rates to Achieve Quality of Life Standards

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1 ABSTRACT

Open and green spaces are comfort elements and the necessary essential landscapes to improve the urban tissue and promote the urban environment of the city. This increases the level of welfare and contributes to the economic and aesthetic value of the city to achieve the quality of life standards. The Urban Regulations represent the cornerstone which help in reformation of a distinguished urban environment. The urban environment is planned through two important elements: buildings (residential –services) and spaces (public –streets –green). The Urban Regulations of the city are the mail element of planning buildings and system of public spaces, which determined the green spaces of the city, whether horizontal represented in (gardens and parks, green spaces, and green spaces in roads, routes and spaces) or vertical represented in (green spaces on building roofs, and vertical spaces on building façades). Therefore, it is necessary to evaluate the current Urban Regulations of construction in some Arab countries to plan a green urban as one of the regulations of the regulations of quality of life standards. This is the research objective.

Keywords: Quality of Life Standards, Green Area Rates, Urban regulations, Green Urban Formation, Arab countries

2 QUALITY OF LIFE AND GREEN SPACE

2.1 Quality of life

The green urban design in cities is one of the tools that helps in recognizing the quality of life standards among people, as the quality of life standards represent the full satisfaction of urban. There is a strong relationship between one of the tools, which is considered as the most important one, of green urban planning represented in (buildings and green services, horizontal and vertical green spaces, and green roads) and quality of life standards represented in (satisfaction of urban planning of a city, satisfaction of natural environment, social satisfaction, satisfaction of city economics). Therefore, we get acquainted of the quality of life standards and definition of green urban planning.

2.1.1 Definition of quality of life

Definition of Quality of Life is a wide and complicated definition, which includes various definitions. In brief, the definition of quality of life measures the level of satisfaction in relation with the most important aspects of individual life. In order to reach a specific definition of quality of life, an integrated research program was conducted to determine the most common definition. The initial research defined number of global indicators that define and measure the quality of life from various aspects. Each indicator was tackled in details for determination of the common elements. [1]

We depended on six indicators of the most important comprehensive indicators, which are globally known as main references: [2]

- Global Liveability Ranking: It is an annual indicator issued by the Unit Intelligence Economist, which categorizes cities in 140 countries in accordance with the urban quality of life, settlement evaluation, healthcare, culture, environment, education, sports, infrastructure, public spaces, and green spaces.
- Mercer Quality of Life Survey: It categorizes 231 countries based on the following aspects: transport, political, social and cultural environment, public service, health, economic environment, schools, education, natural environment, housing, and provision of media, theaters, cinemas, sports, commodities, restaurants, recreation, entertainment, and picnicking.
- Monocle Magazine List for Quality of Life: It is an annual list including 25 cities of the best cities for living around the world. The evaluation is based on the following aspects: global

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telecommunication, environmental issues, accessibility of nature and green places, urban quality, quality of urban designing, healthcare, and infrastructure.

- Happy Planet Index 2017: It categorizes 155 countries in accordance with the levels of happiness based on the following aspects: corruption, free choice, average life expectancy, gross domestic product for individual, social support, and granting.
- Organization for Economic Co-operation and Development Quality of Life Index: It is an index, which compares quality of life among countries based on 11 main aspect in accordance with the Organization: security, health, income, jobs, urban balance, life, work, education, level of satisfaction, housing, environment, society, and civil participation.
- ARRP Quality of Life Index: It is a distinguished initiative by the Policy Public Institute (for Measurement of quality of life of American communities based on the following aspects: transport, health, economy, education, housing, urban quality, residential districts, environment, community participation, and equal opportunities. [2]

2.1.2 Urban aspects of quality of life

Urban quality of life is a multidisciplinary and cross-cutting definition between a network of different aspects. The urban quality resulting from the relationship between these combined and compounded aspects consisting of seven aspects –contributes to the achievement of urban quality of life (environmental, urban, mobility and transport, social, psychological, and political). [3]

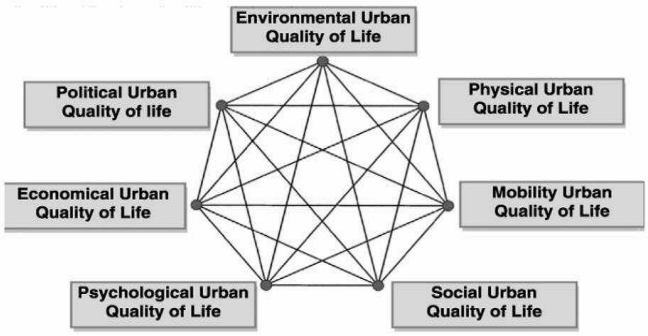

Fig. 1: Urban Quality of Life Aspects.

2.1.3 Quality of life standerds

A group of standards and principles, which achieve the quality of life, were derived by the European Union through a survey about (quality of life in European countries) in 2013. This group included all capital cities in the European countries, which reached to 79 cities. It was approved by the EU General Directorate of Regional and Urban Policy. It concluded to the following urban results, which achieve the quality of life as follows: [4]

Satisfaction of Urban Planning through:	
Sustainable Public Transport	Healthcare Services
Sport Facilities	Cultural Facilities
Educational Facilities	Availability of Shopping and entertainment stores
Administrative Services	Streets and Green Roads
Pedestrian Sidewalks	Public Parks
Public Green Spaces	Complementary Green Spaces
Security and Safety	
Satisfaction of Nature Environment through:	
Quality of Air	Quality of Hygiene
Quality of Water	Combating Climate Changes
Social Satisfaction:	
Feel of Happiness	Participation and Influence
Community Bonding	Living Place
Satisfaction of City Economics:	
Prices of Lands	Job Opportunities
Family Income	Housing Capabilities

Table 1: quality of life standerds

2.2 Green spaces

2.2.1 Benefits of green spaces. [5]

- Improvement of Environmental Conditions in Cities
    - Some of the problems which face cities are air pollution, urban heat island, and severe temperature in summer and winter. The foundation of urban biodiversity is the solution for these problems, as it largely contributes to improvement of environmental conditions in cities in several methods:
    - Green spaces work as CO2 absorbents. It is the gas, which is responsible for climate change. For each 100 m2 of green roofs, the gas, which is responsible for global warming, reduces to be 1.8 ton annually. In addition, installation of 100 m2 of green roofs above buildings results in producing oxygen for 100 persons annually.
    - Pollution resulting from 15 cars annually can be removed by 100 m2 of green roofs, as the leaves of the green space can keep these harmful particles on their surface.
    - Green spaces can reduce the surrounding temperature of cities of 1° C, which reduces the phenomenon of urban heat island and harmful smog in the city. In the same manner, it prevents the urban environments, which are more cold of 1° C, the harmful ozone layer, which happens during the emergence of severe temperature cycles.
    - One of the other features of green spaces that it keeps 40% of rain water too, and can delay disposal of water for 18 minutes in cycles of heavy rains. In addition, it prevents the collapse of sewage network in urban areas.
    - Green spaces work as filters for many harmful air pollutions; for example, 1 meter of green space can keep up to 200g of small health-harmful polluting particles annually.

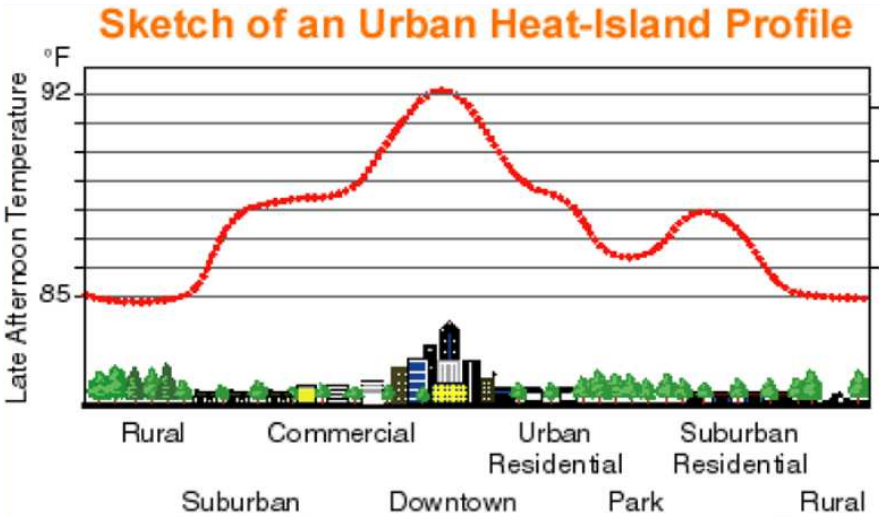

Fig. 2: Urban Heat Island Profile

- Green Space Ratios are one of the Most Important Urban Regulations in Cities

Recently, cities management witnessed the need for ensuring the availability of green spaces in cities to improve the environmental conditions and citizens' health and welfare. In addition, the green infrastructure, promotion of the nature capital of Europe (2013), is one of the EU initiatives to promote designing and establishing of more nature areas for sustainable development. Since 2013, Member States work on implementation of these guidelines through development of new policies aiming at achievement of environmental, economic and social benefits through natural solutions. Thereupon, the urban green spaces indicator allows the measurement of green space for each person in the urban areas, in addition to the green space in the city. In accordance with the World Health Organization, there is a need for 10 to 15 m2 of green space for each person to ensure healthy urban environmental system through various methods to merge green spaces and plan green architecture; for example, vertical gardens on building façades, green roofs, green roads, and urban parks.

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- Improvement of Cities Attractiveness

Beauty can change our view of life in the city. Decoration of building with green spaces does not enrich its architecture only, but also provides an attractive area for people who spend most of their time at the building. This promotes creativity and encourages innovation. Therefore, green cities have many psychological benefits; for example, vertical garden, green roofs and gardens increase city attractiveness, as people believe that it has better quality of life and more healthy and sustainable spaces. In addition, direct communication of green spaces promotes using of renewable energy and greener quality of life. In addition, modern studies show that more travelers choose sustainable destinations and visit cities that are committing to environment and nature, which is characterized by its environmental attractiveness, as it includes many green spaces, high quality of air and huge biodiversity.

- Improvement of Thermal Isolation of Buildings

Installation of green roofs on buildings and private houses provides more isolation resulting in cooler temperature in summer and warmer weather in months that are supposed to be the coldest. In addition, this reduces consumption of energy by 25% in summer and 10% in winter.

- Social Cohesion

In accordance with recent studies, cities with green spaces promote social cohesion and relationships. Who do not like to walk in a green park, or ride a bike or read a book under a tree? It provides points for sharing and establishing bonds between city people. In addition, green spaces positively affect people behavior, as urban garden build and develop relationship between neighbors and promote community bonds and feeling of identity.

- Improvement of People Welfare

In accordance with the World Health Organization, urban green spaces are necessary for people welfare, physically and emotionally. This means that people who live in cities with more gardens and parks have better quality of life that those who live in a high volume of pollution. The allocation of a part of the day for walking or relaxation in green space can make us feel comfort and think well. It reduces life pressures in the city. London is one of the most crowded and fastest growing cities around the world. Few years ago, London has changed some of its urban areas into green spaces to improve life of citizens and their relationship with nature.

Fig. 3: improvement of people welfare through green spaces

2.2.2 Considerations of green spaces desining[6]

- Distribution of green spaces near people.
- Diversity in green spaces.
- Simple design of components of green space.
- Maintenance of green spaces.
- Application of plan principles and ratios.

2.2.3 Green spaces impacts[6]

Green Space Criteria			
accessibility	Aesthetic	Amenities	Management
Location-distance -size - quantity-quality - security	Landscape - quality - perception	Infrastructure - service	Frequency- pesticides- watering

Table 2: Green Space Criteria

Green Space Impacts		
Use and function	Setting features	Environmental regulation service
Active mobility - Food production – Gardening - Physical - activity and sports - Relaxation and leisure - Social exchange	Impact on land price and rent levels - Medications of living environment and residential quality	Biodiversity support - Carbon storage - Pollution regulation - Soil protection - Temperature regulation - Water regulation

Table 3: Green Space Impacts

Pathways to Health		
Individual status	Physical environment	Social environment
Healthy lifestyle - Immune system function - Mental state - Physical fitness	Air quality - Climate change adaption - Neighborhood quality -traffic emissions - Water quality	Living expenses - Safety issues Social cohesion interaction and participation

Table 4: Pathways to Health through Green Space

3 URBAN REGULATIONS AND GREEN SPACES RATIOS

3.1 Definition of urban regulations

The urban regulations is a group of legislations, general regulations, decisions, and practices that control the urban environment in order to improve the Livelihoods and living conditions. However, the urban legislations failed in many developing countries in guiding and supporting sustainable urban development and modern urban orientations in addition to implementation of urban regulations and legislations efficiently. There is a gap between the urban legislations and regulations and objectives and tools of sustainable development, which must be improved and developed to get the urban quality ratios to the highest levels

3.2 Green spaces in Egypt

Green spaces is one of an important and essential element in modern cities planning, as it contributes to development of cities and districts development from the environmental aspect. Lack of green spaces or its low availability results in environmental imbalance of this area, which lacks of trees and gardens. In accordance with the global ratios, which is different from one country to another in accordance with the site and geographical nature of the country, each 5000 people “who are living for example in one district or neighborhood” shall have 3000 m2 of green spaces. These are the average ratios, which apply to the geographical nature in Egypt. By applying the mentioned ratio to the number of people in Egypt, which is 96 million people currently inside the Country, we need to provide 85 million square meters of gardens and parks. However, the existing spaces as mentioned by the Central Agency for Public Mobilization and Statistics are shocking and totally far from the space that should be available across the Country.

The existing green spaces in Egypt are less than 10% of the spaces that should be available to the current population of Egypt, as it is supposed to be “75 million square meters, while the Country, in accordance with the official statistics issued by the Central Agency for Public Mobilization and Statistics, has only 5,370 million square meters only”.[7]

3.2.1 Problems

- Change of cities into cement forests destructing its nature and green spaces: the sole lung and breath for the people.
- Poor distribution of green areas.
- Controlling the mechanics on the urban planning in unfair infringement of pedestrians rights and needs.
- Non-availability of human dimension and scale in designing the existing open spaces.
- Domination of constructed elements on natural landscapes on open spaces.

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- Poor utilization of the existing open spaces

3.2.2 Reasons

- Lack of thinking including planning strategies of green spaces at national, regional and local levels.
- Lack of comprehensive definition for open spaces network, which results in poor distribution of choosing sites and lack of linking to each other.
- Lack of financial resources that allow provision and maintenance of open spaces.
- Increase of population and construction density and increase of construction value of lands, which result in poor utilization of open spaces.
- Neglect and deterioration of the little existing open spaces, and non-maintenance of them periodically.
- Lack of environmental awareness of visitors and users of open spaces and non-application of urban regulations for standards.

3.3 Current Urban Regulations and requirements to the Ratios of Green Spaces

The green spaces are in all planning levels (neighborhood –district –city) and include different spaces for children playing in accordance with different ages, which is necessary for health aspects. However, they are used in cultural and social aspects, as they are used for festivals and public events in different occasions. [8]

3.3.1 City Park (Planning Ratios of Green Spaces)

- Serviced population: (40) thousand population and more.
- Green space around (0.3 -0.4) m2 per capita.
- Total proposed space (20000) m2 and more.
- Provision of car parking; one parking for (2) garden workers, one parking lot for (4) visitors.
- Provision of more waiting areas in the park to serve a specific part. Such parking shall be linked to entrances and exits of the park and internal roads to distribute the motion well

3.3.2 Residential District Park (Planning Ratios of Green Spaces)

- To be available at residential districts in big cities and at small capitals.
- Serviced population: between (15-25) thousand population.
- Green space around (0.4 -0.5) m2 per capita.
- Total proposed space (0.6-1.2) Hectare.
- Provision of car parking; one parking for (4) visitors.

3.3.3 Residential Neighborhood Park (Planning Ratios of Green Spaces)

- To be available at residential neighborhoods.
- Serviced population: between (3-5) thousand population.
- Green space around (0.9 -1.2) m2 per capita.
- Total proposed space (2700-6000) m2.
- Provision of car parking; one parking for (4) visitors.

3.3.4 Children Play Yards (Planning Ratios of Green Spaces)

- To be available at residential neighborhoods or residential groups in all cities.
- Serviced population: between (1500-4000) population.
- Play yards around (0.22-0.33) m2 per capita.
- Space of play yards: (500-900) m2.
- Provision of car parking; one parking for (4) visitors.

3.3.5 Big Gardens and Specialized Quality Gardens (Planning Ratios of Green Spaces)

- To be available at national and big regional centers, in addition to big cities and capitals.
- Serviced population: (100) thousand population and more.
- Big gardens around (0.6-0.8) m2 per capita.
- Space of play yards: (60000) m2 and more.
- Provision of car parking; one parking for (2) park workers and one parking for (4) visitors.

Green Spaces	Population (Thousand)	Per Capita (m^2)	Total Space (m^2)
City Park	40 and more	0.30 -0.40	20000
District Park	15-25	0.40 -0.50	6000 -12000
Neighborhood Park	3-5	0.90 -1.20	2700 -6000
Children Play Yards	1.5 -4	0.22 -0.33	500 -900
Big Gardens	100 and more	0.60 -0.80	60000

Table 5: All Proposed Levels of Green Space Standards

3.3.6 The current per capita green area according to the current urban regulations in some Arab countries

Indicator	Damascus Syria	Manama Bahrain	Dubai Emirates
Area (km)	105	30	4.12
Per Capita Green Space (m^2 per inh.)	0.70	2.5	13.18

Table 6: the current per capita green area in some Arab countries

3.4 Global Ratios of Green Space Distribution

3.4.1 percentage of Green Space Distribution in the City .[9]

It is a simple and clear indicator, but its negatives can be distracting in case of high densities of residents, high building ratios, and high ratios of heights, but the minimum level usually between 10% to 20% of the space of the city. For example, in Germany, the percentage is 40% to 50% for most of the German cities.

3.4.2 Ratios of Green Space Distribution in the City. [10]

Indicator in Europe	Western	Southern	Eastern	Northern
Area (ha)	29625.04	25595.24	18958.96	48816.15
Residential Area	4936.69	2489.48	2665.92	5661.93
Green urban areas	853.24	399.2	462.06	1288.32
Per Capita Green Space (m^2 per inh.)	27.25	10.97	13.71	32.95

Table 7: Ratios of Green Spaces in Europe

Northern Europe (Highest Ratios)	**32.95** Per capita green space
	
	

Table 8:shows the way of distribution of green spaces in the Northern Europe

Southern Europe (Lowest Ratios)	**10.97** Per capita green space
	
	

Table 9:shows the way of distribution of green spaces in the Southern Europe

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3.5 Leading Models of Green Urban Planning to achieve Quality of Life Standards: Malmö [11] and Nantes Metropole [12]

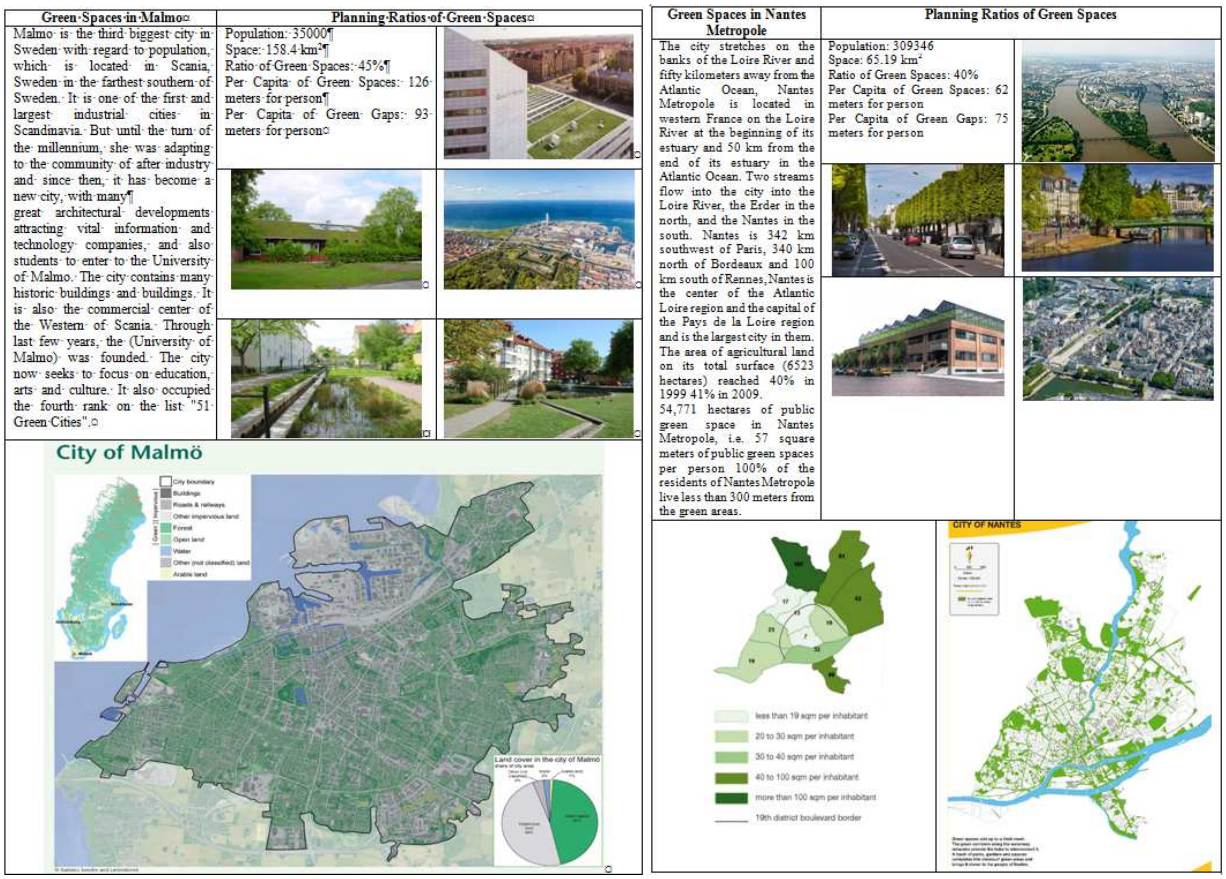

Table 10 (left): shows the Regulations and requirements of Green Spaces in Malmo, Sweden. Table 11 (right): shows the Regulations and requirements of Green Spaces in Nantes Metropole, France

4 EVALUATION AND DEVELOPMENT OF URBAN REGULATIONS OF GREEN SPACES IN ARAB COUNTRIES

4.1 Evaluation of Current Urban Regulations

By comparing the global ratios of green spaces to ratios in our Arab and Egyptian cities, we can find that there is a huge difference between the urban ratios and regulations, which results in an urban construction unqualified to achieve quality of life standards. Therefore, it is necessary to amend regulations and requirements regulating the green spaces system planning and using of new and different approaches and suggestions to raise the ratios of green spaces to achieve quality of life standards. The following table shows the gap between ratios of green spaces:

City	Cairo, Egypt	Nantes Metropole, France	Malmo, Sweden
Per capita (m^2/ person)	1.5	75	93

Table 12:shows comparison between global and local ratios

4.2 Urban Regulation Suggestions to raise Green Space Ratios

4.2.1 Residential Buildings

- Modification of urban construction ratio to the residential volume applicable in the Arab countries from 60% to 45% of the total lands. It is necessary to allocate 50% of the remaining space as a green space.

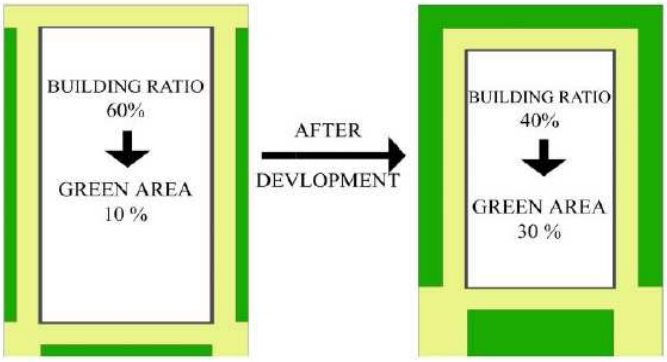

Fig. 4: Modification of Residential Requirements to raise Ratios of Green Space

- Modification and development of urban regulations of residential buildings and change them from nature-destructing cement buildings to green buildings through the reformation of buildings and using the building factor, Floor Area Ratio (F.A.R). The Floor Area Ratio is total space of the building (total land space) to volume of the land on which buildings were built. This factor is usually used as one of the regulations of cities planning in addition to the ratio of building to land) in order to change the residential building from a residential block into a form and height changing block.

Fig. 5: Modification of Residential Requirements through the Building Factor (Floor Area Ratio)

- Using green roof systems, which is represented in live plants fixed on roofs that positively contribute to mitigate urban area impacts and promote thermal and environmental performance. There are three main types of green roofs; each of them has its own characteristics in accordance with table (10),(11) which shows the types of green roofs system. [13]

Characteristics	Extensive	Semi-intensive	Intensive
Depth of material	150 mm or less	Above and below 150 mm	More than 150 mm
Accessibility	Often inaccessible	May be partially accessible	Usually accessible
Fully saturated weight	Low (70-170 kg/m2)	Varies (170-290 kg/m2)	High (290-970 kg/m2)
Cost	Low	Varies	Highest
Maintenance	Minimal	Varies	Highest

Table 13:shows types of green roofs system

Green Roof Components.[13]	Benefits
	**Ecology** Wildlife habitat Air Quality Biodiversity
	Social less stressed Increased productivity Reduced sick days
	Noise Reduction
	Energy and Heat energy consumption Moderate roof temperature Improve solar efficiency
	Economy Reduce size of HVAC equipment Higher productivity Extend roof membrane life
	Rain water Utilization of rain water

Table 14: components of green roof systems and benefits from using them

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4.2.2 Services

- Modification of building ratio of residential block applicable in the Arab countries from 50% to 30% of the total space of the land, and it is necessary to allocate 50% of the space as a green space, and the remaining spaces as parking and service facilities.
- It is necessary to treat service facilities with the F.A.R system.
- Using green roofs

Fig. 5: University of Miami Lakeside Village Student Community Housing

- Using of green façades in the service facilities, which is a type of green wall systems, as plants climbs and form a plants cover. The green façades can be installed on the existing walls or built as stand-alone. [14]

Fig. 6: Green wall, Semiahmoo Library in South Surrey (http://www.vancouversun.com 2013)

4.2.3 Green Spaces

Modification of urban regulations of green space ratios inside the city reaching between 10 50 15 square meters of green spaces for each person to ensure the existing of healthy urban environmental system in accordance with the World Health Organization. In addition, modification of green space ratios (children play yards –district parks –district parks –city parks –big parks) in accordance with the following table.

Green Spaces	Population (Thousand)	Per Capita (m^2)
City Park	40 and more	1.5 -2.0
District Park	15-25	1.5 -2.5
Neighborhood Park		3.5 -5.0
Children Play Yards	1.5 -4	1.0 -1.5
Big Parks	100 and more	2.5 -4.0
Total		10.0 -15.0

Table 15: Modified Green Space Ratios to reach 10-15 meters for person

4.2.4 Roads

Development and improvement of ratios relating to green spaces on roads and streets, and increase the ratio of trees and green spaces on both sides of roads and traffic islands to raise ratios of green spaces in the city. Figures (8) and (9) show the way of distribution of trees on both sides of roads and traffic islands:

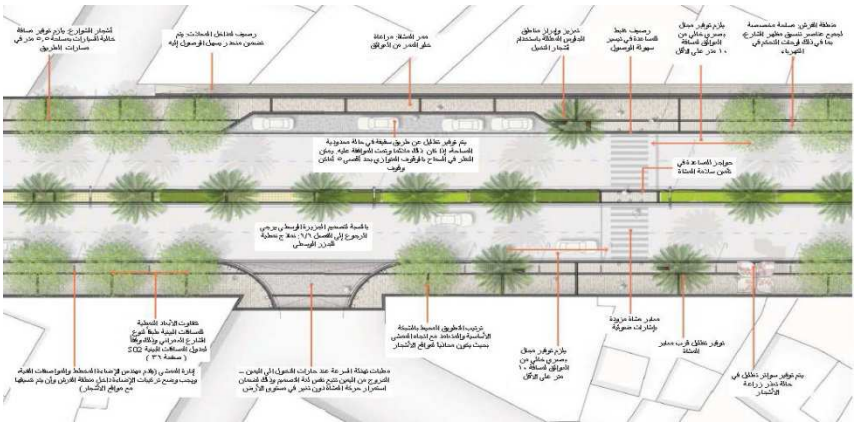

Fig.7: Distribution of Tree Ratios on Both Sides of Roads and Traffic Island

Fig.8: Sector shows distribution of Tree Ratios on Both Sides of Roads and Traffic Island

5 RESULTS

- Definition of quality of life is a wide and complicated definition including several definition. In brief, the quality of life measures the level of satisfaction relating to the most important aspects in person's life. It can be said that judging quality of life standards is represented in one important element, which is green spaces.
- Green spaces are an important and essential element in planning modern cities, as it contributes to development of cities and districts from the environmental aspect. The non-availability or lack of green spaces may result in environmental imbalance in areas that lacks the availability of trees and gardens.
- Green spaces has many benefits to human-beings in improvement of environmental conditions of cities and cities attractiveness in addition to the thermal isolation of cities, social cohesion and human welfare.
- It is necessary to consider many consideration in designing green spaces (distribution of green spaces near people –diversity of types of green spaces –simple design for green spaces –maintenance of green spaces –application of planning principles and ratios).
- Urban regulations are group of legislations, general regulations, decisions, and practices that control the urban environment development to improve livelihoods and living conditions. However, the urban legislations failed in many developing countries to guide and support sustainable urban development and modern construction orientations, and implement urban regulations and legislations efficiently.
- In accordance with the World Health Organization, there is a need for 10 to 15 m2 of green space for each person to ensure healthy urban environmental system.
- Green space ratios in the European countries are between 10 meters to 35 meters, and it increases in some cities to be 93 square meters as in Malmo, Sweden.

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- The existing green spaces in Egypt are less than 10% of the spaces that should be available to the current population of Egypt, as it is supposed to be "75 million square meters, while the Country, in accordance with the official statistics issued by the Central Agency for Public Mobilization and Statistics, has only 5,370 million square meters only". The per capita of green spaces in Cairo is 1.5 square meters.
- By comparing the global ratios of green spaces to ratios in our Arab and Egyptian cities, we can find that there is a huge difference between the urban ratios and regulations, which results in an urban construction unqualified to achieve quality of life standards.
- It is necessary to amend regulations and requirements regulating the green spaces system planning and using of new and different approaches and suggestions to raise the ratios of green spaces to achieve quality of life standards.
- Modification of urban construction ratio of the residential volume to the total space of land, and it is necessary to allocate 50% of the remaining land to be green spaces and allocate the remaining spaces as parking and service facilities.
- It is necessary to treat service facilities using F.A.R system.
- Using green roofs.
- Using green facades.

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🏆 *reviewed paper*

Industrial Landscapes Between Environmental Sustainability and Landscape Constraints: The Case Study of Euralluminia in the Sulcis Area of Sardinia (Italy)

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1 ABSTRACT

In Italy, industrialization had a remarkable development in the 1950s and 1960s, and aimed with priority of ensuring economic growth and development. The location of the industrial complexes was determined by the dynamics of the production that required a territory equipped to supply specific infrastructures such as water connections, sewers, gas pipelines and the electricity grid, and above all areas where to build transport terminals capable of mitigating the costs of handling the product. This led Italy to locate industrial activities in many coastal sites, close to pre-existing urban contexts, resulting in a well-defined coastal industrial landscape especially in the areas of Southern Italy that were chosen as centers of development. Today, the determining factor for location choices is the cost of the workforce and this has made more and more frequent the processes of delocalization of the companies with worrying repercussions both for the direct and induced occupation and for the degradation of the landscape. This process, linked to the safety regulations, to the updating of the systems and to an increasingly more rigorous landscape legislation, makes critical the framework of the existing and not yet abandoned disused industrial realities. For these reasons, the main objective of this article is to evaluate the compatibility between existing industrial areas at risk of delocalization and new interpretations of the environment and the landscape to be reconstituted, in order to allow the realization of goods that maintain the levels of industrial production within a framework of ecological protection rules and recently adopted landscape constraints. In this regard, in this paper the authors use the Eurallumina industry in Sulcis in Sardinia (Italy) as a case study, in order to analyze the problem that concerns the uses in the territories with an industrial vocation and the landscape components, that deserve particular attention to safeguard not only for the economic and social context but also for the quality of the coastal environment. The case study is particularly significant because the Euralluminia industry for some years was at risk of delocalization because it needs of a conversion of some parts of the plants, blocked due to the landscape regulation imposed by the Superintendence of Cultural Heritage of Southern Sardinia for the expected changes in the coastal environment. Therefore, keeping in mind the theories of localization and the pushes for the delocalization of the industrial contexts, the study discusses the importance of the interconnection between economic and landscape factors paying particular attention to the coastal areas.

Keywords: Eurallumina, Environmental Sustainability, Landscape Constraints, Industrial Landscapes , Smart Region

2 INTRODUCTION

For production activities (industries, large commercial chains, agricultural and livestock production) the territory is no longer the keypoint for the location choices, because the theory of the lowest transport cost (Camagni, 1980), from the product and from the correlated production processes to the origin is not decisive as it was before, when the production system at international level was not yet "governed" by multinationals interested only in the financial market (stock market quotations and more).

A factor that has instead assumed a relevant dimension for the location choices is the labor cost, especially when it comes to "heavy" productions that employ hundreds of people with work contracts that are not competitive with respect to those applied in emerging and developing countries (for instance India). For this reason, relocation processes are increasingly frequent for companies that "employ a lot of manpower" and that must remain competitive with respect to competitive markets even when the size of demand changes at local, national and international level.

In Italy, this problem is having worrying dimensions and is not currently easy to find solutions because without radical interventions, which unfortunately mainly affect the workforce, companies decide to move production processes in other countries, leaving the previously used territory, without remediation and restoration for pollution and for degradation.

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In addition, the investment models for the socio-economic development of the various Italian contexts (for example the theories on the industrial development poles of the South are outdated) changed, such as the problem of the land consumption is in constant evolution to allocate businesses, which produce technologically advanced tools for the digital society. This type of low-polluting activities (noise, processing waste etc.) does not require dedicated areas "outside the city" but lends itself to revitalizing urban centers.

In Sardinia, the framework of existing industries and of the ones that are not yet disused (in sectors such as mining, petrochemical and energy) is very critical and lends itself to operations of relocation with worrying repercussions for the direct and induced job.

Unfortunately, in Sardinia - but also in other regions in Italy and in Europe - the decision-making process is uncertain and too slow for taking structural initiatives, capable of reconverting already vocationally industrial areas, such as the Sulcis-Iglesiente in the Province of South Sardinia.

Even for the energy sources (that replaced coal in that area) is a lot of uncertainty and this does not favor negotiations with non-Sardinian companies that require preventive guarantees. The territorial offer is also lacking in administrative and bureaucratic facilities. Considering these assumptions, Figure 1 shows two important industrial areas (Machiareddu and Portovesme), in the southern of Sardinia, that are in crisis for many years with great difficulty in finding reliable policy-makers interested in intervening.

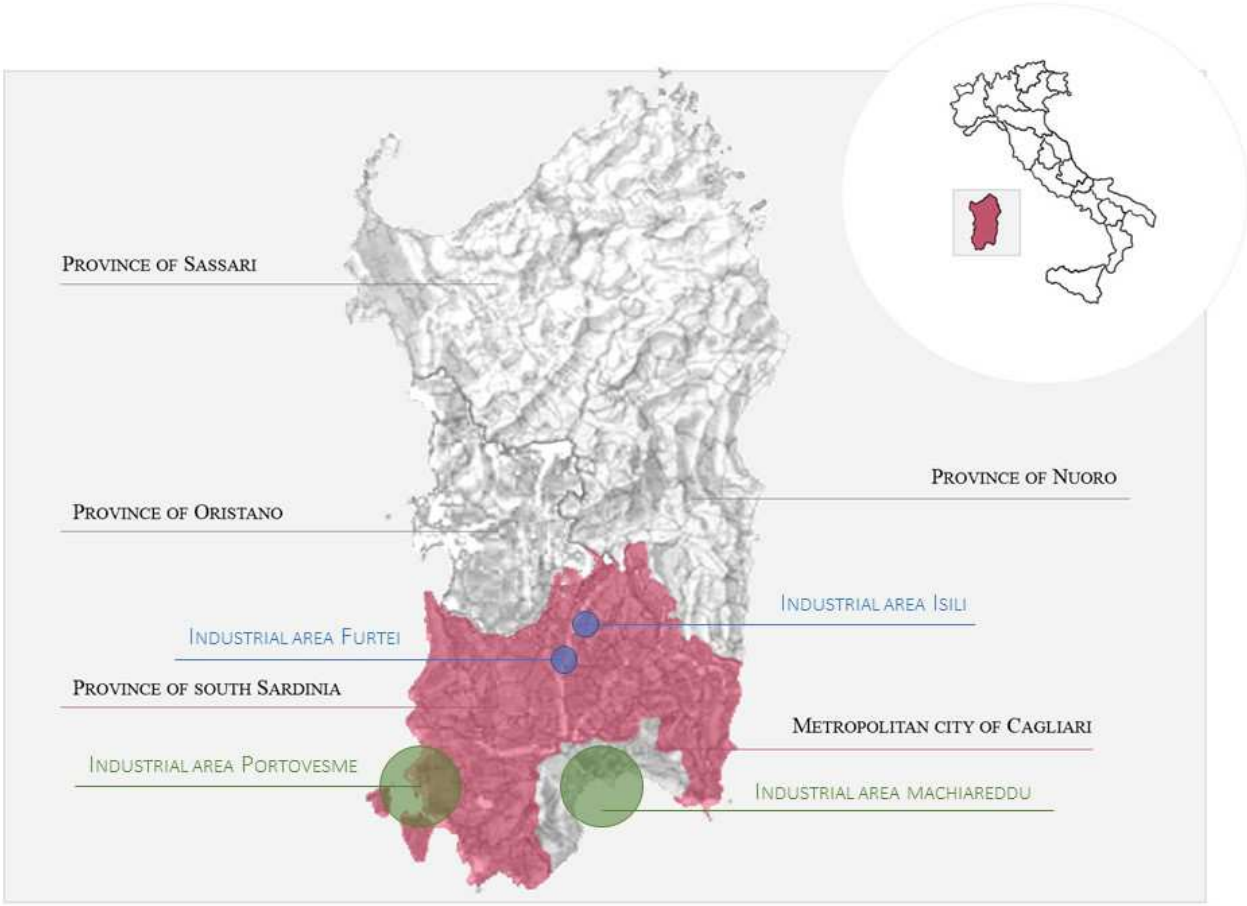

Fig.1: The Province of South Sardinia with the industrial areas of Portovesme and Machiareddu

The analyzed case studies want to focus on the problem that concerns the intended use in the territories with an industrial vocation. In addition, the components of the landscape deserve particular attention for the protection not only of the geographical context but also for the quality of the environment in presence of "polluting" activities.

3 ENVIRONMENTAL SUSTAINABILITY AND LANDSCAPE CONSTRAINTS IN SARDINIA

In this discussion, the historical process to evaluate the decision-making behavior of the policy on the territory with the succession of legal rules (of planning and of bargaining) is really important because in the past 50 years also the economic interests of the companies changed and, with them, the formulas for

establishments managing, for realigning the use of new technologies and digital tools and finally for increasing the competitive and unstable market frontier.

In addition, the historical process allows to understand the substantial changes in the way of life and the relationships of the inhabitants with the new dimension of the relationship space. It is hard to believe it, but different philosophies of thought with as many behavioral codes are still evident. The historical conflict between two cultures, the agro-pastoral one and the urban-industrial one, consolidated in this area of Sardinia, arose because the former was a simpler culture measured by the sites and the environment, while the latter was considered a certainly more advanced culture, but complex to evaluate the balance between the built and the environment (Mistretta, Garau; 2011).

It is also necessary to take into account how much the territory identifies itself as an expression of people's well-being or people's suffering, so much that in some cases it creates habituation phenomena and little interest in changes, in other cases it can produce the appreciation or refusal of projects aimed at having large industrial complexes which, through steel and reinforced concrete structures, verticalized by fireplaces with a continuous flame, the productive culture and work of thousands of workers are a diversified expression of industrial culture.

Therefore, the reasoning cannot be reduced to the tension between safeguarding the landscape “tout court” and the production process of industrial activities. In fact, in continuity with the plans launched in the context under study since the 1960s, the territory is equipped with specialized ports, road infrastructures and with technological energy and hydraulic networks. In addition, the classical rules of homogenizing the building typologies cannot be applied on the urban planning for industrial use, because the evolutionary scenarios of the production system of each company (from the first phase of the establishment to the subsequent phases that guarantee the competitiveness of the industrial product in the markets by innovating the establishments for production) require volumetric flexibility for the working spaces and for the use of the areas.This presupposes an Urban Master Plan (UMP) with non-detailed intervention proposals in order to use the territory in a way that incentivize the location of new companies and the relaunch of existing ones.

Unfortunately, the tendency to plan the territory in a sectoral way, both dimensional and typological one, does not allow to evaluate the processes and the proposals (even if they are excellent from a technical planning point of view) in a more composite framework of theories, experiences and professionalism that represent as many ways of operating, but with different goals.

This cultural and planning "conflict" occurs when green economy proposals call into question the persistence of economic realities that are still financially and occupationally efficient. This does not mean that all the industrial settlements that played an important role in the development of the areas and in the regions in which they operated are to be safeguarded without taking into account the necessary environmental and hygienic-sanitary remediation and those concerning the typology of buildings with new technologies. In other words, the compatibility between green expectations and the related guarantee rules must be guaranteed with a smart collaboration between public administrations and private operators in order not to cause irremediable crises that could induce delocalization processes that are in any case harmful to the general economy of the territory. This is to establish the relationships between the different social and economic functions for estimating the central level that are able to express the settlements.

Sardinia is an emblematic case because the legislation on landscape safeguarding (through the Regional Town Planning, RTP of 2006 [Garau Pavan; 2010; Pintus et al., 2019]) of not building within 300 meters from the sea in the coastal areas struggles with existing and economically active situations that concern two specific typologies: 1) the hotel accommodation; 2) the industries activated on lots that are part of specific industrial development plans, of which Sardinia, like the other regions of Southern Italy, was able to benefit from the industrial development poles (1965) to be located in the areas with the highest settlement vocation such as Cagliari with its port called “porto Canale”.

The authors are well aware that the "remote past" in urban planning can only have an experiential value for changes in the rural environment and in particular on the organization and remuneration of work, but it cannot be underestimated because the effects of the medium and long term are still evident in the territory with the urbanization works of scale and with the redistribution of the inhabitants urged by the central functions of the cities with directional activities (Cagliari, Sassari). This presupposes the precise identification and planning of the functional areas at urban level and of the infrastructures, directly related to

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the traffic flows, which have a particular meaning when they integrate the commercial and service functions with the other more important ones than the residential ones.

The habit of people, in general and without being socially and economically involved, is to look only at the geographical and environmental composition of the landscape, expressing a cold or emotional judgment based only on the aesthetic components, although behind the eye of the beholder of the landscapes, they are the different components of its DNA. Behind the eye of the viewer, the different components of its DNA coexist: environment and social context, affection for places, quality of life and level of well-being, education, culture, sensitivity, experience, age and gender.

General data of the Eurallumina company	Eurallumina is a company, today 100% owned by U.C. Rusal, through its subsidiaries, which built in the early 70s and operates in Portoscuso in Sardinia, in the Sulcis Iglesiente industrial area, an establishment for the transformation of bauxite into alumina (aluminum oxide) according to the Bayer process. The company operates on a transformation account for its shareholder or for U.C. group companies. Rusal which supply the establishment with bauxite and collect the alumina and aluminum hydrate produced. Eurallumina, therefore, does not directly sell its products on the market but delivers them entirely to the shareholders who, in turn, market them through the United Company Rusal.
Production Establishment	The Portovesme production establishment entered in production in May 1973 and has a potential production of approximately 1,100,000 tons/year. On 30 November 1990 the Council of Ministers adopted the resolution with which the Sulcis-Iglesiente area was declared an area at high risk of environmental crisis pursuant to and for the effects of art. 7 of the law of 8 July 1986, no. 349, as amended by art. 6 of the law of 28 August 1989, n. 305. In 1993 the Ministry of the Environment highlighted the main environmental problems in the Sulcis-Iglesiente area and the examinations and discussions with the bodies involved and with the appropriate coordination committee State-Region-Local authorities, on April 23, 1993 with Decree of President of the Council of Ministers n. 72, the decontamination plan for the restoration of the Sulcis -Iglesiente area was approved. In the conclusions of this document (point 2.4) of Chapter 2.0 "Summary of environmental problems", the main problems were hierarchized into 6 points, including Point 4: "the aspects of landscape and urban degradation and marine pollution related to the presence of the industrial center of Portovesme, although not insignificant, appear to be second-rate, especially in view of their limited extension (essentially limited to the areas closest to the pole, in the Municipality of Portoscuso), verified on the basis of available data". The production of the Eurallumina establishment was temporarily suspended in March 2009 after about 36 years of uninterrupted operation, due to the changed cost situation, mainly energy as mentioned in the 2009 Memorandum of Understanding and in the subsequent addendum of 2012, which they undermined economic competitiveness, and because of the global economic crisis that brought down the demand and price of alumina. Economic competitiveness, on the other hand, is critical for the high production costs, largely due to structural factors such as: the high cost of energy and the distance from the source of supply of the raw material (bauxite from Australia). The technological competitiveness of the Eurallumina establishment is good, although it can be further improved by using tri-hydrate type bauxites.
The Industrial Establishment	The Eurallumina establishment was built by EFIM (through ALSAR), in the 60s and 70s, like the other main establishment in the aluminum chain which form part of the Portoscuso Industrial Core with the aim to create a strategic hub of worldwide importance for the production of aluminum. The industrial area was built near the sea where an existing port was also expanded to make it suitable for unloading raw materials and shipping products.
Employees	Eurallumina currently has about 300 employees, many of whom have long experience in the refinery. Today, despite the suspension of the production process, the company guarantees the maintenance of the establishments using 70 daily work units in the company.
Regulation for this area (Scope Datasheet n° 6 Carbonia and Sulcitane Islands pp. 11 - 12 of the RTP)	"1. Redevelop the coastal landscape of the inland sea between the archipelago and the mainland, rebalancing the relationship between industrial activities, traditional fishing activities and tourist use, in a perspective of integrated conservation and management of the Area, also in reference to the "Marine area to find the island of San Pietro". 2. Progressively rebalance the relationship between the industrial presence of the Portovesme pole, the urban settlement, the tourist use, the agricultural activities and the marine and lagoon fishing of the Area, reducing the problems of interference of industrial activities with the environmental system. 3. Redevelop the areas of industrial degradation, selecting priority areas of intervention, on which to activate a progressive process of clean-up and environmental regeneration, which requires unitary coordination for the municipalities concerned in relation to problems of high environmental risk, for the programs of pollution control and environmental monitoring." 4. Part of the red sludge basin, the coal loading area (CHP site), the area on which the conveyor belt insists (site 2), the area of the Eurallumina port quay fall within the coastal territories included in a strip of depth of 300 meters from the shoreline, even for high ground on the sea.

Table 1: identity scheme of the case study of Eurallumina

With these premises, the main objective of this article is to evaluate the compatibility between existing industrial areas at risk of delocalization and new interpretations of the environment and landscape to be

reconstituted, in order to allow the realization of works that maintain the levels of industrial production within a framework of ecological safeguard rules and recently adopted landscape constraints.

In this regard, in this article the authors use the Eurallumina industry in Sulcis in Sardinia (Italy) as a case study, in order to analyze the problem that concerns the intended use in the territories with an industrial vocation and the components of the landscape, which deserve particular attention to safeguarding not only the economic and social context but also the quality of the coastal environment. The case in question is particularly significant because it encompasses the fundamental points of the discussion. In fact, the industry is at risk of delocalization for some years because it is asking for reconversion of some parts of the establishments, blocked due to the landscape relationship which provides for changes in the coastal environment which are excessive for the Superintendency of Cultural Heritage of Southern Sardinia. So keeping in mind the theories of location and the pushes for the delocalization of industrial contexts, the study discusses the importance of the interconnection between economic and landscape factors, paying particular attention to coastal areas.

4 THE EURALLUMINA OF SULCIS IN SARDINIA

The topic is particularly felt in Sardinia because, of all the industrial interventions realised in the past decades, the only one still in activity is that of the Sulcis Iglesiente which, heir to the mining culture, demonstrates competitiveness in the national and international market. Therefore, the case study that describes the events suffered by Eurallumina, constitutes an opportunity for political reflection and scientific evaluation that can be compared with other realities in Italy but also in Europe in corporate suffering due to localization factors.

The U.C. Rusal (global aluminum producer) as an example of resistance in Sardinia

Before tackling the discussion on the compatibility between industrial settlements and the protection of the environment and the landscape, it is necessary to analyse the most significant data through the table 1, in order to know the context and to understand the attitude taken by the various public decision-makers and environmental associations.

After Table 1 which describes the Eurallumina establishment, it is necessary to underline the points on which the technical discussion that empowered the political decision maker of the Sardinia Region and activated the binding opinion of the regional Mibact on the compatibility landscaping required for changes to the systems of the production system.

Environmental remediation (4.1.1): 1. Hydrogeological with reference to aquifers to eliminate causes and effects of pollution; 2. sanitary hygiene to make the area affected by the fumes of the production cycle healthy

Landscape compatibility (4.1.2): 1. the intended use of the area of land included in the Sulcis Iglesiente Industrial District with the destinations of the 2006 RTP; 2. the impact of the company's structural changes on the coastal landscape

4.1.1 Environmental remediation

After five years of discussion, not without tensions with the workers of the factory under the cassaintegration regime, the Board of the Sardinia Region adopted the plan presented by the RUSAL company regarding the interventions on the aquifers, on the red mud accumulation basins, on the emission of fumes and finally on public health not only referred to workers but also to the populations of the Municipality of Portovesme and the impact areas, concluding the procedure with the approval of the Environmental Impact Assessment (EIA) DELIBERATION N . 49/17 OF 5.12.2019). A complex document that analyzes all the most delicate points of the conversion of the industrial plant which in fact authorizes the resumption of the production process until January 2020. A historical result that rewards the tenacity of the workers who fought for this goal.

In fact, the restarting of EurAllumina is crucial for the recovery of the Alumino supply chain, which is valid as an official statistical multiplier of 1450 total jobs.

4.1.2 Landscape compatibility

Unfortunately, this is still an open problem because the Superintendency of Cultural Heritage of Southern Sardinia, which had not pronounced at the conference of services promoted by the Region, expressed its

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contrary opinion in its own seat for some of the proposed changes as they do not respect the environmental and landscape value requirements referring to the territory concerned. Another chapter of the infinite dispute that once again highlights the conflict of competences between a State body and the Sardinia Region, which according to the Statute has primary competence in urban and landscape matters.

To better explain the size and content of the respective interpretations, authors believe it useful to make some reflections on the interpretation of the natural environment and the landscape with reference to some points:

a) The first one marked by the physicality of the places and their interpretative relevance. However, although geodiversity is the most characteristic and stable landscape factor over time, it is not sufficient to excavate and study the anthropological components of the past and the current ones that emphasize the mountains, valleys, villages and cultivated fields.

b) The second one takes into account the anthropization in the history of the island through the types of settlement in the form of scattered villages and houses (Gallura and Sulcis) and which contribute to humanising the coastal landscapes, the flat hinterland, the areas of mountain.

c) The third one identifies itself as an expression of people's well-being or suffering, so as to create in some cases, habituation phenomena and of little interest in changes, in other cases the appreciation or rejection of the projects aimed as in the realities where they coexist large industrial complexes which, through steel and reinforced concrete structures, verticalized by the chimneys with a continuous flame, are a diversified expression of the productive culture and work of thousands of workers.

Attention to the historical process is fundamental to understand the substantial changes in the way of life and the relationships of the inhabitants with the new dimension of the relationship space where different philosophies of thought are still evident with the historical conflict between the agro-pastoral and urban culture -industrial. Great attention must therefore be paid to the ability of the communicative language that makes the relations between politics, economy, land use and environment manifest (Mistretta, Garau; 2011).

Furthermore, it should be considered that the European Landscape Convention (Council of Europe, Florence, October, 2000) has brought substantial innovations to the interpretation of the landscape and to the method for safeguarding and designing. Particularly significant is the description of the landscape, seen as "a certain part of the territory, as perceived by populations, whose character derives from the action of natural and / or human factors and their interrelationships". (Art. 1 letter. A). Equally important is the subtitle which on the "safeguard of landscapes" «indicates the conservation and maintenance actions of the significant or characteristic aspects of a landscape, justified by its heritage value deriving from its natural configuration and / or the type of human intervention» (Art. 1 lett. D).

This description of the industrial landscape of which Eurallumina was not considered sufficient to allow the regional superintendency of MIBACT to express a positive opinion on the changes described in the redevelopment and relaunch projects of the industrial process. In fact, to justify the negative opinion, the regional superintendency of MIBACT notes that the context is characterized by: a) natural and landscape features of exceptional relevance, characterized by the presence of numerous assets - protected by the law pursuant to Art. 142 of the Code; b) characterized by the succession of lagoons and dune complexes; c) directly overlooking the coast; and therefore; d) inserted in an aqueous space of relationship in which the various coastal contexts (Calasetta, Carloforte and S. Antioco) constitute mutually perspective and landscape scenes.

In this regard, the authors indicate the most significant observations (Biolchini, 2011) made for the discussion on the landscape in industrial areas already built and subject to innovation:

1. The project presented does not show the implementation process of the mitigation works, on the contrary it would seem that "the proposed mitigation works are feasible only at the end of the cultivation of the relative deposit and that the intermediate landscape impacts generated in the long term are not taken into consideration period for using the landfill"

2. "The final evaluation of the VIncA regarding the "wetlands" (SIC) immediately concerning the deposit of the" red mud "has not yet been acquired and, therefore, it is not possible to evaluate the impact of the project in question on the conservation of the 'natural area, recognized as a landscape asset by the RTP and, therefore, a subject of direct interest of this Superintendency for its conservation".

3. "The intervention is likely to adversely alter the skyline that characterizes the context of the numerous areas declared of considerable public interest pursuant to art. 136 of Legislative Decree 42/2004" as "The works envisaged by the project are in clear visual relationship with a vast air of the coastal territory" with "significant and negative morphological changes observable from numerous lookout points - including the water mirror included between the coast and the sulcitano archipelago - also subject to protection".

4. In this regard, it has yet to be highlighted that "the expansion of the Red Mud Basin determines the occupation of soils currently also free and it doubles the height of the landfill, generating a huge artificial hill of toxic waste, about 40 meters high".

5. The works envisaged by the project further contribute to altering the systems of relationships, introducing new elements of strong impact, absolutely dissonant and not compatible with the quality elements that the measures protect and that find in the water in front of the privileged area of relationship natural and environmental emergencies that define a context whose panoramic value is recalled by all the protection measures that are part of the coastal marine space which represents the identity and relationship element of the complex system of historical center, settlement and environmental resources with the centers urban with a historical layout (Carloforte, Calasetta, Portoscuso, Sant'Antioco).

The Superintendency concludes with this negative opinion: “definetely, the intervention conflicts with the protection purposes defined for the area concerned since it increases the landscape impact of the existing industrial complex and therefore is not consistent with the rules of the RTP explained for the areas of environmental recovery and in the reference area"

5 DISCUSSION: REASONS AND DEDUCTIONS ON THE INTERPRETATIONS OF THE LANDSCAPE OF PORTOVESME

It is important to consider the validity and legal competence, translated on the territory, of the RTP (approved with regional law 25 November 2004, No. 89) and those of the Provincial Industrial Consortium Sulcis - Iglesias (established with LR No. 10 of 27 / 07/2008) on the areas included in the Portovesme area (Fig. 2). In fact, it is necessary to assess whether the purposes of the 2008 law (SICIP) are conditioned by the previous provisions of the RTP (2004) which would subordinate the objectives of the same law described in article 1 letter a) and b) with the obligation to ensure coordination of the interventions.

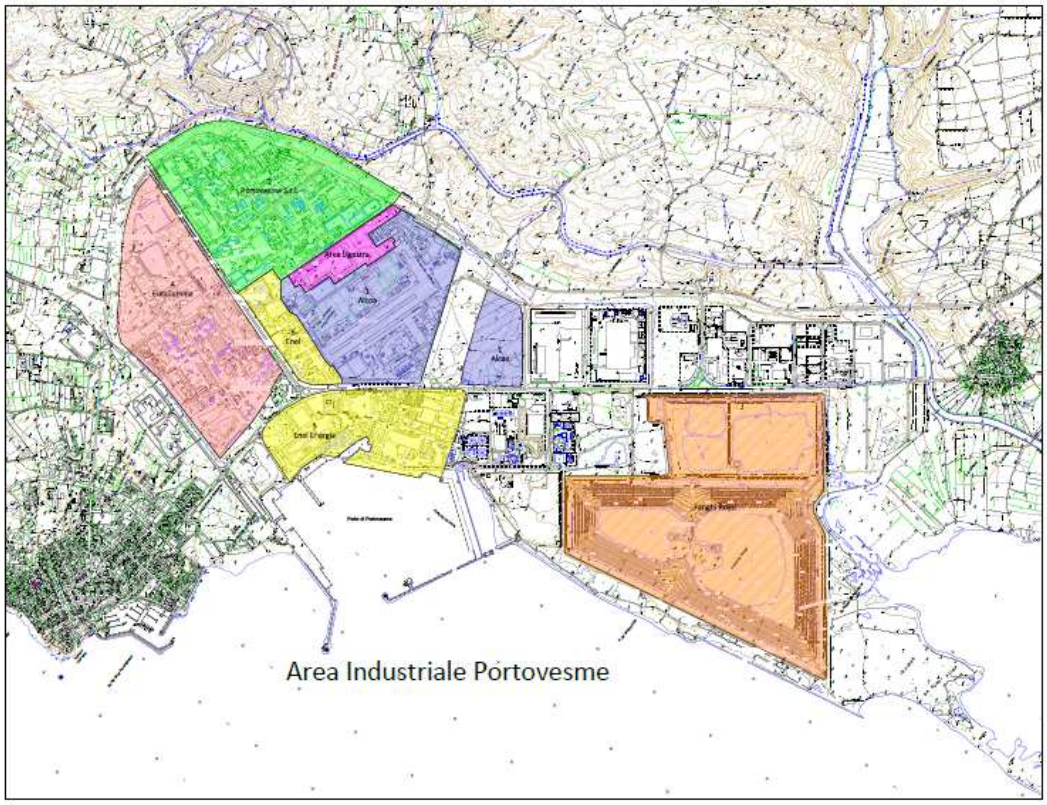

Fig. 2: Portovesme Industrial Area

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The reasoning is not only based on legal quibbles inherent in the consequentiality of dates and intentions of the Regional Legislator - "fought" between the industrialization and the landscape protection of a territory with an industrial vocation since the 1960s, which has equipped itself with a port specialized, with road infrastructures and with technological energy and hydraulic networks paying particular attention to the compatible treatment of waste water with the natural river basin - but on the planning of the territory for industrial use which requires not only the installation of industrial activities in the lots to be assigned to the individual companies, but above all the evolutionary scenario of the different production systems of each company, from the first phase of the establishment to the subsequent phases to guarantee the competitiveness of the company product in the markets by innovating the production systems, reducing the energy cost and keeping the specialization of the workforce high.

Therefore, the analysis of the document of the Superintendency resumed below to make the deductions based on the interpretations of the landscape, already formulated in this paper.

In point 2 at letter a) reference is made to the "natural and landscape features of exceptional importance". It is important to emphasize that in the on-site and remote inspections it has been difficult to find cultural and substantial reasons to justify "landscapes of exceptional importance". In fact, the territory included in the S.I.C.I.P. consortium, even if all the existing industries were eliminated, would have a flat morphology, barely moved by the artificial hills produced by the landfills of the mines, today covered by spontaneous Mediterranean vegetation. In other words, although there are significant landscapes that Sardinia also shows in the Iglesiente area, this area of Eurallumina does not deserve any attention and therefore no invitation to visit it by virtue of the natural landscapes (Fig. 3).

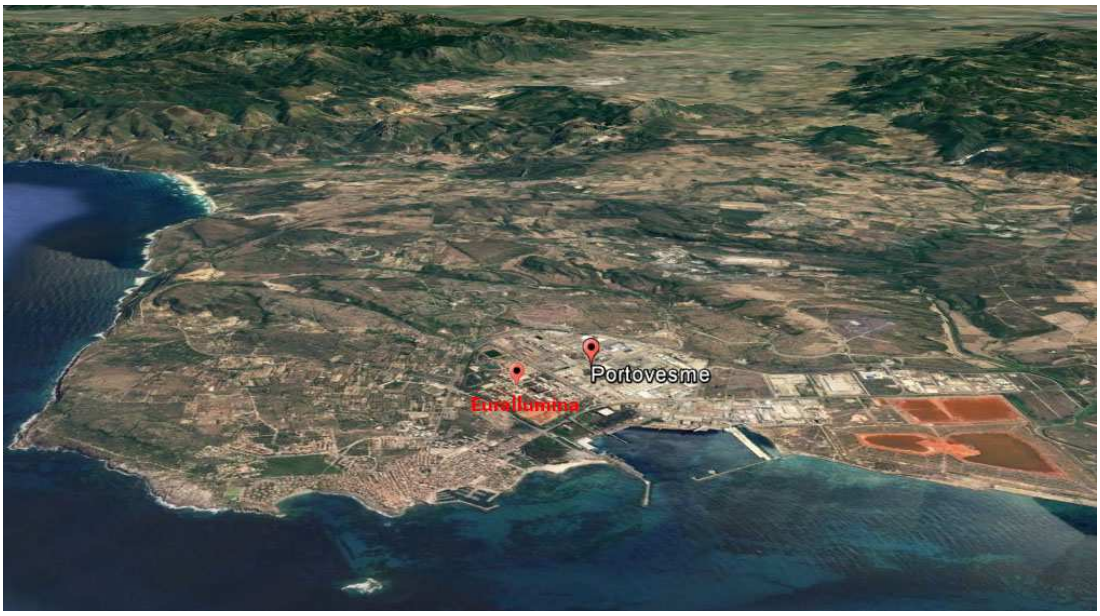

Fig. 3: Panoramic view of the territory without emerging factors of importance (Google earth)

This judgment is not intended to be malicious towards Portoscuso and its inhabitants, but can also be confirmed by the remote visions which are considered important in the Superintendency document with reference also to the horizons observed by Carloforte and Calasetta.

In point 2 at letter c) it is possible to evaluate how much the industrial establishment and the sludge basin are "directly facing the coast". It is quite obvious that we are dealing with a company that was born and develops its production in front of the sea as the supply of raw materials is guaranteed by ship carriers placed alongside the docks of the specialized port. So all the equipment for transporting materials to the storage area, which are part of the production process, must be viewed with the emotional attention that the conveyor belts at height with their structures.

As for the prospecting on the coast of the mud basin, the problem is less significant because with the natural vegetation that already guarantees the total mimicry of the retaining walls, the elevation of the main basin will be seen from below as a green hill facing the sea. A sea front of very little value composed of breakwater boulders and one that extends for a few kilometers and which does not offer bathing spots. With regard to the mitigation that according to the Superintendency would not be guaranteed with continuity over

time, it is noted that they are instead guaranteed by the spontaneous vegetation that grows along the stone walls, in steps, camouflaging them with the continuity of the seasonal rhythms.

6 CONCLUSIONS

To conclude this discussion on the interpretation of the landscape that reinforces the emblematic nature of the Eurallumina question in Sulcis Sardinia, the authors consider some food for thought (on which they have already had the opportunity to express theirselves) which are useful because they open up to a Sardinia to be "known and to love" not only through the slides and posters posted at the airports or entrusted to splendid videos, as well as to the many books on landscapes, beaches and culturally effective cultural heritage, but which do not reveal the true characters of the island society.

In any case, the relationship and the difference that exist between the impact of "things" on the landscape and the visual impact is important, as the former affects character, quality and cultural factors; the second is limited to seeing the changes through the available "views" and the effects they have on people. There is not necessarily coincidence between the two, in fact the impact on the landscape can also occur in the absence of a visual impact where the development is, for example, completely shielded from the available views; and similarly, when in already characterized areas very high works for mainly technological use emerge (electric pylons, wind turbines, industrial chimneys, antennas). And this is why the authors defend the thesis of the interpretative flexibility of the landscape; because it is necessary to take into account and foresee the possible changes in the territory that you would like to "fix" which in Sardinia are due to the extraction quarries, the mining landfills to be reclaimed, the forestation with the probability of fires, viaducts and road tunnels, productive settlements and the intensification of the agricultural use of soils which can influence geometry and also changes in natural factors.

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8 AUTHOR CONTRIBUTIONS

This paper is the result of the joint work of the authors. Pasquale Mistretta wrote 'Discussion: reasons and deductions on the interpretations of the landscape of Portovesme' and 'Conclusions'. Chiara Garau wrote the 'Introduction'. Giulia Desogus wrote the 'Environmental sustainability and landscape constraints in Sardinia' and 'The Eurallumina of Sulcis in Sardinia'.

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🏆 *reviewed paper*

Integrate Traditional Ecological Knowledge into Disaster Mitigation and Adaptation Strategies in High Risk Settlements – a Case Study of Taiwan

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1 ABSTRACT

The accelerated pace of climate change in today's global world has intensified the frequency and intensity of extreme weather events. Structural engineering measures are the common ways to cope with disasters. However, with the increasing frequency and intensity of extreme disaster events, the general engineering design standards could not stand with severe disasters. Non-structural engineering measures are the alternative including zoning and insurance. In fact, resettlement or relocation is the possible approach to relocate people from high risk areas to relative safer places. Nevertheless, such relocation might destroy the original living context and livelihood thoroughly. In the other hand, traditional ecology knowledge is the long lived knowledge inherited from ancestor. Traditional ecological knowledge could become a useful warning system to warn people when should retreat and when should be prepared. As a whole, the purpose is to collect possible traditional ecological knowledge in areas suffered from disasters and improve such knowledge to become a feasible disaster mitigation approach.

Keywords: non-structural engineering measures, traditional ecological knowledge, extreme weather events, mitigation, adaptation

2 INTRODUCTION

Global climate change has intensified the frequency and intensity of extreme disaster events suchs as torrential rain, snow storm, drought and so on. Acoording to the scientific reports, the extreme weather events caused by climatic variability have already occurred in the past decades and it is very likely to emerge in the future (Pareek & Trivedi, 2011). In order to respond the increasing disasters, a four-phase disaster management strategy has been applied in the worldwide including (mitigation, preparedness, response, and recovery to cope with climate variabilaity (O'Brien et al., 2006; Alexander, 2002). Structural and non-structural enignnering measures are the two common approaches. Structural enginnering measures such as dikes, pump stations, dams are based upon engineering technologies to mitigate potential impacts. In the other hand, non-structural enginnering measures such as land use plan and insurance to lead human settlements away from the disaster risks areaas. Due to the frequent and intensified extreme disasters, the design standard of traditional structural engineering measures might not enough to cope with such disasters. Therefore, more attentions have been put on non-structural enginnering measures.

Among a suite of strategies, retreat from hazard-prone locations seems to be a great solution to reduce the risk posed by climate change (King et al., 2014). In fact, whether temporary, permanent, internal or international migration is recognized as a viable and sustainable adaptation strategy to reduce disaster risk and adapt climate change (King et al., 2014; Marino, 2012; Gemenne, 2011; IOM, 2011; Mayer, 2011; Black et al., 2011; Warner, 2010; Morton et al., 2008). However, such relocation and climatic migration might further result in the break down of couumities or unanticipated social chnges (King et al., 2014; Lizarralde & Boucher, 2004; UNDRO, 1982). In addition, involuntary outmigration involves changes in family commitment, livelihood opportunities, financial constraints and emotional ties and maladjustment is likely to occur (King et al., 2014; Oliver-Smith, 1991). The impacts of the society which has settled for centuries may cause devastating consequences and threat to its existence (Oliver-Smith, 1991). A great amount of research has indicated that relocation may levies high social cost, including impoverishment, social disarticulation, and decrease in livelihood security, social capital and cultural ties (King et al., 2014; Marino, 2012; Scudder, 2012; Usamah & Haynes, 2012; De Wet, 2006; Oliver-Smith, 2006; Cernea, 1996, 1997, 2000; Oliver-Smith, 1991).

In traditional disaster management systems, the long-term accumulated local knowledge has been one of indispensable components and is a significant tool today (Mavhura et al., 2013; Pareek & Trivedi, 2011). In order to adapt severe damages from climate change, traditional ecological knowledge (TEK) has been gradually recognized of the feasibility on coping disasters (Berkes, 1993). TEK refers to people's knowledge

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of their local environments, and is derived from experience and traditions evolving by adaptive processes and has been passed down through generations by cultural transmission, about the relations of specific human societies to the local environments (Hernández-Morcillo et al., 2014; Leonard et al., 2013; Houde, 2007; Folke, 2004; Berkes et al., 2000; Berkes, 1999). TEK has enabled local communities to live in harmony with their environment for generations and included information necessary for survival (Folke, 2004; Mwaura, 2008; Pareek & Trivedi, 2011; Iloka, 2016). The long-term persistence of settlement can be seen as an evidence enough that the knowledge accumulated through trial and error over many years works (Folke, 2004; Freeman, 1992).

Past studies have showed that settlements located at hazard-prone areas might come up traditional ecological knowledge (TEK) including prevention and mitigation, early warning systems, preparedness and post-disaster recovery (Pareek & Trivedi, 2011). In fact, since the 1970s, a growing evidences show that TEK can improve disaster preparedness and practice (Hiwasaki, Luna & Shaw, 2014; Dekens, 2007). The inheritance of long live experiences and knowledge can be applied to possible disaster mitigation and adaptation in the future. Therefore, the knowledge acquired through perceiving disaster and respond to natural hazards can help understand environmental science and improve disaster mitigation and adaptation strategies (Dekens, 2007). Hence, this This study attempts to build up community resilience in hazard-prone area under traditional ecological knowledge. First of all, this study will review the nature, forms, and cases regarding traditional ecological knowledge. Afterwards, this study will apply GIS-based land suitability analysis methods to search for hazard-prone indigenous tribes in southern Taiwan. And then this study will apply a systematic literature review in indigenous tribes with hazard-prone area to collect traditional ecological knowledge. As a whole, the purpose is to integrate traditional ecological knowledge (TEK) into scientific knowledge and help human beings improve capacity to disaster adaptation and resilience strategies to adapt the changing environment.

3 LITERATURE REVIEW

3.1 Migration in high risk areas

Migration from high risk areas (post-disaster resettlement, post-disaster relocation, pre-disaster migration etc.) seems to be inevitable while it is much more complicated than expected. In fact, climatic migration might be related not only safety but also social and economic issues (King et al., 2014; Usamah & Haynes, 2012; Oliver-Smith, 1991). Although resettlement indeed could reduce direct exposures from disasters, individual vulnerability might be increased due to the process such as the loss of livelihood, loss of community context, loss of religious belief and so on (Usamah & Haynes, 2012; Gaillard, 2008; Cernea, 1997; Oliver-Smith, 1991; Quarantelli, 1984). An outmigration strategy in Mayon volcano in the Philippines shows that the area has successfully reduced risks from volcanic- and typhoon-related disasters. Instead, the community has lose the livelihood options. In order to make their livelihoods, people return to their old workplaces or commute great distances to maintain lifehood. The continuing mobility of resettles who travel for their livelihoods may cause the loss of community connections (Usamah & Haynes, 2012). The economic advantages which people have built in their original settlement are the main cause of failure. (Oliver-Smith, 1991). Thus, the consequences of migration can be more devastating than the disaster event (Usamah & Haynes, 2012; Oliver-Smith, 1991).

Formalizing outmigration into disaster policy may reduce resilience for those communities in the long term, thereby initiating unanticipated changes based on economic, political or sociocultural factor and expose people to greater risks (King et al., 2014; Hernández-Morcillo et al., 2014; Oliver-Smith, 1991). In most migration policies,in order to maximize efficiency, the location of migration are mainly determined by authorities. Land which government owned or controlled may be considered as a priority for migration. With the ignorance or lack of concern for social and economic, the resettlement in a top-down manner frequently cause the failure of migration (Oliver-Smith, 1991). In addition to socioeconomic issues caused by migration, people's attitude towards relocation is also a material concern. Evidence shows that people in hazard prone areas often show the reluctance to migrate. In the case of Antigua, suffered from severe earthquakes and a huge landslide, the city was relocated for the third time to safer terrain (Oliver-Smith, 1991). Although the citizenry refused to immigrate, a new capital, Guatemala City, was founded. However, people remained in the old city and repopulated it immediately. Today, the old city continues to exist and is

one of Guatemala's major tourist attractions (Oliver-Smith, 1991; Tobriner, 1980). Given such difficulties, it is suggested that migration should not be adopted as a strategy and efforts are make to rebuild original sites (Oliver-Smith, 1991; Aysan & Oliver, 1987).

3.2 Traditional Ecological Knowledge

Over the last two decades, traditional ecological knowledge (TEK) has increasingly recognized as a source of information for environmental science, policy, and management (Hernández-Morcillo et al., 2014). There is a growing awareness on TEK for to contemporary resource management problems in various parts of the world (Berkes, 1993; Freeman, 1992). For illustration, people in Uganda have forecasted seasonal weather in order to increase or stabilize crop yields (Okonya & Kroschel, 2013). It is quite common for people to use words such as "local," "indigenous," "folk," and "traditional" as synonyms to describe their local environments (Hernández-Morcillo et al., 2014; Mercer et al., 2010; Sillitoe, 1998).

TEK is holistic and dynamic in nature and is gathered over generations through accumulation of experiences, society-nature relationships, community practices and institutions, and observation in long term (Mercer et al., 2010; Berkes, Colding & Folke, 2000; Flavier et al., 1995). The knowledge based on tradition and non-industrial societies is ecology-oriented, it attempts to understand and explain the operation of ecosystems, containing many interacting species of animals and plants (Freeman, 1992). Evolved through trial and error, Traditional ecological knowledge has a unique living style to confront a variety of environments and transmitted to future generations by oral narrative and practical experiences (Berkes et al., 2000; Ohmagari & Berkes 1997). Therefore, TEK can be viewed as part of the adaptive strategies to dwell and survive (Hernández-Morcillo et al., 2014).

Since the 1970s, there is grown evidence that TEK can improve disaster preparedness and practice (Hiwasaki et al., 2014; Dekens, 2007). Those have settled in inhospitable environments may develop a capacity for the survival of whole groups and have collectively accumulated a vast number of knowledge on disaster prevention and mitigation, preparedness and response and post disaster recovery (King et al., 2014; Pareek & Trivedi, 2011; Freeman, 1992). The nature of the community affects the knowledge which those have acquired (Dekens, 2008). The region in Himalaya had often been suffered from landslides and flash floods. Through experience and accumulated knowledge of the generations, the people here develop the sensitivity to select habitation places that were relatively safe from these disasters.

Though people cultivate lands closed to areas affected by these disasters, they decided to settle down at the upslope locations where are less vulnerable to disaster (Rautela, 2005). During the December 26 tsunami which caused 163,795 death in Indonesia's northern Aceh province, the knowledge of the sea phenomenon and the behaviors of buffaloes helped people in the Simeulue community flee the shore for nearby hills (de León, Bogardi, Dannenmann & Basher, 2006). As mentioned previously, over the course of history and up to this day, it is demonstrated that traditional ecological knowledge is critical to save lives in the face of disasters (Pareek & Trivedi, 2011; McAdoo, Moore & Baumwoll, 2009). Traditional ecological knowledge gained from local experience and practices should be integrated into disaster mitigation and adaptation to further aim for sustainability.

4 RESEARCH DESIGN

4.1 Conceptual Model

The purpose of this study is to integrate traditional ecological knowledge (TEK) into scientific knowledge to improve disatser adpatation and resilient strategies under global climate change. Therefore, this study begins with the suitability analysis of overlaying disaster risk areas (such as flood-prone areas, soil liqifaction, Dip slope areas, landslide-prone areas, collapse-prone areas, fault zone areas, rockfall-prone areas and detritus sliding-prone area) and human settlements. Afterwards, the study conduct comparative analysis between disater risk and past disaster records to find out settlements located at hazard-prone areas and suffered with disasters. This study assumes that such hazard-prone settlements might have TEK to help them continue live in such high risk areas. Therefore, a systematic review will then be applied to collect possible TEK. Figure 1 is the conceptual model of this research.

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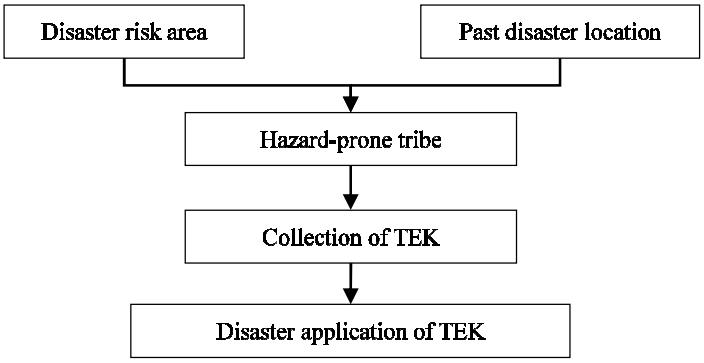

Fig. 1 Conceptual model

4.2 Suitability Analysis

This study applies geographic information system (GIS) as the main methodology to precede suitability analysis on hazard-prone settlements. GIS is a computer-based tool that analyses and visualizes geographic data on the map. There are various software could be used for analysing and visualizing geographic data such as MapInfo, ESRI ArcGIS, QGIS, GeoDa and so on. ArcGIS can visualize the features that can recognize the patterns and provide vital information to the users. It can demonstrate and convert numerous diverse data into a single visualization platform. In this study, we apply ESRI ArcGIS as the basic workstation to find out the spatial distribution of hazard-prone settlements.

4.3 Systematic review

Systematic literature review is one of the methods applied to summarize both present and past findings in specific topic. The main purpose is to integrate and categorise relevant research to collect information. It aims to assess the strengths and limitations of existing findings and integrate the fingings into conceptual framework (Uscher-Pines, 2009). In this study, systematic literature review enables us to understand how people in high risk area respond to disasters, and to reveal the application of traditional ecological knowledge related to disaster management.

5 HAZARD-PRONE SETTLEMENT

This study has applied suitability analysis via geograpgic information system to select settlements located at hazard-prone areas. Afterwards, the comparative analysis is conducted to further find out settlements which had disaster loss. Eventually, the results will be overlapped with historical disasters including flood, debris disaster and slope disaster. The purpose is to explore why people could continued live in such high risk areas and find out whether traditional ecological knowledge exists or not. After the screening process above, three settlements that located at landslide-prone areas and suffered from disasters are selected.

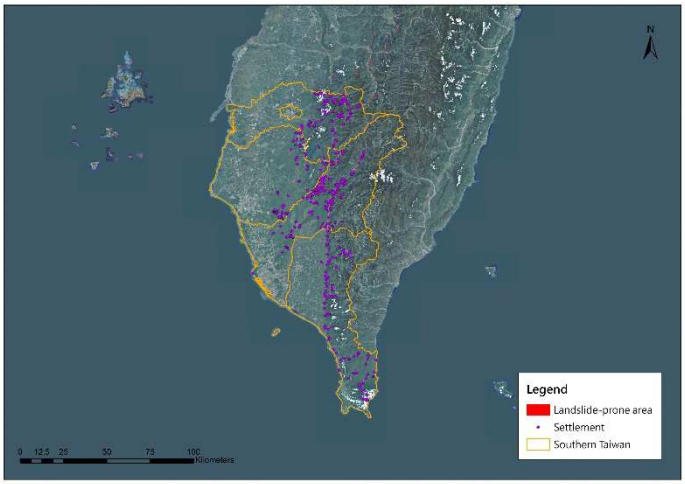

Fig. 2 Potential disaster risks. (A) Landslide-prone area

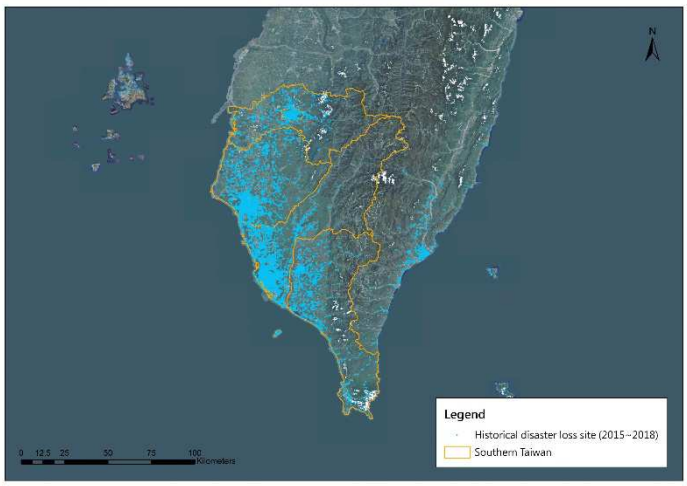

Fig. 3 Historical disaster loss site

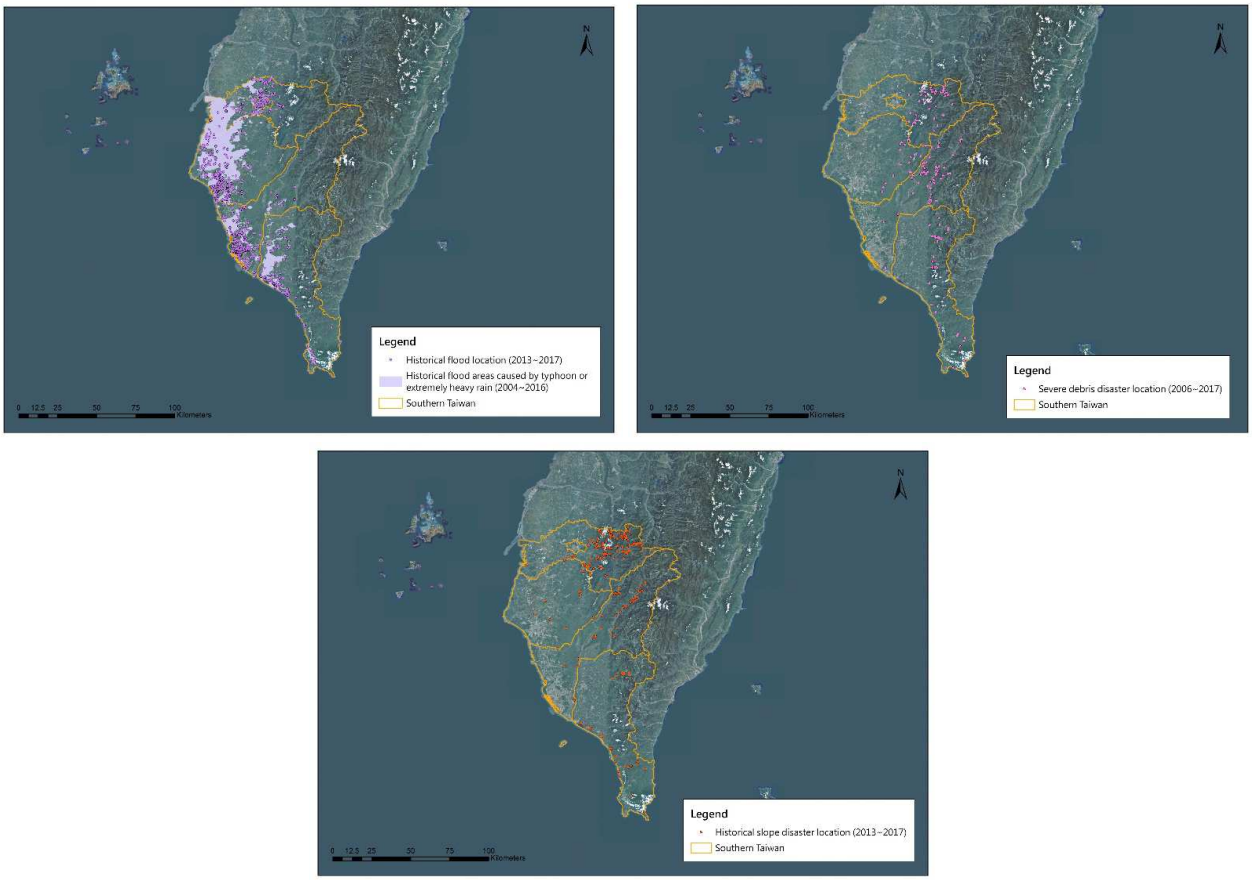

Fig. 4 Historical disaster records: (A) Historical flood disaster, (B) Severe debris disaster, (C) Historical slope disaster

According to the suitability analysis, three settlements of Paiwan peope have been selected including Yilin tribe is located in Laiyi Township, Siadanlu tribe and Chiaotung tribe had settled in Shizi Township. The historical disaster data shows that Yilin tribe was attacked by Typhoon Megi in 2016. In 2010, typhoon Fanapi brought extremely heavy rain and caused mudslide which buried roads and rivers and rushed into houses. Typhoon Trami in 2013 caused Siadanlu tribe suffering from slope disaster. Because of the debris accumulation affecting the waterway, the tribe was in urgent need of help from the government during typhoon Haitang and Nesat in 2017. During typhoon Nepartak in 2016, collapse of trees crushed high-voltage power lines and traffic was impacted in Chiaotung tribe because of the damage of electric pole. In addition, historical disaster records indicate that slope disaster occurred in neighboring area due to heavy rain in the winter of 2017. To sum up the above, disasters are very likely to occur repeatedly in the three settlements that located at hazard-prone area and made them suffered from disasters continuously. Therefore,

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the study attempts to explore if there is any TEK among Paiwan people to keep them staying such high risk areas.

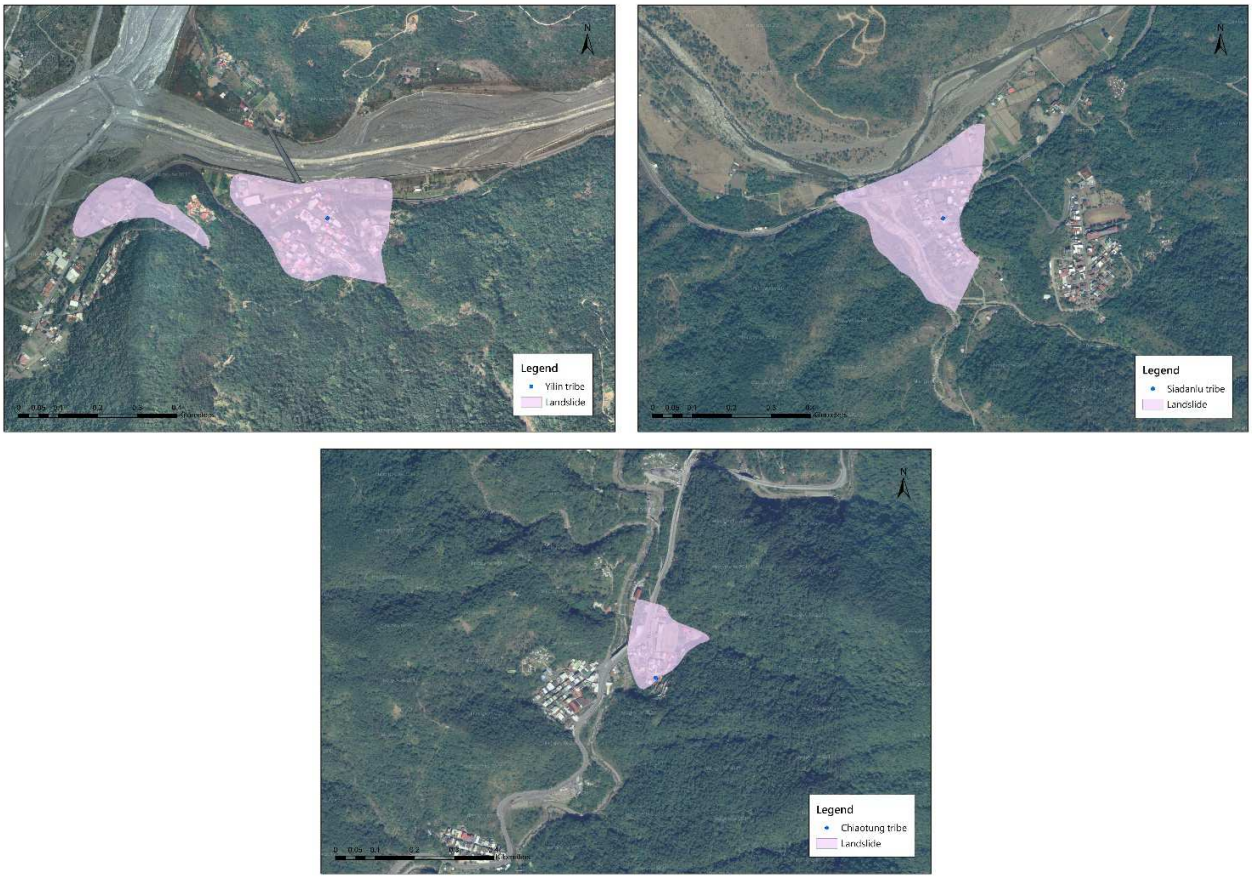

Fig. 5 Study area: (A) Yilin tribe, (B) Siadanlu tribe, (C) Chiaotung tribe

6 TRADITIONAL ECOLOGICAL KNOWLEDGE OF PAIWAN PEOPLE

Paiwan is one of the indigenious people in Taiwan. Paiwan people practice traditional social context and believe in Christianity, Catholicism and aboriginal traditional beliefs (Laiyi Township Office, 2020). The settlement pattern is collective village and mainly distributed in the southern part of Taiwan mountains in Pingdong and Taitung (the height is around 500 meters to 1,300 meters) and most of Paiwan people are located in Laiyi township, Pingtung county (Lin, 2010). Situated in the subtropical monsoon region, heavy rain and cyclones occur frequently in Taiwan. For Paiwan people, because of weather and geographical environment, is often affected by earth and rock disasters and floods. Hence, Paiwan people have extensive knowledge to cope with disasters.

Fig. 6 Landscape of Yilin tribe

Traditional ecological knowledge could be divided into various stages including days before disaster and during disaster. There are multriple signs could be applied to forecasting whether there is a storm coming or how bad will the storm is. In general, Paiwan people could predict a storm is coming by observing weather condition such as thunderstorm comes in summer afternoon and stops suddenly, feather shaped clouds or horsetail shaped clouds. or the color of the sky might be changed right before the storm. In addition to meteorological changes, unusual animal behavior can also be used to predict the onset of extremely heavy rain. Ant migration is believed to sense the nearness of heavy rains. There's a Paiwan nursery rhymes about it, "window in the sky, window in the sky, when does it rains, look at the ants climbing up (Guo & Chen, 2017)."

Fig. 7 Cloud signs

Landslide are predicted when it's raining. Paiwan people observe environmental conditions to judge whether landslide will happen. Depending on the environmental changes, Paiwan people will determine whether the disaster will happen and when to leave. It's mainly based on changes in rivers and indicators included the rising of water level and the rivers become turbid. It is noted that when the flow rate and velocity of rivers changes, accompanied by strong ground vibrations, and fog appears upstream, these signs represent the appearance of the landslide (Guo & Chen, 2017; Xiao, 2013).

7 CONCLUSION

Traditional ecological knowledge enables local people to adapt to their environmental problems for long periods of time. Although limited by the open data, only information in recent years has been collected. It is still revealed from the literature that indigenous tribes in high risk area have traditional ecological knowledge to cope with disasters. The study found that the application of traditional ecological knowledge in Paiwan is mostly used for disaster prediction or reducing disaster risk and less for disaster recovery. In this case, migration is not a necessary solution which may cause disruption of a society. In contrast, high risk areas without traditional ecological knowledge are more in need of migration strategies or require the traditional ecological knowledge from surrounding area. Traditional ecological knowledge should contribute to disaster application and help people in high risk improve their capacities to disaster adaptation and resilience strategies to adapt the changing environment. With the expansion of traditional ecological knowledge, it is highly possible to reduce the need for migration in high risk areas and the economic, political or sociocultural problems derived from migration.

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🏆 *reviewed paper*

Integrated Qualitative and Quantitative Analysis of Causal Urban Food-Water-Energy Relations towards more Climate-Resilient Cities

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1 ABSTRACT

Currently, the world is facing great challenges in terms of securing water, energy and food for all. With continuous increase in urbanisation and and changed lifestyles, the demand within the three sectors food, water and energy (FWE) in cities is increasing as well (Sukhwani et al., 2019). Due to the limited availability of natural resources, the pressure on urban land use is equally increased, thus more attention needs to be given to sustainability and resource efficiency. Furthermore, climate change and the related increased frequency of extreme weather events such as stormwater events and/or dry periods pose additional challenges for infrastructure and (agricultural) land use as well as for the quality of life. These challenges call for more systemic, integrated and cross-sectoral approaches helping to build resilient urban systems. These approaches should focus more on a holistic urban system transformation, rather than tackling problems within one sector. Thus, the main goal of reaching a sustainable future should be to create integrated, informed and well-coordinated interventions to support cities to become more climate resilient.

As a response to the problem setting, the concept of FWE Nexus emerged. The Nexus describes and analyses the interlinkages between the three sectors, with the goal to identify potential synergies and minimise trade-offs between the three sectors (Hoff, 2011).

The paper discusses a number of methods on how to describe the FWE system: Firstly, to show how different elements in the entire FWE system are interrelated and to create a common system view among the involved stakeholders, a qualitative system analysis, has been carried out. This qualitative system analysis enables experts (from FWE sectors, city authorities, urban planners) to understand the causal relations and the feedbacks between the system elements. Thus, to cope with the challenges and system immanent drivers, a basis for the discussion and development of strategies is established. The qualitative analysis was also used to gain a specific view on the differences between different case study regions. Secondly, based on this qualitative analysis, a more specific quantitative GIS-based analysis of land use changes and resulting water demand has been performed as input for a simulation model. This model will be used to analyse the impacts of spatial planning scenarios for the sustainable resources management and shall support urban planners to create more resilient cities and regions.

Keywords: FWE Nexus, population growth, land use change, urban agriculture, qualitative and quantitative system analyses and simulation

2 BACKGROUND AND OBJECTIVE

Rapid urbanisation, growing population and the evolving challenges posed by climate change are causing an increased need for security of supply of water, energy and food for all. Due to the limited availability of natural resources, the pressure on urban land is increasing and competition for land use is created. This requires a stronger focus on the sustainable and efficient use of the resource land. Bren d´Amour et al.(2017) concluded that the rapid expansion of cities will result in the loss of some 300,000 square kilometres of particularly fertile farmland worldwide by 2030. This arable land, which will probably disappear in the future, is almost the size of Germany. Furthermore, climate change and the related increased frequency of extreme weather events such as stormwater events and/or dry periods, pose additional challenges for infrastructure and (agricultural) land use as well as for the quality of life.

In this context, the Sustainable Urbanisation Global Initiative (SUGI)/FWE-Nexus call was jointly established by the Belmont Forum and the Joint Programming Initiative Urban Europe. Within this call, the AIT Austrian Institute of Technology GmbH is involved in the project IN-SOURCE (INtegrated analysis and modeling for the management of sustainable urban FWE ReSOURCEs), which aims at developing a joint urban data and modelling framework that will help cities and regions to analyse and characterise the FWE-Nexus interdependences. This framework is based on the extension of semantic 3D city models as well as on

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geoinformation applications to be developed and applied in the three case study regions: Vienna, New York and the administrative district Ludwigsburg as a metropolitan region. The paper focuses on the case study region Vienna.

The objective of the qualitative system analyses, the causal relation analyses, are (i) understanding the system elements interaction and feedbacks in the entire FWE-System, (ii) building a joint vision of these system elements interactions between the project partners, (iii) supporting the discussion with stakeholders in interactive workshops.

3 QUALITATIVE SYSTEM ANALYSIS

Causal relations can be expressed by using the method of Causal Loop Diagrams (CLDs). The approach became famous during the 70ies as they have been used by the Club of Rome to explain the system structure of the developed World3 models (Meadows et al., 1972).

CLDs use a simple "language" to describe dynamic systems and can be used to analyse, communicate and discuss possible system behaviour. Interrelations between system elements expressed as arrows with polarities (+, -) and time delays are the components used to visualise the entire system. CLDs have no starting point or end point, they are rather closed circuits. The system elements are entities, which can increase or decrease. The arrow with the polarity indicates how an entity changes when the influencing entity changes. A link marked positive (+) indicates a positive relationship and a link marked negative (-) indicates a negative relation. A positive causal link means the two entities change in the same direction, i.e. if the entity in which the link starts decreases, the influenced entity also decreases. Similarly, if the entitiy in which the link starts increases, the influenced entity increases as well. A negative causal link means the two entities change in the opposite direction: if the entitiy in which the link starts increases, the influenced entity decreases, and vice versa. With these simple "rules" complex system structures can be visualised. For the CLDs developed in IN-SOURCE and shown in this paper we used coloured arrows (blue) and solid lines for "+" interrelations and red arrows and dashed lines for "-" to increase the readability in the paper.

The aim of the FWE CLDs which are specifically developed for each case study region is to get a more appropriate view about the most important interactions. The diagram neither consists of all possible system elements nor all connections as this would make it hardly manageable to interpret. For example, we didn´t differentiate between different water qualities which would have restricted use for different purpose only (drinking water, treated waste water, rain water etc.).

The decision of which element/parameter/factor is important, was met according to different information: expected system element changes, e.g. population changes (increases or decreases), effects of climate change, together with challenges the case study areas are currently facing, e.g., mitigation of heat islands, air pollution. Other important factors to identify important links were the interest of the relevant stakeholders and available tools to quantify the causal relations. Within the specific CLDs for each case study region we indicated the more important links by increasing the thickness of the arrows as the specific CLD for Vienna in Figure 1 shows.

3.1 Causal FWE relations in Vienna

The causal relations diagram for Vienna was established under the assumption of a growing urban population. According to forecasts, Vienna will grow moderately by 289.000 people (about 16%) over the next three decades and the population of the city will be about 2,200,000 in 2048 (MA23, 2018). Additionally, climate change has been taken into consideration as a determining factor that will change the future system logic. The CLD shows relations between the three systems of water, energy, and food and challenges Vienna is currently facing (e.g. heat islands, air pollution, urban land availability). Due to the high complexity of the topic, this analysis can only show a few relevant connections that are primarily connected to the Nexus. Figure 1 shows the causal FWE relations that have been assigned to the three systems using different colors.

3.1.1 Urban Food System

Population growth would also increase the related Food consumption which in return reduces the Food availability. To meet the increasing demand for food, importing food results in an increasing transportation demand which causes additional CO_2 emissions what can be called a Nexus effect with the energy system.

Another option to supply the city with sufficient food is to increase Urban Agriculture (UA) which again increases the traffic to transport the food and affects the energy used for UA. Not only can food be grown on the available farmland, but it can also be used as an energy source by producing biofuel. This of course means again a reduction of Food availability.

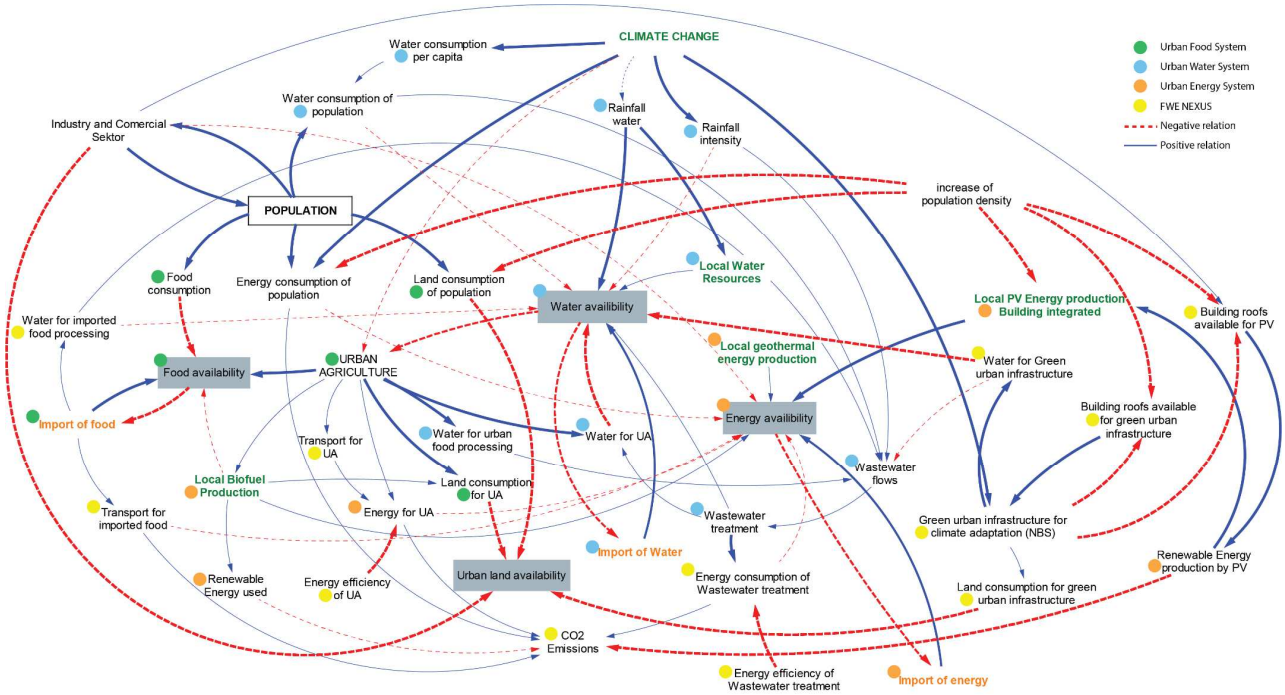

Fig. 1: Specific Causal food-water-energy relations for Vienna. ©AIT

The urban food production system is obviously closely related to the availability of urban land which creates conflicting interests. The main conflict due to population growth arises between urban food production and the construction of new dwellings and industrial areas including green urban infrastructure (e.g. parks). As construction activity for housing and industry increases, the availability of arable land decreases. Innovative forms of UA as vertical farming and aquaponic reduce this conflict but are currently not in the scope of the city of Vienna. To minimize the land consumption of the assumed population growth, the population density could be increased too (e.g. by increasing the building height). This would result in a decrease of the Land consumption of the population and might subsequently result in increased Urban land availability.

Another parameter that needs to be involved as a key impact factor in the future urban food production system is Climate Change. More than almost any other sector, agriculture depends on climatic influences. Even slight changes in temperature and precipitation have a noticeable impact on the level and annual variability of yields and agricultural incomes. Both in past and future growing seasons, heat waves result in dry and dusty fields and an unbalanced distribution of precipitation severly affects the agricultural yields (Mitter et al., 2014; BMLRT(a), 2019).

3.1.2 Urban Water System

Climate Change has also an important effect to the water availability. Increased Rainfall water would increase the local Water availability, whereas current climate models for Vienna make it very difficult to estimate the changes in the amount of rainfall. The Rainfall intensity is, according to the current climate models, easier to predict and will increase. This would increase the Wastewater flows and reduce the Water availability because the total amount of rainwater could not be stored by the environment – soil, lakes etc. – (the surface runoff will increase). Additionally to the more frequently occurring heavy rainfall, the climate models are predicting that heat stress/heat waves will also occur more frequently in the future. One of Vienna´s strategies to cope with this problem is to increase the green and blue urban infrastructure (e.g., on bulding roofs and facades or urban places (MA18(a), 2015)) which results in an increase of Water demand for Green urban infrastructure but will further reduce the Water availability due to the required irrigation needs. In general, the current water system for Vienna regarding drinking water and water for industry is

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dominated by water import from outside of Vienna and a growing population will further increase the need for more imports to the system.

3.1.3 Urban Energy System

The energy system of Vienna is currently dominated by energy imported to the system. Almost 90 % of the energy consumed in Vienna is imported (MA20, 2019). In the future a higher share of renewable energy produced within the city as well as a more efficient use of energy is key to meet the 2050 targets regarding the reduction of CO_2 emissions. Energy efficiency in urban agriculture aims e.g. at increasing the utilisation of waste heat from other uses for example to heat the green houses during winter season. The above-mentioned conflict for urban land and the possible mitigation strategy to use vertical farms would increase the amount of energy needed to grow the plants in these facilities. The source of this additional energy demand is decisive. Photovoltaic (PV) systems producing electricity on the roofs of the vertical farms would for sure be a starting point to tackle the energy demand, especially during the winter season. In general, increasing the amount of building integrated PV is part of the Smart City framework strategy for the future (MA18(b), 2019).

The population growth resulting in an increased population density would also decrease the Building roofs available for either PV or green urban infrastructure due to limitations of urban land availability and the construction of high-rise buildings (which could affect the solar radiation). Thus, a more vertical development of Vienna (like New York City) would also have negative side effects on other resources (Renewable energy from PV) due to limited space availability for the installation of the necessary infrastructure.

Another important Nexus connection related to the water system is the Energy consumption of Wastewater treatment which will increase with the population growth. An increase in the Energy effciency of Wastewater treatment would decrease the energy needs. The increased amount of treated wastewater could be used in Urban Agricuture (UA) and increases therefore the Water availability in the system.

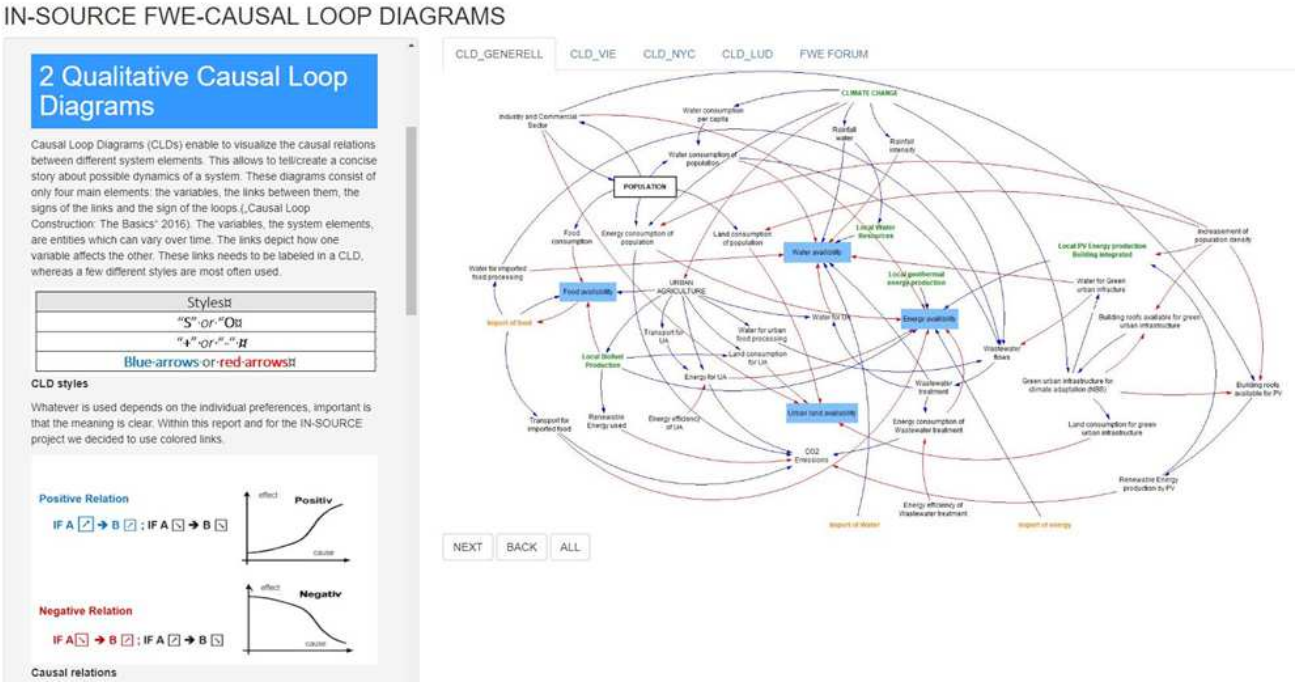

Fig. 2: Screenshot of the web-application to discuss the FWE-System – Specific CLD for Vienna, ©AIT

3.2 Story telling with CLDs

These causal relations discussed so far are only a part of the relations presented in the CLD (Figure 1). The aim was to present the use of the developed specific CLD to "tell a story" on what would happen if some of these causal relations would change (increase or decrease). During the discussion with the stakeholders (energy experts, urban planners, food related NGOs from Vienna) in the workshops, the CLD has been very valuable as the experts found important connections of their own domain to others and missing interrelations

could also be identified by the experts which improves the entire system knowledge. As Figure 1 shows, CLDs are often very complex in the sense which makes it difficult to follow and analyse. To increase the usability, a step by step introduction is recommended. For this purpose we developed within the IN-SOURCE project an interactive web-application to help users to understand the contex more easily by telling the story.

Figure 2 shows a screenshot of this interactive web application (AIT(a), 2020). For the other case study regions, that are considered in IN-SOURCE, New York City (NYC) and Ludwigsburg specific CLDs were also created, which also can be found in the web-application.

4 QUANTITATIVE ANALYSIS

As mentioned above, based on the qualitative FWE Nexus system analysis, a quantification for important causal relations was performed. Main part of this was a GIS-based water demand analysis for different land use categories in Vienna. As basis, the current land use in Vienna, as shown in the following Figure 3, was used. The map illustrates the spatial distribution of urban agriculture-related land use categories in the city of Vienna in the year 2016. The map was created using open-source data supplied by Open Government Data Austria (OGD, 2019).

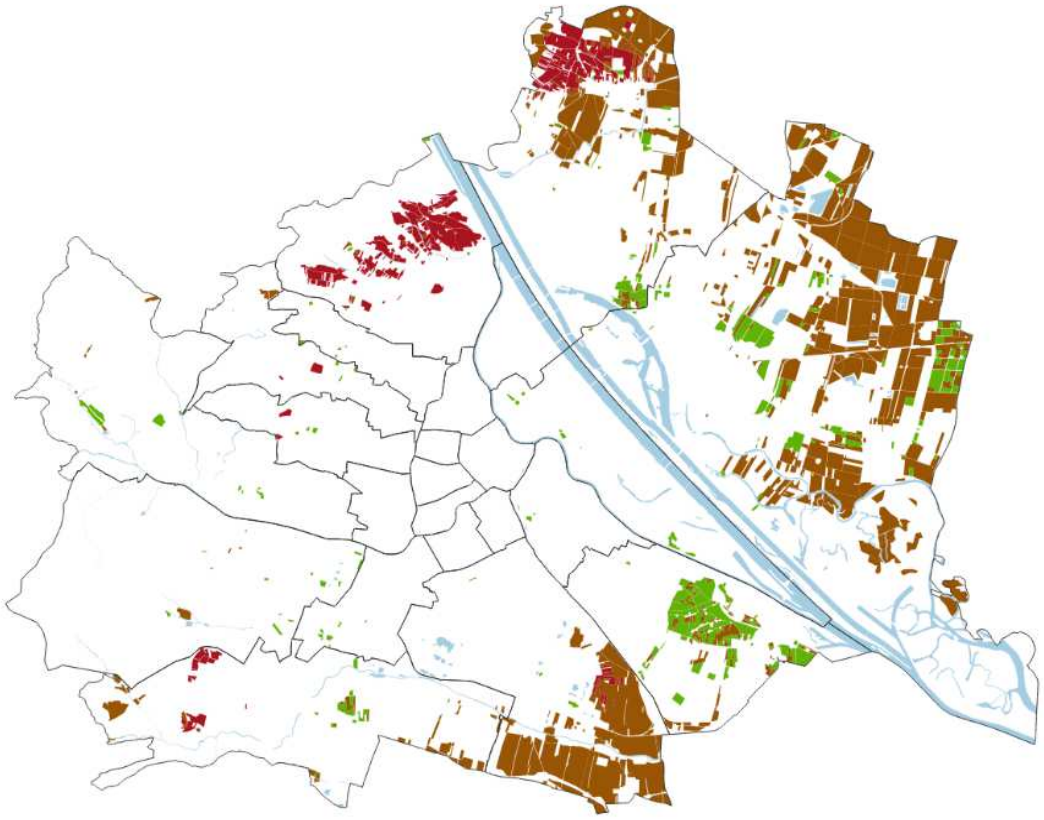

Fig. 3: Agricultural areas in Vienna 2016 (OGD, 2019), incl. water bodies and district boundaries of Vienna, ©AIT

There are 31 land use categories provided in the data set (OGD, 2019), while for this paper only so called "Urban Agricultural Areas" are of interest. These areas are divided into the three categories farmland, vineyard, nursery and orchard which cover 14% of the total area of Vienna. Farmland is most important because of the large proportion of urban agricultural area it occupies. Arable farming is mainly operated in the north, east and south of the city. Farmland corresponds to about 10% of the city's total area, which is significantly higher compared to e.g. 4% of agriculturally used area in Berlin. (UBA, 2019).

In 2016 almost 38,000 tons of field crops (grains, oil fruits, pulses, potatoes) have been cultivated on about 3,000 ha arable land (used for cultivation of field crops) in Vienna. Wheat accounts for around 50% of the total harvest. Nevertheless the level of self-suffiency for Vienna within these products is rather low – about 8% self-sufficiency for grains (Landwirtschaftskammer Wien, 2017). Table 1 gives an overview of the per capita consumption of different foods in 2017/18 for selected products.

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Vegetables		**Grains**		**Others**	
	[kg/capita]		*[kg/capita]*		*[kg/capita]*
Tomatoes	29.0	Wheat	63.3	Sugar	33.3
Onions	9.4	Barley	0.5	Potatoes	49.0
Carrots	9.1	Maize	13.4	Legumes	0.9

Table 1: Per-capita consumption July 2017 to June 2018 of main foods in Vienna in kg (Statistik Austria, 2019)

For estimating the water demand for farmland, it was necessary to estimate the water demand of different field crops. For our approximation we used potatoes, tomatoes, wheat and sugar since they correspond to the biggest amount of herbal foods consumed per capita in Vienna. Thus, these crops were considered to simulate the water demand of the land use category farmland. For the calculation of the water demand of these crops, the simulation tool AquaCrop by FAO was used (AquaCrop FAO, 2019). AquaCrop is a crop growth model developed by FAO's Land and Water Division to address food security and assesses the effects of the environment and management on crop production.

AquaCrop uses the input parameters climate, crop information, irrigation and soil to calculate the water demand of certain crops. The crops wheat, tomatoes, potatoes and sugar beet chosen for Vienna were already implemented as default files in the simulation tool. Thus, it was only necessary to make adjustments regarding sowing and harvesting time for the considered crops according to common practice in Austria (Agrana, 2019; Laendle - Kartoffel, 2019; Vereinigung der Pflanzenzüchter und Saatgutkaufleute Österreichs, n.d.). It should be noticed that AquaCrop calculates the water demand for crops that are cultivated in open field production. In the case of tomatoes in Vienna, the results could differ from the real situation as the tomatoes are mainly grown in greenhouses. Since the per capita consumption of tomatoes in Vienna is rather high, the water demand of tomatoes nevertheless was simulated with AquaCrop, as a first approximation.

The software simulates the irrigation requirement for optimal crop development. This means that the plants are always supplied with sufficient water, naturally via precipitation or by additional irrigation, so that the plants do not suffer from water stress and can therefore develop optimally. Chernosem was defined as soil type, which is a common and suitable soil type for agriculture in Vienna (MA22, 2019; ViennaGIS, 2019).

For the simulation of Viennese crops, the local climate is of great importance. Climatic data provided by AIT (supported by high resolution dynamic simulations carried out with the regional climate model COSMO-CLM (AIT(c), 2019; Cosmo, 2020)) was used for present as well as for future climate. Therefore, it was possible to simulate the water demand of agricultural crops in the future. Table 2 illustrates the development of the average water consumed by typical Viennese crops in the climatic periods 2019-2048 (P1), 2049-2078 (P2), 2079-2098 (P3). Climatic periods were used to reduce the annual fluctuation in precipitation. The calculated water demand presented in the table below considers only water consumed by the crop growth. Water consumption for transport, processing or washing, etc. is not included.

	Water demand in mm/m²				
	P1: 2019-2048	P2: 2049-2078	Change (P1 to P2) [%]	P3: 2079-2098	Change (P2 to P3) [%]
Tomato	885	900	+1,7%	920	+2,2%
Spring wheat	1235	1265	+2,4%	1335	+5,5%
Sugar beet	1225	1235	0,8%	1245	+0,8%
Winter wheat	780	810	+3,8%	980	+21,0%
Potato	1045	1075	+2,9%	1145	+6,5%

Table 2: Development of the average total water demand of typical Viennese crop plants due to climate change

Although there is only little difference in total average water demand, the figures don't reveal the sources of water. As the changes show, the water demand remains rather constant for all considered crops except for winter wheat. However, there is a current trend towards increased winter wheat cultivation, which Austrian farmers are following. According to the Federal Ministry of Agriculture, Regions and Tourism (BMLRT), the cultivation of spring wheat is declining due to climate change and the resulting hot and dry summer months (BMLRT(b), 2019). Statistical data confirms this trend: From 2016 to 2019 the cultivation area for spring wheat declined by 57 % (2016: 101 ha; 2019: 43 ha) in Vienna (Statistik Austria(b), 2020).

To understand this trend, it is necessary to reflect upon the sources of water – from irrigation or precipitation – as mentioned above. Figure 4 seperates the sources of water into precipitation and irrigation for the same time period. It should be noticed, that the following figure exclusively shows water which is actually consumed and therefore necessary for plants to grow. The diagram shows the trend that in future the share of irrigation will increase continuously for all selected crops. Since all crops have different growing periods, the amount of precipitation, which can be used, differs. The best example is spring wheat and winter wheat. Whereas spring wheat is sown in spring and harvested in autumn, winter wheat is sown in the beginning of autumn. That is one of the reasons why the proportion of natural and water from irrigation differs between these two crops. Due to changing climate conditions, the distribution of precipitation during the year is shifting and can also be a reason for having to adapt the crop types.

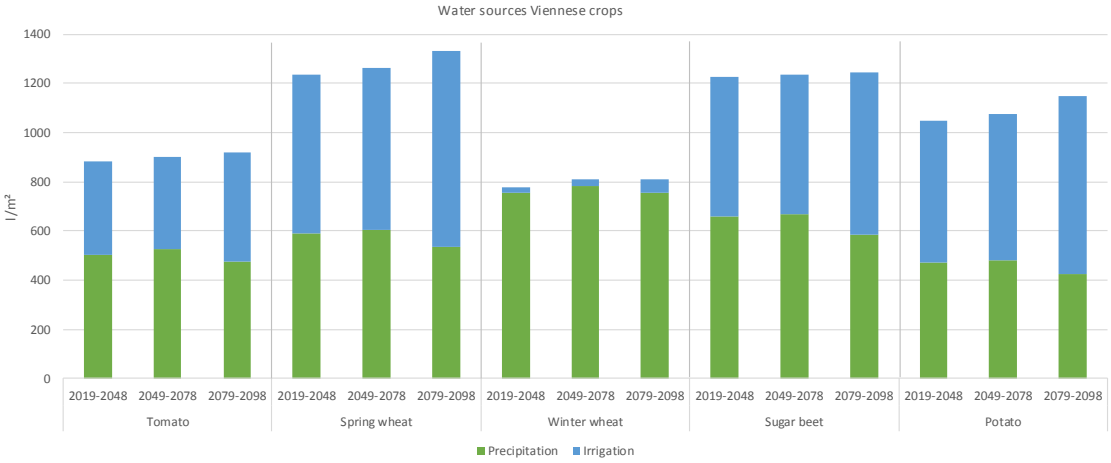

Fig. 4: Development of the average precipitation and irrigation requirement of typical Viennese crops 2019 to 2098, ©AIT

Focusing on spring wheat, the diagram illustrates that the irrigation requirement is sigificantly increasing: in the climate period 2079-2098, the proportion of irrigation will even be greater than that of natural precipitation. This development contributes to the conversion of the cultivation of winter wheat in Austria, as mentioned above. Whereas irrigation requirement represents the main share of the total average water demand for most of the considered crops, the share of irrigation requirement for winter wheat remains relatively low. The following figure 5 shows the monthly mean temperature and precipitation for the respective climate periods to compare the results with climate data.

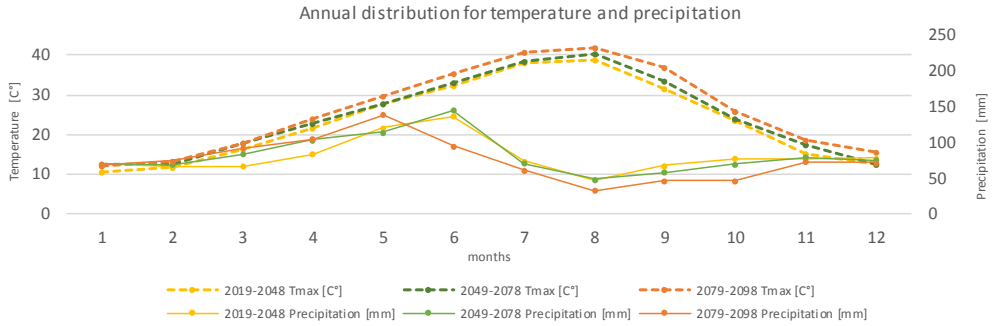

Fig. 5: Development of the monthly mean temperature and precipitation averaged over a 30-year span representing a time period from 2019 to 2098, ©AIT

As can be seen in the diagram, precipitation is steadily decreasing over time which is reflected in the irrigation demand for the considered crops. The climate model predicts a significant decrease of about 6% of precipitation for the period 2079-2098 compared to the previous period 2019-2048, as one factor leading to the required irrigation demand for the crops. In addition, the diagram shows an higher increase in temperature in the considered period during the entire year, which also increases the need for irrigation. The results of the climate model provide an outlook into the future, enabling to estimate the impact on the water demand for urban agriculture, in order to adapt to climate change. In summary, the results of the climate model show that a change is imminent in the next decades which will definitely influence the handling of resources.

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As part of the IN-SOURCE project, these analyses shall lead to an estimation of water demand for Vienna, based on land use categories. In this context, additionally to the water demand for arable land, water demand factors have been investigated within the project for all relevant land use categories.

The research has shown that currently only limited (publicly available) data on water consumption in Austria, especially in Vienna, is available for different land use categories, or is difficult to obtain. For the residential category, an average daily water consumption of 130l/(capita*day) was used (wien.gv.at, 2019), whereby this was in turn divided into several density categories as distinguished in real use (OGD, 2019) (e.g. dense residential area, garden city, large-volume residential construction, loosely built residential area/single-family houses area), as the water consumption in these housing options differ considerably from one another (Neunteufel, 2010). For industrial, commercial and service-oriented areas, estimating the water demand is difficult due to several parameters. According to Neunteufel, 2010, on the one hand, there are no figures on what proportion of Austrian industrial companies cover their water needs from the public water supply and what proportion is covered by self-supply (e.g. from ground water). On the other hand, the processes in industry/trade are very heterogeneous, which makes it difficult to estimate on a general level. In the commercial sector, values are usually set which, depending on the commercial enterprise, are multiplied by the number of employees or the quantity produced in order to take account of the different consumers. Nevertheless, there are some data that was collected from different studies and used in the project.

	Land use category	Mio.m³/a
Infrastructure	Industry & Service	46
	Social Infrastructure	7
	Mixed use	3
	Streetscape	3
	Technical Infrastructure	1
	Total:	**60**
Residential	Residential & Mixed use	66
Agriculture and Natural area	Recreational and leisure facilities	21
	Agriculture	30
	Natural area	49
	Total:	**100**
Total		226

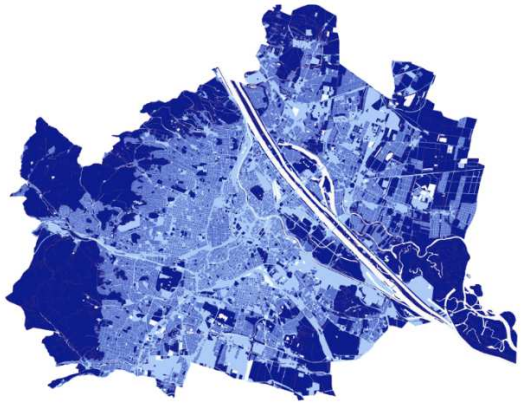

Fig. 6: Water demand by land use categories, ©AIT

The results of the water demand analyses show a total water demand of 226 Mio. m³ per year in Vienna (calculation base year 2018). The residential use accounts for the largest share. The average water consumption for industrial/commercial areas was calculated at approx. 31,000 m³/ha and year, the agricultural and natural areas are estimated to consume an average of 5,000 m³/ha per year, which corresponds to about 1/6 of the demand of industry. For residential areas, between 2,000 and 19,000 m³/ha and year are needed, depending on the density of the residential area.

5 SUMMARY AND OUTLOOK

The aim of the qualitative approach using CLDs to highlight important FWE relations was to get a more appropriate view about the most relevant interactions. And indeed, the multiple connections give an idea of the complexity of the topic. The specific quantitative GIS-based analysis of land use changes and resulting water demand has shown, that there is further need for research activities in this area. The influencing factor of climate change concerning the change in water consumption needs to be investigated in more detail. Besides climate change, many other factors need to be taken into account, but cannot be assessed and truthfully projected into the future due to unpredictable trends. For example, changes in lifestyles like dietary habits are difficult to foresee. Scenario simulations can at least help to prepare for different possible futures and enable to create adquate adaptation measures.

Another research question that was raised in the project deals with the topic on how do new forms of urban agriculture (vertical farming, insect breeding, aquaponics) affect the specific water and energy consumption? Besides that, the development of green and blue infrastructure will also become a crucial topic in the future in order to accelerate climate change adaptation and benefit from the positive cooling effects to improve quality of life and well-being of citizens.

Our analyses has shown that still high uncertainties exist, but this first estimation enables to get an idea of the most important leverage points to influence the water balance and existing FWE Nexus relations. The next steps in the project are to use the first results to simulate a future water demand using input data from the climate model. These results will be used as input for the simulation model URBANICA (Gebetsroither, 2014; Gebetsroither, 2015; AIT(b), 2020) which enables the user to analyse the impacts of spatial planning scenarios for the sustainable management of resources. The aim is to support urban planners in creating climate resilient cities and regions with regards to the FWE aspects.

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Interventionen für eine nachhaltige Mobilitätskultur?

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1 ABSTRACT

Der Anteil an Flächen in städtischen öffentlichen Räumen sind hauptsächlich zu Gunsten des motorisierten Individualverkehrs verteilt (Havemann, 2010; Knoflacher, 2009) – Fußgängerinnen, Fußgängern, Radfahrerinnen und Radfahrern bleiben meist nur die Restflächen (Notz, 2017). Während der Nutzungsdruck durch neue Mobilitätsformen weiter steigt und unterschiedliche Interessenslagen ausgehandelt werden müssen, rückt die Bedeutung und Umgestaltung des öffentlichen Raumes zunehmend ins Zentrum des Diskurses. Neue (urbane) Initiativen und Bewegungen fordern diese Räume und alternative Umgestaltungen vermehrt ein. Allerdings sind Prozesse der Stadt- und Verkehrsplanung starr und langfristig angelegt und reagieren meist zu langsam auf aktuelle Herausforderungen und Bedürfnisse. (Fugmann and Karow-Kluge, 2019). Dies wird zunehmend kritisch diskutiert und mehr Flexibilität, Experimentieren und Partizipation eingefordert (Savini et al., 2015), um eine „faire“ Verteilung des öffentlichen Raumes und eine nachhaltige Mobilitätskultur zu bewirken. Ein wesentlicher Ansatz für das neue Planungsverständnis ist die Herangehensweise des „Tactical Urbanism“. Dabei werden Interventionen als zeitlich begrenzte Veränderungen des öffentlichen Raumes sowie auch „als Instrument der prozessualen Stadtentwicklung, als Teil von Planungs- und Beteiligungsprozessen und als städtebaulicher Lösungsvorschlag“ (Drobek and Tran, 2017) herangezogen.

Der Forschungsansatz des „Tactical Urbanism“ wird im Projekt „Tactical Mobilism – Interventionen für eine nachhaltige Mobilitätskultur“ aufgegriffen mit dem Ziel zeitlich begrenzte, einfache und kostengünstige Interventionen zur Transformation von Mobilitätsräumen zu testen und zu etablieren. Das Projekt wird im Rahmen des Forschungsförderungsprogramms “Mobilität der Zukunft” durch das Bundesministerin für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie (BMK) gefördert. Dieser Beitrag beschäftigt sich daher mit dem Begriff und Ansatz des „Tactical Urbanism/Mobilism“, verschiedenen Fallbeispielen aus der räumlichen Praxis und einen Einblick in den Use Case Villach.

Keywords: Urbanism, Mobilitätskultur, Tactical, öffentlicher Raum, Interventionen

2 HINTERGRUND – NUTZUNGSDRUCK UND STARRE PLANUNGSPRAKTIKEN

Im Zuge der Massenmotorisierung beginnend in den 60er Jahre hat die Stadtplanung und Verkehrsorganisation zunehmend die Ansprüche des PKWs gegenüber anderen priorisiert (Monheim, 2018) Dies wirkte sich nicht nur auf eine hohe Flächeninanspruchnahme auf Kosten der gemeinschaftsbildenden Funktion des öffentlichen Raums, des Zusammenlebens und nachhaltiger Mobilität, aus, sondern hat auch negative Umweltfolgen (VCÖ, 2018; Dover and Massengale, 2014).

Doch es findet ein Umdenken statt den motorisierten (Individual-)Verkehr in seiner Dominanz in der Stadt zurückzudrängen (Degros and Bendiks, 2019). In den letzten Jahren rückte eine Fülle von städtischen Aktivitäten in den Fokus wissenschaftlicher, aber auch planerischer Diskurse. Höhere Investitionen in Radinfrastruktur und Fußgängerzonen, die Förderung des öffentlichen Nahverkehrs und die Reduktion von Stellplätzen sind beispielhafte Maßnahmen in Städten (VCÖ, 2019). Dem gegenüber treten immer mehr teilkollektive Interessensgruppen, die nach heterogenen, zukunftsweisenden Gestaltungen öffentlicher Räume verlangen und ihre Ansprüche aus verschiedensten Phänomenen unserer heutigen Zeit, wie Klimawandel, Energiekrise, Strukturwandel und Mobilitätswende, ableiten (Lange, 2014: 16). Unter Begriffen wie "Tactical Urbanism", "Informeller Urbanismus", oder "Subversiver Urbanismus", sowie „Bottom-Up-Urbanism“, „Self-Made-City“ oder „Grassroots-Bewegungen“ (Saiko, 2013: 26) wird eine Reihe von diesen städtischen, kreativen Praktiken zusammengefasst, die eine Aneignung des öffentlichen Raums anstreben und häufig durch direkte Interventionen sichtbar werden (Sandholzer, 2019; Iveson, 2013; Saiko, 2013). Insbesondere das Konzept des „Tactical Urbanism“ hat zum Ziel zeitlich begrenzte, einfache

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und kostengünstige Interventionen (z.B. Umbaumaßnahmen wie Parklets, temporäre Sperrungen, Begrünungsmaßnahmen) im Verkehrsbereich zu etablieren.

2.1 Nutzungsdruck in öffentlichen Räumen steigt

Zurzeit sind öffentliche Räume in Städten hauptsächlich zu Gunsten des motorisierten Individualverkehrs verteilt. Aufgrund des Zielkonflikts zwischen verkehrlichen und lokalen Nutzungen verlieren die öffentlichen Räume in urbanen Gebieten immer mehr an ihrer sozialen Funktion (Notz, 2017). Zum einen tragen die durch die autozentrierte Verkehrsplanung der letzten Jahrzehnte überdimensionierten Verkehrsflächen zur Einschränkung von Nutzungsmöglichkeiten und Reduzierung potentieller Aufenthaltsflächen im öffentlichen Raum bei (Degros and Bendiks, 2019). Zum Anderen sorgt die hohe Verkehrsbelastung für gesundheitsschädliche Lärm- und Stickstoffemissionen, wodurch das Wohlbefinden und die Lebensqualität der Bewohnerinnen und Bewohner sinkt und auch die Aufenthaltsqualität stark beeinträchtigt wird (Randelhoff, 2017). Der notwendige Wandel zur Umverteilung der Flächen in urbanen öffentlichen Räume zugunsten der aktiven Mobilität und ein Anstoß zu einer nachhaltigen Mobilitätskultur findet noch zu wenig statt. Insbesondere bei Parkplätze bzw. stehende Fahrzeuge nehmen den meisten Platz im öffentlichen Raum ein. Ob es sich dabei um „eine Privatisierung öffentlichen Eigentums“ (Notz, 2017) handelt, wird zunehmend diskutiert.

Großstädte und Metropolen stehen meist im Zentrum des Diskurses um die faire Aufteilung des öffentlichen Raums und sind Drehpunkt disruptiver Kräfte von Bottom-Up Initiativen. Aber „[e]s ist kaum bewusst und wird selten diskutiert, dass es noch ganz andere Formen urbanen Lebens gibt“ (Schmidt-Lauber, 2010), die sich nicht in den Großstädten und Metropolen abspielen. Auch Klein- und Mittelstädte fordern und fördern zunehmend ein Umdenken in Richtung nachhaltiger Mobilität und lebenswerter öffentliche Räume ein, sind offen für informelle Planung und verstehen ihre Rolle als wichtige Wirtschaftszentren und Wohnstandorte in der Region (Baumgart et al., 2011). Da in Österreich, als auch in Deutschland, ein großer Anteil der Bevölkerung in solchen Klein-und Mittelstädten leben, ist es nicht nur statistisch relevant, sondern sollte auch ins Blickfeld der Forschung rücken. Jede/r sechste Österreicherin oder Österreicher wohnt in einer Klein- oder Mittelstadt (Statistik Austria, 2020). In Deutschland sind es sogar fast jede/r Vierte (Destatis, 2018). Daher ist im hier beschriebenen Projektvorhaben die Stadt Villach Pilotstadt und in diesem Beitrag als Use Case aufgeführt.

2.2 Bottom-Up vs. Top-Down

Top-Down und Bottom-Up sind die zwei Gegenpole der Einflussnahme und Beteiligung, die in der Stadtplanung diskutiert werden (Breuer et al., 2014). Bottom-Up drückt sich im urbanen Handeln als Partizipation, Teilhabe und Offenheit sowie in der Stärkung der Rolle der Bürgerinnen und Bürger und der Identifikation innerhalb der eigenen Gemeinschaft in einem direkt-demokratischen Prozess aus. Top-Down sind zum Beispiel Gesetze, die von oben herab durch eine Institution, Verwaltung oder durch politische Entscheidungsträgerinnen und Entscheidungsträger auf die Bürgerinnen und Bürger und das Verhalten wirken (Jessop et al., 2013).

Traditionelle Planung und Steuerung äußert sich häufig durch starre Strukturen, die nicht dafür ausgelegt sind auf Änderungen und Anforderungen schnell zu reagieren, aber auch gleichzeitig Planungs- und Rechtsicherheit garantieren (Pogačar and Šenk, 2018; Hoelzel, 2015). Durch den Eintritt von „Grassroot“-Bewegungen oder anderen Bottom-Up-Initiativen in das Feld der urbanen Politik und Governance lässt sich eine Verschiebung im Verhältnis zwischen privaten Investoren und öffentlicher Verwaltung feststellen, was neue Strategien in Richtung vermehrter Kooperationen und Verschiebungen in klassischen Rollenzuschreibungen und –bildern auslöste (Domaradzka, 2019: 7). Es besteht dennoch die Gefahr, dass die langen Planungsprozesse die aktuell vorherrschenden Bedürfnisse der Bevölkerung verfehlen, da sie in einigen Jahren nicht mehr den Status Quo abbilden und/oder auch nur einen Teilaspekt behandelt haben.

2.3 Flexibilität in der Planung

Das Top-Down Prinzip in der Stadtplanung wird zunehmend kritisch diskutiert und gleichzeitig von Planerinnen und Planern mehr Flexibilität, Ausprobieren und Experimentieren eingefordert (Bertolini and le Clercq, 2003; Salet et al., 2013; Savini et al., 2015). Das gemeinsame, partizipative Erarbeiten und Ausprobieren im öffentlichen Raum in einem sogenannten Reallabor bzw. –experiment kann auch neue

Sichtweisen eröffnen, zum notwendigen Umdenken bei den Akteuren führen und positive Impulse in Richtung einer nachhaltigen Mobilitätskultur setzen (West, 2018). In der Praxis sehen Bergevoet und Tuijl (2016) eine zeitliche Flexibilität als einen stufenartigen Prozessablauf in dem die Resultate immer offen für Veränderungen oder Anpassungen sind (Bergevoet, Tom; van Tuijl, 2016: 39). Eine integrative Planung und Neukonzeption von städtischen Straßen erfordert ein neues Regelwerk zum Prozessablauf, zum Design der Straßenräume und zur damit verbundenen Neuverteilung des Raumes. Der Einsatz von partizipativen Prozessen und Werkzeugen hat einen noch geringen Stellenwert in der Verkehrsplanung und wird nur vereinzelt bisher angewandt (Scherz, 2018: 77). Vereinzelte Kultur-, Kunst- und Sozialprojekte lassen jedoch erahnen, welches Potenzial in einer gezielten Einbindung der Bewohnerinnen und Bewohner, Initiativen, Vereinen etc. und der Belebung des öffentlichen Raums als Lebensraum vorhanden ist. Wichtig ist es erstmal den Raum für Experimente sowie Flexibilisierung von Prozessen und Umsetzungsprojekten zu forcieren, was sich in temporären und kurzfristigeren Lösungen von „Tactical Urbanism“ widerspiegelt. Ein kurzer Vergleich zwischen dem deutschsprachigen Raum und Skandinavien macht dahingehend einen klaren Unterschied deutlich: Wohingegen in Dänemark die Planung eines Radweges nur zwischen 6-9 Monaten dauert, werden für diesen Prozessschritt in Deutschland 24 Monate veranschlagt (Reidl, 2019). Allein durch dieses Beispiel wird deutlich, dass Flexibilisierung und ein Umdenken in unseren aktuellen Planungssystemen dringend notwendig sind.

3 TACTICAL URBANISM UND VERWANDTE ANSÄTZE

In den letzten Jahren rückte eine Fülle von städtischen Bottom-Up-Aktivitäten in den Fokus wissenschaftlicher, aber auch planerischer Diskurse. Unter Begriffen wie "Tactical Urbanism", "Informeller Urbanismus", „Placemaking“ oder "Subversiver Urbanismus" wird eine Reihe von urbanen Praktiken zusammengefasst, die Interventionen im öffentlichen Raum anstreben. Diese Aneignungen sind begründet im Aufbegehren und dem Wunsch nach direkter Teilhabe seitens der Bürgerinnen und Bürger und haben ihre Ursprünge in Jane Jacobs einflussreichem Werk „The Death and Life of Great American Cities“ (Jacobs, 1961). Etwa zeitgleich wie Jane Jacobs’ Buch erschien auch jenes Werk in dem Henri Lefebvre erstmals von einem „Recht auf Stadt“ schrieb (Lefebvre, 1968). Ein wesentliches Stichwort in dieser Debatte ist die „Flächengerechtigkeit“ in der Stadt im Zeitalter nach den großen Plänen der „funktionalen Stadt“. Dieses Leitbild ging weiter über in die „Stadt der kurzen Wege“, die Idee der „Nahmobilität“ und jetzt die „Städte für Menschen“ und die „lebenswerte Stadt“ (Sabine Drewes, 2019) als zentrale Paradigma.

„Tactical Urbanism“ hat sich in diesem Diskurs als Überbegriff für unterschiedliche Interventionsansätze im städtischen, urbanen Raum entwickelt. Neben der Erstellung von Modellen zur Nutzung leerstehender Stadträume (Németh and Langhorst, 2014) und informellen Aktionen innerhalb rechtlicher Grauzonen (Bermann and Clough Marinaro, 2014) umfasst „Tactical Urbanism“ hauptsächlich Interventionen im öffentlichen Raum und auf Straßen zur Förderung nicht-motorisierter Mobilitätsformen (Birdsall, 2015). Tactical Urbanism Initiativen werden einerseits als neue Alternativen, andererseits auch als Herausforderungen für formelle, offizielle Planungsmethoden und -prozesse gesehen. Sie deuten jedoch darauf hin, dass Planungssysteme anpassungsfähiger und flexibler werden müssen. Ins Rollen brachte diese Bewegung das Duo Lydon und Garcia, die 2011 erstmals den „Tactical Urbanist Guide“ veröffentlichten und so auch den Begriff „Tactical Urbanism“ wesentlich mitprägten und versuchten zu definieren (Webb, 2018). Es gibt jedoch bereits die Angst, dass das radikale Potential von „Tactical Urbanism“ in klassischen Planungsprozessen verloren gehen könnte, da etablierte Demokratie- und Entscheidungsstrukturen in Verbindung mit wirtschaftlicher Macht diese zu ihren Zwecken nutzen könnten (Webb, 2018).

Generell sind taktische Interventionen kostengünstige, kurzfristige Aktionen, die auf eine langfristige, realistische Verstetigung und Umsetzung ausgelegt sind. Umsetzerinnen und Umsetzer können verschiedenste Akteurinnen und Akteure von Architektinnen und Architekten, Planerinnen und Planern, Künstlerinnen und Künstlern, öffentliche oder private Institutionen, aber auch hin zu lokalen Initiativen, sein. Diese Definition neuer Stadtmacherinnen und Stadtmacher geht also von einer transdisziplinären und kollaborativen Herangehensweise aus (Lydon et al., 2012; Lydon et al., 2011). Durch „leichte“ provisorische Maßnahmen können Lösungsansätze getestet werden, die in ihrer permanenten Umsetzung wesentlich kostenintensiver und komplexer wären (Leonard, 2015). Durch diese temporären Installationen wird außerdem das Bewusstsein für Probleme und alternative Lösungsansätze bei Politik und Verwaltung, sowie bei Bürgerinnen und Bürgern erhöht. Zusätzlich bietet sich die Möglichkeit potenzielle

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Langzeitauswirkungen der Umsetzungen frühzeitig abschätzen und ungefähr evaluieren zu können. Diese können von kleinen Demonstrations- und Pilotprojekten mit geringen Projektkosten und einem kurzen Zeithorizont, bis hin zu kostenintensiven Langzeitvorhaben zur Neu- und Umgestaltung bestehender Räume, reichen. Dennoch finden sich Interventionen häufig nur in großen Städten bzw. ziehen dort die meiste Aufmerksamkeit auf sich.

Aktionen und Projekte des Tactical Urbanism lassen sich meist nicht ganz klar einem Begriff zuordnen und variieren in zeitlicher und räumlicher Ausprägung, sowie planerischen Aussrichtung (Top-Down, Bottom-Up, (in)formell) stark. Bis jetzt gibt es keine wirklich klare theoretische Abgrenzung in diesem Bereich. Die Begriffe und Theorien sind in ihrer Qualität und in ihrem Umfang unterschiedlich weit gefasst und können sich auf verschiedenen Maßstabsebenen abspielen (Marshall et al., 2016). Versuche diese verschiedenen, breit gefächerten und kleinräumlichen Aktionen zu beschreiben, führten meist zu einer Gruppierung in Überkategorien (Iveson, 2013) oder in einer Beschreibung von (Umsetzungs-) Methoden (Lydon and Garcia, 2015). Im Folgenden werden nun die wesentlichsten Überbegriffe in diesem Planungsfeld umrissen und in Relation zueinander gebracht. Im Bereich des „Tactical Urbanism“ gibt es weitere Ansätze bzw. Spielformen, die hier kurz skizziert und anhand eines Beispiels veranschaulicht werden. Die Abbildung 1 zeigt in welchem Verhältnis diese zu verorten sind – wobei die Bezeichnung „Tactical Mobilism“ (vgl Kapiel 4) darüber liegt und viele verschiedene Ansätze mit einbezieht.

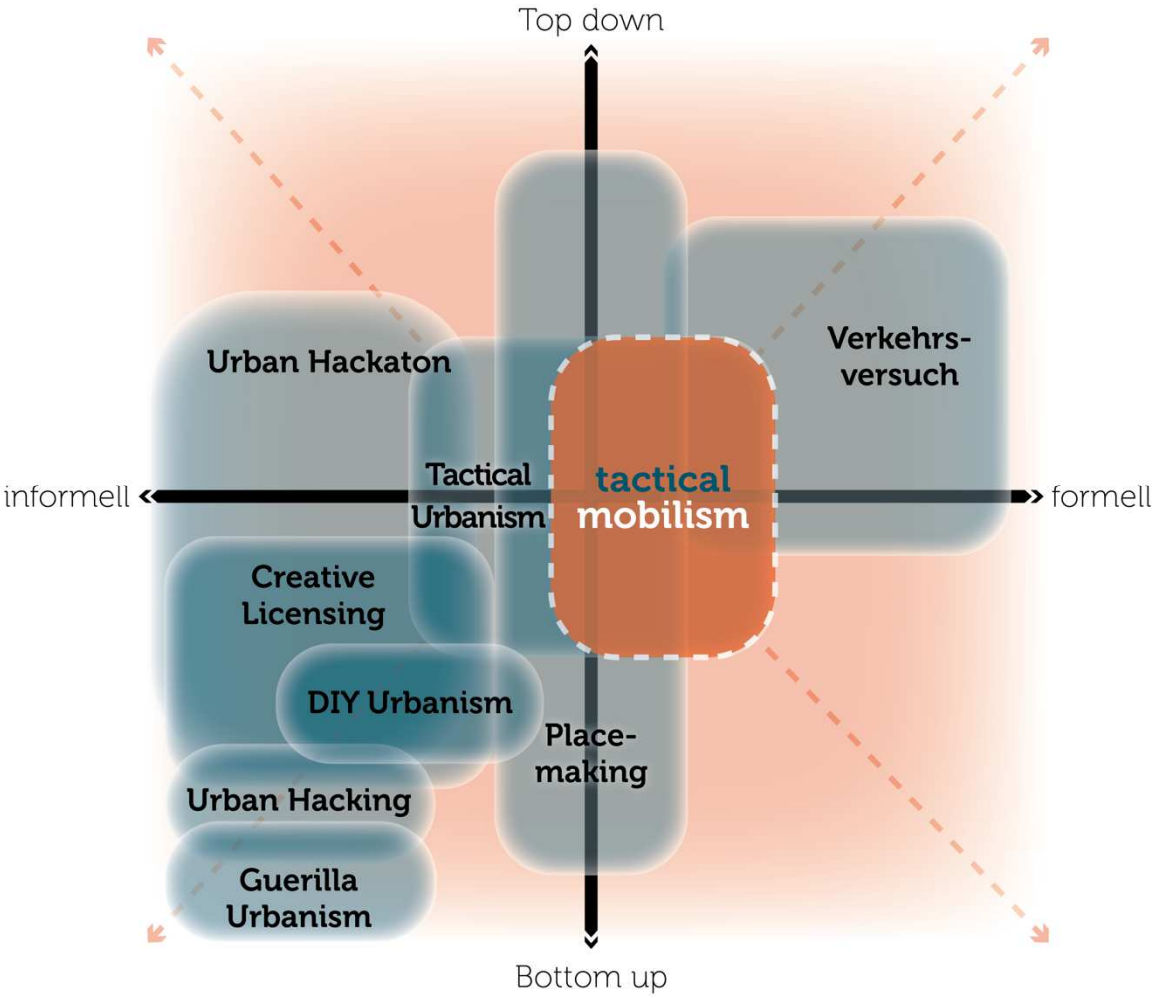

Abb. 1: Verortung der Theorien rund um „Tactical Mobilism” (eigene Darstellung)

3.1 Guerilla Urbanism und Urban Hacking

„Guerrilla Urbanism“ kämpft als Ansatz oftmals gegen die steigende Regulierung, Privatisierung und das Verschwinden alternativer Formen öffentlichen Raums (Hou, 2010: 1) in verschiedenen kaum fassbaren Ausformungen, wie Guerilla Gardening. Der öffentliche Raum wird von Bewegungen hierbei durch Guerilla Taktik regelrecht eingenommen (Eismann and Zobl, 2011). Urban Hacking als Form der Urbanen Intervention umfasst kleine, oft nicht genehmigte, räumliche Interventionen, die die „Einschränkungen” von Systemen aufbrechen wollen (Pogačar and Šenk, 2018; Gadringer, 2010). Diese Form der Aneignung beinhaltet einen klaren aktionistischen, selbstermächtigenden, Bottom-Up Ansatz (Schneider and Friesinger, 2009). Beide Handlungsweisen können nicht klar voneinander unterschieden werden, wobei Guerilla-Taktiken eher auf die Stärke der Überraschung setzen und Urban Hacking mehr die Nischen im System erforscht und ausmacht (Morandini, 2013: 102–103).

Der Urban Hackathon, der Begriff kommt ursprünglich aus der studentischen Hacker- und Computer-Szene, ist eine Spezialform von Urban Hacking und kann als Teil partizipativer Planung in Form eines Events beschrieben werden (de Waal and de Lange, 2019). Es werden teils definierte Problemstellungen in einem limitierten Zeitfenster (z.B. 24 oder 48 Stunden) gelöst. Informationstechnologien und Kollaboration sind zentrale Bestandteile (Pogačar and Žižek, 2016). Im Jahr 2015 wurden im Rahmen des Programms „Actors of Urban Change“ der Robert Bosch Stiftung drei Hackathons gefördert die „von unten“ im Bereich der Koroska Straße in Maribor (Slowenien) realisiert wurden. Ziel war es den jahrelangen Stillstand im Prozess zur Umgestaltung der Hauptstraße der Altstadt aufzubrechen und Anwohnerinnen und Anwohner zu motivieren am Prozess aktiv teilzunehmen (CityToolBox, 2020; Pogačar and Žižek, 2016)

3.2 DIY-Urbanism und Creative Licensing

DIY- und Tactical Urbanismus werden oft als synonyme (Über-) Begriffe verwendet. Sie unterscheiden sich jedoch fundamental darin, dass Tactical Urbanism darauf abzielt langfristige Veränderungen herbeizuführen, wohingegen DIY-Urbanism meist im kurzfristigen Umsetzen kleinräumiger Interventionen verharrt (Lydon and Garcia, 2015; Douglas, 2014). DIY (Do-it-yourself), oder oft auch DIWO (Do-it-with-others), zielt klar auf den Gedanken ab unabhängig von wirtschaftlichen und kommerziellen Zwängen eigene Wünsche und Ideen umzusetzen. Konkret bezogen auf den Raum zeigt sich dies in Form von Urban Gardening oder ähnlichen kleinräumigen, handwerklichen Projekten (Baier et al., 2013: 86). Creative Licensing kann hierfür ein nützliches Werkzeug sein, das ermöglicht bürokratische Hürden im öffentlichen Raum zu überwinden, beziehungsweise vorhandene Schlupflöcher zu finden und nutzen. Beispiele hierfür sind der alljährliche „Park(ing) Day” oder die Institution der Spielstraßen. (Pogačar and Šenk, 2018)

Parklets als ein Beispiel sind frei zugängliche, öffentliche Sitzplattformen, die sonst rein als Parkplätze für PKWs genutzte öffentliche Räume in nachbarschaftliche Treffpunkte verwandeln (können). Sie können das Ergebnis von Partnerschaften zwischen der Stadtverwaltung, lokalen Betrieben, Anwohnerinnen und Anwohner oder Nachbarschaftsgruppen sein. Verschiedene Nutzungen, wie Sitzmöglichkeiten, Begrünung, Bepflanzung oder Radabstellplätz, sind möglich (NACTO, 2013: 77–80). Teile des Parklet-Konzeptes entstanden aus einer Aktion des Design Studios „Rebar Group“ aus San Francisco. Sie transformierten 2005 einen Parkplatz in einen temporären öffentlichen Park. Nach Bezahlung der Parkgebühren bauten sie Bänke, Bäume und Rollrasen auf. Darauffolgend wurde auch der weltweite PARK(ing) Day ins Leben gerufen (Birdsall, 2013). Mit dem Hinweis auf vermehrten Bedarf an urbanen Erholungsflächen findet dieser alljährlich am dritten Freitag im Monat statt (Saitta, 2010: 78–79). 2010 wurde das erste offiziell genehmigte Parklet in San Francisco im Rahmen des städtischen Programmes „Pavement to Parks“ errichtet (Birdsall, 2013). In Wien gibt es seit 2015 die finanzielle Fördermöglichkeit durch das Aktionsprogramm „Grätzeloase“ der Lokalen Agenda 21 (Lokale Agenda 21 Wien, 2019).

3.3 Placemaking

Placemaking hat sich in den letzten Jahren als wachsende Bewegung etabliert, die zum Ziel hat Bürgerinnen und Bürger zu ermächtigen ihr eigenes Lebensumfeld zu gestalten und zu transformieren (Placemaking Plus, 2017: 6). Räume sollen sich mit diesem Toolset in Orte des Dialoges, der Inklusion und demokratischer Partizipation wandeln (Toolis, 2017; Project for Public Spaces, 2007). „Placemaking” kann als Bottom-Up, personen- und objektbezogener Prozess beschrieben werden, der großen Wert und Schwerpunkt auf Kollaboration und gemeinschaftliche Partizipation legt, um die Lebensqualität in Gemeinden und Städten zu

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verbessern (Laven et al., 2019; Toolis, 2017). Die oftmalige Kritik spielt auf die apolitische Herangehensweise und die Exklusivität für manche Gruppen an. Die Revitalisierungsbestrebungen zielen oft auf Verschönerung und Verbesserung öffentlicher Räume für Investitionen ab. Ausgeschlossen werden oft Überlegungen zum Abbau wirtschaftlicher und sozialer Ungleichheiten (Toolis, 2017).

Beim Projekt Österreichischer Platz in Stuttgart wurde eine ehemalige, witterungsgeschützte Parkfläche für KFZ unterhalb einer Autobrücke als städtisches Experimentierfeld umgenutzt Der Prozess der gemeinschaftlichen Raum (-re-) produktion stand bei diesem vom Verein Stadtlücken initierten Prozess im Mittelpunkt. Die Vision der Initiatorinnen und Initiatoren war es Spielräume zu öffnen und ein Experimentierfeld für einen kooperativen Stadtraum zu schaffen und zwar gemeinsam mit den Bürgerinnen und Bürgern Stuttgarts. Von Frühjahr 2018 bis Herbst 2019 fanden hier unzählige Veranstaltungen, Workshops und Vieles mehr statt (Stadtlücken e.V., 2019). Die vorhergehend erwähnte Kritik der Exklusivität trifft bei diesem Beispiel von Placemaking nicht zu. Am Österreichischen Platz wurde nämlich auch ein „Stadtregal“ errichtet, was als Stadtmöbel zur Betreuung und Versorgung von und zum Austausch zwischen Wohnsitzlosen und Drogenabhängigen Menschen diente (Heißenbüttel, 2019). Für die kommenden beiden Jahre ist die Finanzierung des Projektes und dessen Verstetigung durch die Stadt Stuttgart mit 1,6 Millionen Euro finanziell garantiert (Gall, 2020).

3.4 Verkehrsversuche

Verkehrsversuche sind kleinmaßstäbliche Experimente, um eine zukünftige, verkehrliche Gestaltung auszuprobieren sowie Planungsvorhaben vor der finalen Realisierung temporär umzusetzen (Pogačar and Šenk, 2018). Oftmals scheitern visionäre und utopische Ideen an der fehlenden Vorstellungskraft betroffener Akteurinnen, Akteure, Entscheidungsträgerinnen und Entscheidungsträger und dem daraus resultierenden Widerstand und Unverständnis. In der temporären Übersetzung dieser Visionen in einem Experiment liegt die große Stärke des Verkehrsversuchs. Diese eher neuere Herangehensweise kann diesbezüglich zu mehr Verständnis und Akzeptanz führen und ist in Deutschland in der StVo in § 45 definiert und wie folgt festgeschrieben: „Die Straßenverkehrsbehörden können die Benutzung bestimmter Straßen oder Straßenstrecken […] beschränken oder verbieten und den Verkehr umleiten. Das gleiche Recht haben sie […] zur Erforschung des Unfallgeschehens, des Verkehrsverhaltens, der Verkehrsabläufe sowie zur Erprobung geplanter verkehrssichernder oder verkehrsregelnder Maßnahmen“ (Aichinger and Frehn, 2017; Bundesamt für Justiz, 2013). Diese „Erprobungsklausel“ in der deutschen StVo soll bald erweitert werden und somit die „Mitbestimmung der Kommunen gestärkt“ werden (Bundesministerium für Verkehr und digitale Infrastruktur, 2020). Getestet werden kann zum Beispiel die Errichtung neuer Radwege (Pogačar and Šenk 2018, 177) oder auch die temporäre Umgestaltung ganzer Straßenzüge, wie es in Potsdam, München oder anderen deutschen Städten bereits geschehen ist (Aichinger and Frehn, 2017). Die Methode der „Experimentellen Co-Production” kann hier als Schlüsselelement partizipativer Steuerung gesehen werden und hat das Potential beidseitig positive Synergieeffekte, sowohl für Bürgerinnen und Bürger als auch für Entscheidungsträgerinnen und Entscheidungsträger, zu schaffen. Vorteile dieser kooperativen Herangehensweise an Planungsaufgaben sind die Etablierung einer erhöhten Akzeptanz und eine erhöhte Legitimation von gemeinschaftlich getroffenen Entscheidungen. (Bartenberger and Sześcilo, 2016)

In München wurde ein Teil der Sendlinger Straße noch vor einer angedachten Erweiterung der Fußgängerzone temporär als verkehrsberuhigter Bereich für die Bevölkerung erlebbar (Aichinger and Frehn, 2017). Für ein Jahr wurde der Autoverkehr vollständig verbannt. Aufgrund der prominenten Lage und Bekanntheit der Gegend war dies ein sensibles Vorhaben. Über die gesamte Zeitdauer wurde deshalb dieser Versuch mit einer umfassenden Evaluierung und Bürgerbeteiligung begleitet. (Netzwerk Bürgerbeteiligung) Die Evaluation ergab die Empfehlung zur dauerhaften Umgestaltung der Maßnahme an den Stadtrat (Referat für Stadtplanung und Bauordnung, 2017). Bis Anfang 2020 sollen die letzten Arbeiten zur Umgestaltung in eine Fußgängerzone abgeschlossen sein (Portal München Betriebs-GmbH & Co. KG, 2019).

Die verschiedenen Ansätze unterscheiden sich stark in ihren Kosten, der Umsetzung, der Prozesse sowie im Maßstab. Auch ob eine Verstetigung angestrebt oder nur vereinzelt auf Bedürfnisse und auf Ansprüche an öffentliche Räume aufmerksam gemacht werden soll, ist ganz unterschiedlich. Tabelle 1 bietet hier zu eine knappe Übersicht und soll einen weiteren Diskurs in der Frage nach der Definition und Abgrenzung der genannten Ansätze von Interventionsmöglichkeiten im öffentlichen Raum anstoßen.

Ansätze	Gesamtkosten Umsetzung	Gesamtzeit Umsetzung	Verstetigung angestrebt?	Wer initiiert und setzt um?	Maßstab	Rechtliche r Rahmen
Tactical Urbanism	Niedrig angestrebt	Kurz – Mittel	Ja	Versch.	Versch.	Informell – formell
Guerilla Urbanism / Urban Hacking	Niedrig - Mittel	Kurz	Unklar	Privatpersonen, Vereine	Punktuell im öffentliche n Raum	Informell
DIY-Urbanism & Creative Licensing	Niedrig	Kurz	Nein	Privatpersonen, Vereine	Kleinräuml ich (z.B. Stellplatz)	Informell
Placemaking	Niedrig - Hoch	Mittel - Lang	Ja	Versch. – eher informell	Versch.	Informell - formell
Verkehrsversuch	Hoch	Lang	Ja	Politik, Verwaltung	Straßenabs chnitte, Grätzl	Formell

Tabelle 1: Tabellarische Einordnung der Theorien rund um "Tactical Mobilism"

4 USE CASE DES TACTICAL MOBILISM

Da Interventionen und Projekte im öffentlichen Raum nicht nur Implikationen auf diesen direkt besitzen, sondern in weiterer Folge auch auf den Verkehr und die verschiedenen Mobilitätsformen, die diesen nutzen, entstand die Wortschöpfung des „Tactical Mobilism". Dieser Ansatz ist zwischen Verkehrsversuch, Tactical Urbanism und Placemaking verortet (siehe Abb. 1) und weißt damit inhaltlich sowie prozessual Überschneidungen auf. Damit verbunden und unter dem Titel „Tactical Mobilism – Interventionen für eine nachhaltige Mobilitätskultur" wird beim BMK ein Forschungsvorhaben mit dem Ziel anhand von zeitlich begrenzten, einfachen und kostengünstigen Interventionen eingebettet in einen Partizipationsprozess ein Umdenken seitens der Bevölkerung, Politik und anderer Akteurinnen und Akteure anzuregen, gefördert. Neben dem Forschungsbereich der Verkehrssystemplanung (TU Wien) als Konsortialführung und der Stadt Villach, komplementieren das Institut für Städtebau (TU Graz), queraum. kultur- und sozialforschung, PLANUM Fallast Tischler & Partner GmbH sowie Artgineering das interdisziplinäre Team.

4.1 Methodischer Ansatz

Das adaptive und flexible Ausprobieren unterschiedlicher „Spielarten" des Tactical Mobilism stellt das Hauptanliegen des Projekts dar. Dabei wird Tactical Mobilism als integrativer Prozess verstanden, der von der Auswahl über die Konzeption bis hin zur Intervention und Wirkungsmessung reicht und mittels einer sehr umfassenden Evaluierung begleitet wird. Im Rahmen des Reallabors wird mittels der Methode des Community Organizing gewährleistet, dass unterschiedliche Bevölkerungsgruppen (z.B. Kinder, Jugendliche, Familien, ältere Menschen, Menschen mit Behinderung, sozial benachteiligte Personengruppen) einbezogen und empowert werden, ihre Sichtweisen einzubringen und ihre Lebenswelt aktiv mit zu gestalten. In Anlehnung an die Phasen des Community Organizing kommen unterschiedliche Methoden zum Einsatz (z.B. Befragungen, Begehungen, Raumbeobachtung). Das Reallabor und die darin stattfindenden Interventionen bzw. Experimente in den Testräumen unterstützen eine Bewusstseinsbildung in Bezug auf die räumliche (Ungleich-)Verteilungssituation zwischen den einzelnen Modi im öffentlichen Raum. Außerdem ist eine Verstetigung von temporären zu permanenten Maßnahmen und Projekten, also ein „pilot-to-permanent" Modell, angestrebt.

4.2 Der Ort

Innovativer Ort und Use Case ist darin die Stadt Villach - eine 60.000 Einwohner Stadt im österreichischen Südalpenraum, nahe des Dreiländerecks Österreich, Italien und Slowenien. Aufgrund der Lagegunst ist Villach ein attraktiver Ort für Unternehmen und bietet gleichzeitig spannende und attraktive öffentliche Räume in der Innenstadt. „Während die städtische Peripherie eine Zunahme verzeichnet, sieht sich das Stadtzentrum mit zunehmendem Leerstand konfrontiert. In diesem Zusammenhang hat sich die Stadt dazu entschlossen sich mit den möglichen Potentialen der öffentlichen Raumqualitäten der Stadt intensiv auseinanderzusetzen" (Fachkonzept Öffentlicher Raum Villach 2015, 2019).

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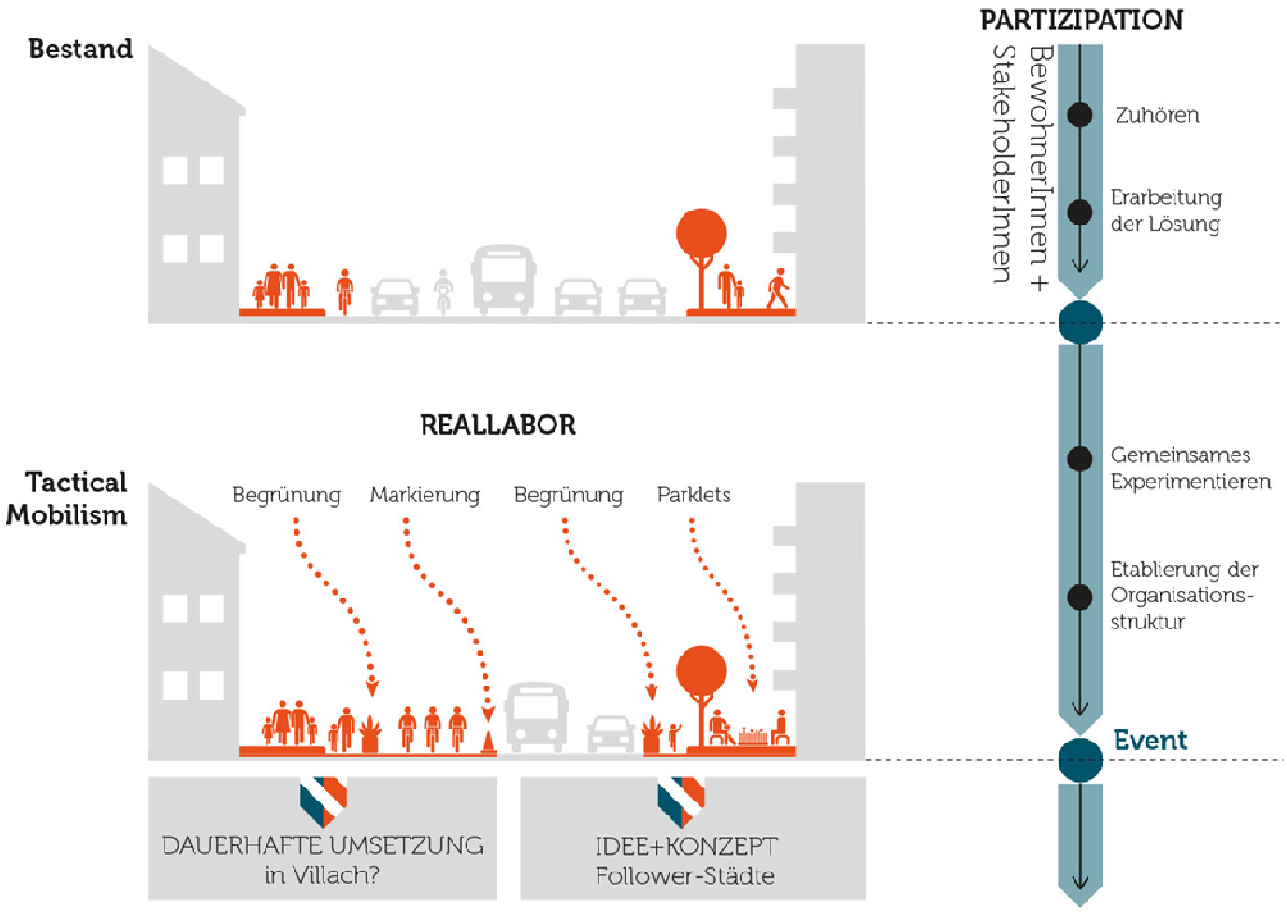

Abb. 2: Konzept zur Umsetzung von "Tactical Mobilism" (eigene Darstellung)

Die Stadt Villach als Partner im Projekt eignet sich aus mehreren Gründen als Pilotstadt:

- Die Stadt gehört zu den österreichischen Mittelstädten. Die Erfahrungen im Projekt können somit für zahlreiche größenmäßig und strukturell ähnliche Städte in Österreich (z.B. St. Pölten, Wels, Dornbirn, Steyr) und auch europaweit als Vorbild dienen.
- Villach versteht sich als „innovativer Impulsgeber für soziale, technologische, wirtschaftliche und ökologische Innovationen" und verfügt über einige Vorerfahrungen und bereits umgesetzte Aktivitäten.
- Villach ist des Weiteren Mitglied im Netzwerk „Gesunde Städte" und bietet Angebote wie essbare Stadt, öffentliche Gartenbeete und gezielte Bewegungsangebote für verschiedene Zielgruppen.
- Die Stadt Villach beschreitet im Fokus der nachhaltigen Stadtentwicklung seit mehreren Jahren konsequent den Weg der Innovation. Im integrativ unter Beteiligung der Öffentlichkeit erarbeiteten Stadtentwicklungskonzept „Stevi :konzept 2025" wurde die Bedeutung einer innovativen urbanen Mobilität für Villach besonders hervorgehoben.
- Im Fachkonzept Öffentlicher Raum Villach ist im Aspekt der aktiven und smarten, urbanen Mobilität eine fairere Aufteilung von 13 urbane Achsen (urbanen Straßenräumen) strategisch festgelegt worden.
- Das Reallabor-Gebiet von Tac | Mob ist die Innovationsachse Hauptbahnhof – Innenstadt – Infineon. An dieser Achse liegen die wichtigsten öffentlichen Einrichtungen, die wichtigsten Mittelschulen und das größte und innovativste Unternehmen Kärntens, Infineon Villach.

Insbesondere der Klimawandel im Zusammenhang mit dem öffentlichen Raum sind der Stadt Villach ein Anliegen und sollen anhand von Interventionen sichtbar und greifbar werden. Es wird sich zeigen müssen, inwieweit und in welcher Ausprägung Tactical Mobilism Interventionen forciert und umgesetzt werden können. Interventionen sind im Sommer 2020 geplant und sollen Politik, Verwaltung, Bewohnerinnen und Bewohner gemeinsam auf die Straße und in den öffentlichen Raum bringen.

5 CONCLUSIO UND AUSBLICK

Auch wenn veschiedenste Fachrichtungen und Arbeitsfelder wie Architektur, Raumplanung, Kunst, Aktivismus und Initiativen, mit der Thematik der Intervention, insbesondere im öffentlichen Raum, eine längere Tradtion pflegen (Mohr and Landau, 2017; von Borries et al., 2012), ist der Ansatz Tactical Urbanism ein nicht klar umrissenes Feld, dessen Differenzierung und Definition nach wie vor schwierig ist. Dieser Beitrag hat den Anspruch einen Überblick zu verschiedenen Ausprägungen, die sich räumlich, zeitlich und prozessual stark unterscheiden, zu geben und deren starken Bezug zu Verkehr und Mobilität aufzuzeigen. Sowohl das Projekt, als auch die Wortneuschöpfung des Tactical Mobilism, konnte in die Reihe der Begrifflichkeiten eingeordnet werden. Das Projekt mit dem Fokus auf Klein- und Mittelstädte ist nicht nur ein wichtiger Beitrag das Konzept der „taktischen" Interventionen in der Planungspraxis bekannt zu machen und die Begrifflichkeit mehr zu schärfen, sondern auch langfristig neue Handlungsoptionen in der Planung aufzuzeigen und ein Umdenken „in den Köpfen" seitens der verschiedensten Akteure zu bewirken. Da urbanes Leben sich nicht nur in größeren Städten und Metropolen abspielt, ist es umso wichtiger das Experimentieren zu forcieren und aktivistische, informellen Kräfte außerhalb dieser zu erkennen und zu aktivieren. Villach als innovative Mittelstadt traut sich an das Experiment. Es wird sich zeigen, wie lokale Politik, Bevölkerung, verschiedene Initiativen und Vereine auf das Vorhaben reagieren, sich einbringen und weiter vorantreiben.

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🏆 *reviewed paper*

Is Green Infrastructure a Game Changer for Sustainable Regional Development? A Scenario Approach for Stuttgart Region

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1 INTRODUCTION

There are numerous challenges for municipalities and regions: affordable housing, overburdened infrastructure, air quality, increasing pressure on open spaces, expansion of renewable energies, climate adaptation. Certainly, the list is not complete. Moreover, these issues – as a typical characteristic of complex situations – interact with one another in various ways.

As one of Germany's most dynamic and densely populated locations the Stuttgart Region is particularly affected by these challenges. Therefore, protecting and developing the landscape is a longstanding concern of its overall spatial planning strategy (e.g. development-axes, regional green corridors, landscape park, public transport policy). In view of the sheer number of tasks, the ongoing dynamics as well as strong sectoral policy instruments, the question can be raised as to how far green infrastructure can be a game changer for a substantive transformation towards sustainability.

Against this background, a scenario-approach is carried out aiming for the integration of various knowledge-areas into a supra-sectoral and strategic view on regional transformation. Taking the example of the Stuttgart Region, the diversity and interdependencies of land use are taken into consideration and synthesised in form of a qualitative system analysis.

The scenario development is part of the RAMONA-project, which is funded by the Federal Ministry of Education and Research (BMBF) in the framework of the "Stadt-Land-Plus"-measure. The project deals with the intervention regulation under the Nature Conservation Act[1] ("Eingriffsregelung") and inherent opportunities for urban and regional development. The scenario based approach therefore starts with open-space-indicators such as "degree of imperviousness", "compensation measures" as well as "green infrastructures" and puts them into a wider perspective of socio-technical development (e. g. settlement structure, infrastructure, traffic volume, agriculture or health) in order to obtain comprehensive pictures of the Stuttgart Region in the year 2050.

Keywords: impact regulation, great transformation, spatial development, landscape, system analysis

2 CONSTRUCTING CONSISTENT SCENARIOS – METHODOLOGY AND PROCESS

Scenarios describe alternative, consistent future developments (Kosow & Gaßner 2008). They provide a platform to reflect, communicate and discuss the openness of the future, the interdependence of developments as well as the steering effects of possible policy interventions. When selecting a suitable scenario-technique for the RAMONA-project it was essential that it offers a formalised system-analytic structure to interconnect a wide variety of drivers (as land use is a highly interdisciplinary issue) but at the same time is capable of handling qualitative information (as units, scale levels and calculability differ).

According to these requirements, cross-impact-balance-analysis (CIB) (Weimer-Jehle 2018) offers a viable option. It constructs impact networks based on expert surveys and finds plausible configurations by applying a mathematical algorithm. These plausible configurations are taken as scenarios. Thus, qualitative insights in interdisciplinary questions can be formulated, documented and synthesised into overall pictures.

Among others, the method has been used several times for scenario analyses in the field of energy supply and sustainability research (Jenssen & Weimer-Jehle 2012; Renn et al. 2007).

To put emphasis on the communicative and facilitating quality within the group-process CIB was closely blended with metaplan-technique. The current case-study involves fifteen regional practitioners and academics and is based on a five-step procedure:

(1) Identification of sectoral indicators (named descriptors), each assigned with a range of possible alternative developments (or variants) by 2050, in a moderated group discussion within workshop I (14

[1] RAMONA is an acronym for "Urban-regional compensation strategies as an engine of sustainable land use". For more information about the project and the institutions involved, see http://www.fona-ramona.de/

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persons, September 2019). The descriptors are chosen in order to sufficiently describe the system of land use in Stuttgart Region.

(2) Building a common understanding within the group as well as specifying and defining the descriptors with brief descriptions in desk-work subsequent to workshop I.

(3) Assessment of direct impacts between the system elements in pairs and on an ordinal scale by the involved experts as well as providing the reasons for the evaluation in a written questionnaire (October – November 2019). "0" is used if one element does not have any influence on the other one. A strongly promoting influence is indicated by using "+3", whereas "+2" and "+1" are used for minor effects. Vice versa, restricting impacts are assessed by negative values.

(4) In case of strong deviations between the written assessments, a clarification-process was carried out via group work (3 groups à 3 to 4 persons) and moderated group discussions (10 persons) in workshop II (November 2019). Mostly, the group found consensus on the assessments, in a small number of cases majority decisions were taken.

(5) Examination of all theoretical combinations and computer-aided selection of consistent scenarios and interpretation of the results.

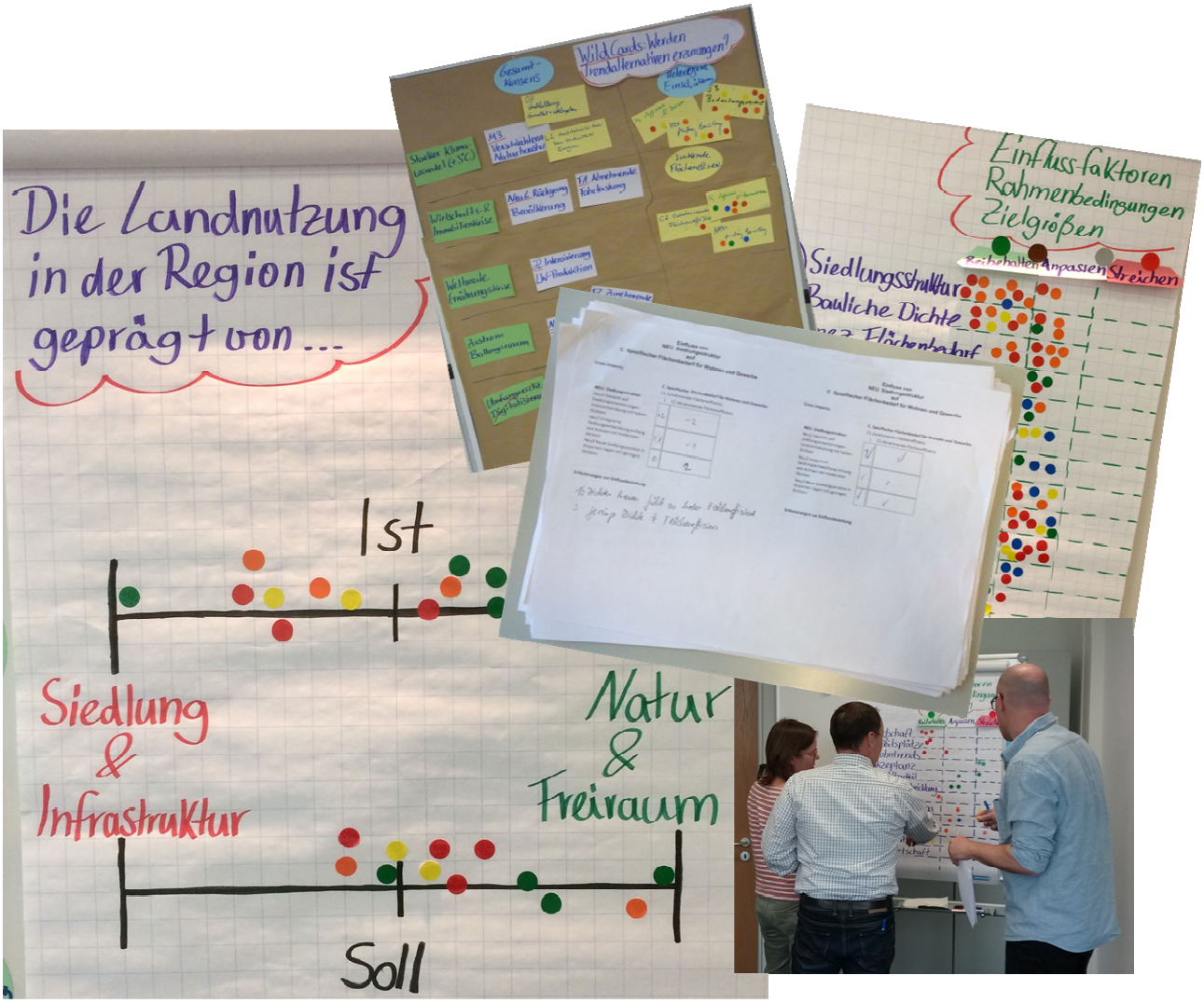

Fig. 1: Impressions of the scenario process

3 SYSTEM ELEMENTS AND THEIR ROLE – A FIRST GLANCE

Within the scenario-process 13 descriptors and 34 variants were identified as system variables for land use in 2050 by the involved experts. These variables are then arranged in a matrix-structure and produce a "morphological" box representing the mental mindset of the group. Examining each and every possible combination of the variants shown in table 1 would imply to check 186,624 assumption bundles by hand. As

this would be very time consuming and error-prone, the computer software “scenario wizzard” is applied to check each system state for possible contradictions and to finally to “eliminate” implausible solutions.

Descriptors	Variants
a. Settlement	a1. Re-development of existing built up areas with high densities
	a2. Development axes with moderate densities
	a3. Development in dispersed locations with low densities
b. Floor Space Demand	b1. Increasing floor-space-efficiency
	b2. Decreasing floor-space-efficiency
c. Population	c1. Population increase
	c2. Constant population
	c3. Population decline
d. Traffic Volume	d1. Decreasing traffic volume
	d2. Increasing traffic volume
e. Degree of Imperviousness	e1. Constant degree of imperviousness
	e2. Increasing degree of imperviousness
f. Compensation Measures (Impact regulation)	f1. Compensation at the intervention site
	f2. Pooled substitution or compensation (within the region)
	f3. Disjointed substitution or compensation (within the region)
	f4. Substitution outside the region
g. Landscape Development	g1. Local development of open spaces
	g2. Coherent System of green Infrastructures
h. Agriculture	h1. Extensification and provision of public services
	h2. Intensification of agricultural production
	h3. Marginalisation
i. Transport Infrastructure	i1. Operation / Maintenance
	i2. Traffic reduction and expansion of public transport
	i3. Traffic management and expansion of roads
j. Energy Infrastructure	j1. Stagnation in expanding renewable energy
	j2. Major progress in expanding renewable energy
k. Natural Environment and Ecosystem Diversity	k1. Significant improvement
	k2. Constant level
	k3. Significant deterioration
l. Social Values and Consumer Behaviour	l. Sufficiency and postmaterialism
	l2. Hedonism and materialism
m. Health and Well-Being	l1. Significant improvement
	m2. Constant level
	m3. Significant deterioration

Table 1: Overview on descriptors and variants for future development until 2050.

The working-principle of the automated consistency-check can be highlighted by the example of three descriptors shown in figure 2. A scenario consisting of (a1, b1 and i1, coloured in green) is considered as consistent according to the mental setting of the group as it has the highest positive sum in each column (+4, +2 and +2). This matches the discussions during workshop II: the group argued for example that a limitation to the exisiting settlements (a1) – as a physical boundary for habitation – gives an impuls to increase floor space efficiency (+2). Moreover, the group agreed that maintaining current transport infrastructure limits settlement development and thus supports a re-development within the existing built-up areas (2). In contrast to the above-mentioned configuration, a combination of a3, b1 and i1 has a negative balance in one column (-4 in column a3, highlighted in red) and is therefore classified as implausible.

	a			b		i		
	a1	a2	a3	b1	b2	i1	i2	i3
a. Settlement								
a1 Re-development of existing built up areas with high densities				+2	-2	+3	0	-3
a2 Development axes with moderate densities				+1	-1	0	+2	+1
a3 Development in dispersed locations with low densities				0	+2	0	+1	+3
b. Floor space demand								
b1 Increasing floor-space-efficiency	+2	+1	-2			0	+1	-1
b2 Decreasing floor-space-efficiency	-2	+1	+2			0	-1	+1
i. Transport innfrastructure								
i1 Operation /Maintenance	+2	0	-2	0	0			
i2 Expansion of Public transport	0	+1	-1	0	0			
i3 Expansion of roads	-2	0	+2	0	0			
Balance:	+4	+1	-4	+2	-2	+3	+1	-4

Fig. 2: Exemplary impact balances for three descriptors

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In addition to the consistency-check it is worth to look at the general role of the descriptors in order to find out how much effect they have ("activeness") and how much influence they receive ("passiveness"). To do so, all impacts exerted by one descriptor in a row ("active sum") and all impacts exerted onto a descriptor in a column ("passive sum") are summed up and shown in a system grid (see figure 3).

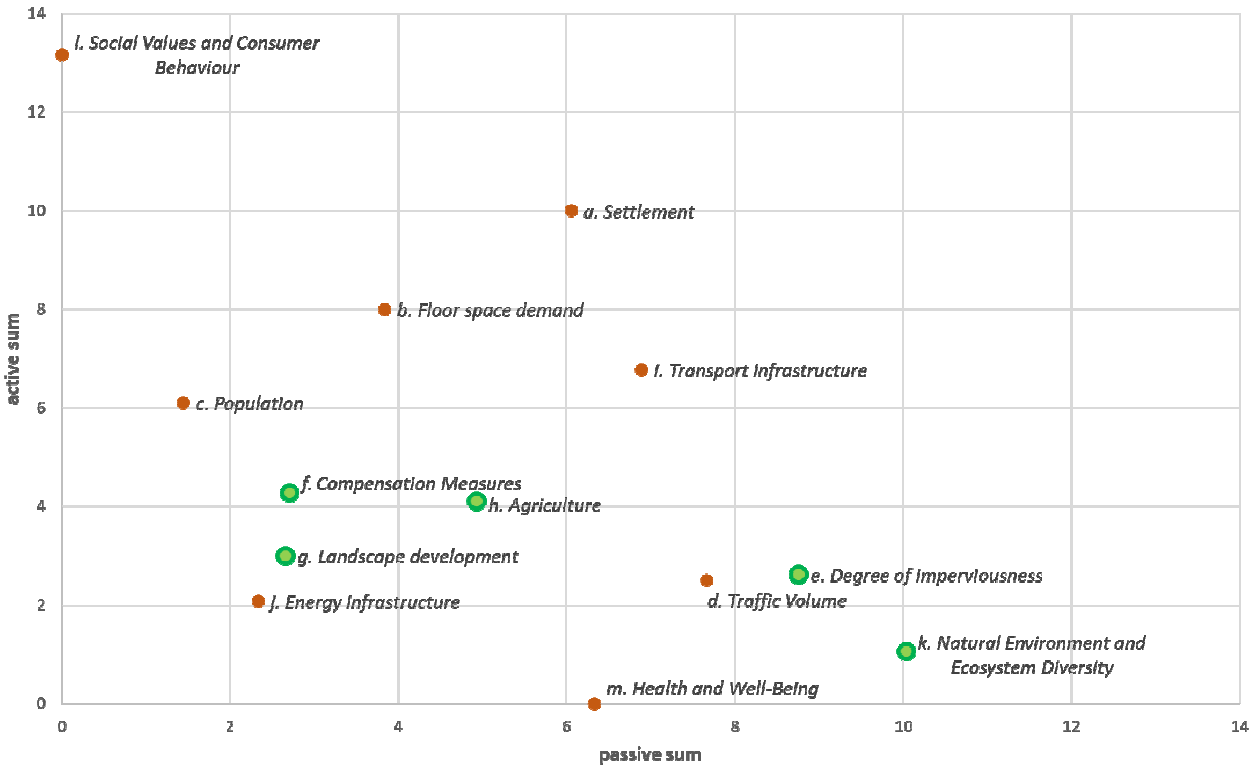

Fig. 3: System grid "land-use 2050 in Stuttgart Region"

The strongest position within the system grid holds descriptor l "social values and consumer behaviour" – a driver which is seen as independent from regional influences by the experts. Besides, the three most important forces in the grid belong to the built environment (settlement, floor space demand and transport infrastructure). In turn, open-space-indicators marked in green colour (imperviousness, compensation, landscape development, agriculture) have rather small effect. Descriptor k "natural environment and ecosystem diversity" is barely seen to exert activity at all but at the same time it is the descriptor receiving the highest influence. In summary, "land use" can be classified as a moderately complex system containing active, passive and bipolar elements.

4 A RANGE OF FUTURES – A DEEPER LOOK AT THE SCENARIO SPACE

Scanning the collected data for internal inconsistencies, twelve scenarios for land use by 2050 with completely consistent configurations in Stuttgart Region remain. These twelve descriptor-bundles leave a clearly reduced scenario space (compared to 186,624 possible combinations) but at the same time comprise a multitude of possible developments being determined systematically. They cover nearly all considered variants (e. g. increasing, constant and decreasing population levels), allthough in distinct combinations. Coming from an open space perspective it is, however, particularly noticeable that an improvement of natural environment (descriptor k1) does not appear at all in the scenario space of the consistent scenarios.

Taking settlement (descriptor a), floor space demand (descriptor b) and transport infrastructure (descriptor i) as the most influential and regionally internal drivers a scenario-taxonomy can be provided containing four fundamentally different types of regional development (see figure 4). This classification helps building a better understanding of the scenario-structure as well as uncovering similarities and differences in the scenario space. Type III- and IV-scenarios for example always co-occur with environmental degradation (k3) as well a significant deterioration in health and well-being (m3).

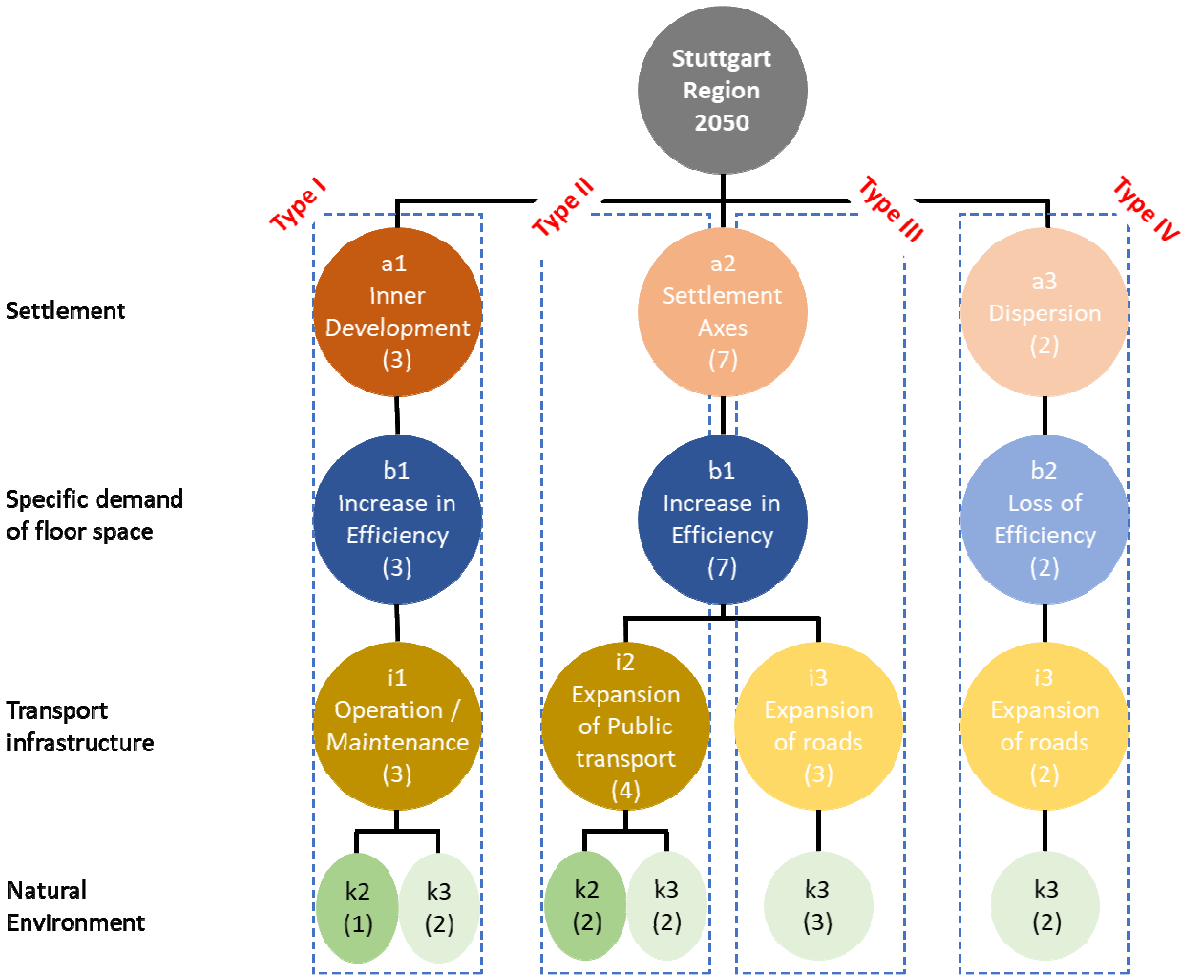

Fig. 4: Scenario tree of 12 completely consistent scenarios

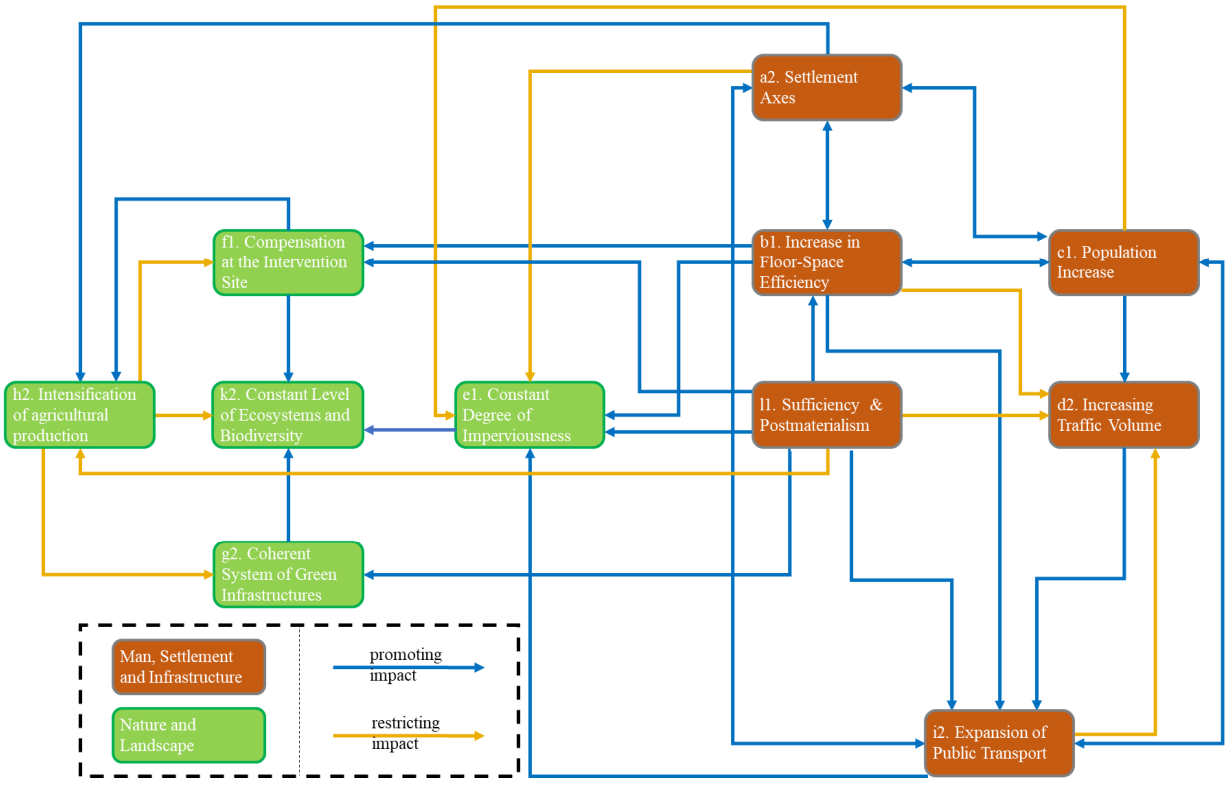

Fig. 5: Assortment of impacts within scenario # 9 “Unstable balance in the city region“ (type II)

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In contrast, type I- and II-scenarios generate more heterogenous results consisting of constancy or deterioration of natural resources (k 2 and k3) as well as – in a few cases – even improvements in health and well-being (m1). Actually, three type I- and II-scenarios come along with a stable ecosystem (k2). According to the way of thinking expressed in the CIB-matrix they achieve this under two prerequisites only:

- when compensating ecological interventions within regional borders (f1 or f3) and
- when establishing a coherent system of green infrastructures (g2).

Moreover, the scenarios suggest that a constant ecological status can be further enhanced if agriculture provides ecosystem services (h1) and if boundaries are set for further settlement development (a1 or a2). This can be interpreted in such a way that open space governance – in the sum of its effects – can play a significant role in growing agglomerations if it is carried out in a stringent and coordinated manner.

As shown in figure 5 impact relations can be promoting or restricting and they can be one-sided or reciprocal. As a whole, the system tends to configurations in which promoting impacts outbalance restricting ones. Scenario # 9 “Unstable balance in the city region” (type II) is such a scenario, although it includes some ambivalent and restricting drivers. The reason is that at the same time it includes plenty of reinforcing loops, especially between settlement axes (a2), floor-space efficiency (b1) and population growth (c1). These drivers are mutually supportive and therefore help generating and stabilising type II-scenarios.

5 CONCLUSION – PLANNING IN THE FACE OF MULTIPLE FUTURES

In contrast to common scenario development CIB correlates different parameters by developing, analysing and interpreting impact networks in a multidisciplinary, discourse-oriented and transparent manner. The application of this heuristic method thereby contributes to understanding land-use as a dynamic system with mututal impact relations as well as increasing transformation-knowledge for a sustainable regional development.

As a communicative and transparent toolkit, CIB is a good starting point for reflections on the current state of land use as well as on political goals and appropriate strategies (for different frame conditions) as it helps illuminating the space of possibilities thoroughly with well-founded assumptions instead of guessing “random” scenarios.

Looking at the land use in Stuttgart Region in the year 2050, each open-space descriptor seen individually shows rather small impact (“active sum”). Nonetheless, in combination they trigger noticeable effects and within the context of their systemic-interactions they pan out to be a necessary – but not sufficient – prerequisite for a constant or improving level of natural environment and human well-being.

Within the scope of this work a huge variety of future pathways for regional development could be constructed. In view of the discourse on the great transformation, the created scenarios will now be further explored with regards to change agents (who?), normative issues (why?), disruptive forces (what if?) as well as the context adequacy and adaptabillity of policy options (how to?).

The task of the scenario-process for Stuttgart Region, however, is not to come up with one definitive future but multiple possibilities – may they be seen as positive, neutral or negative – as well as raising awareness for essential obstacles, catalysts or amplifier. Thereby, clarity in the face of uncertainty can be gained helping planners to prepare their plans for regional transformation as well as to adjust or change them over time.

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🏆 *reviewed paper*

Klimabelange in der Bauleitplanung

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1 ZUSAMMENFASSUNG

Aufgrund steigender Bau- und Bevölkerungsdichten und der Ausweitung des Siedlungsflächenanteils in urbanen Räumen, einer Verschiebung der Altersstruktur und einer durch den Klimawandel bedingten Zunahme von Extremwetterereignissen wird die Stadtbevölkerung zunehmend Umweltbelastungen ausgesetzt sein. Klimaindizierte Auswirkungen (u. a. Hitzeperioden, Starkregen) werden zudem innerhalb des Stadtkörpers in Folge hoher Versiegelungsgrade, einem verringerten Luftaustausch der urbanen Atmosphäre und einer steigenden lufthygienischen Belastung nochmals verschärft.

Um diese Herausforderungen in Städten zu bewältigen, bedarf es u. a. entsprechender Lösungsmöglichkeiten in der Bauleitplanung, die mit der Flächennutzungsplanung die gesamtstädtische Entwicklung und mit der Bebauungsplanung kleinräumige Bebauungs-, Erschließungs- und Freiflächenstrukturen rechtsverbindlich festlegt. Das Aufgabenspektrum der Bauleitpläne ist dabei vom Gesetzgeber u. a. mit der im Jahre 2011 in das Baugesetzbuch eingefügten Klimaschutzklausel in § 1a Abs. 5 BauGB (sog. Klimaschutzklausel) erweitert worden. Sie soll seither auch dazu beitragen, dem Klimaschutz und der Klimaanpassung, insbesondere in der Stadtentwicklung durch Konzeptionen und die konkrete Festlegung baulicher Maßnahmen angemessen Rechnung zu tragen.

Der Gesetzgeber hat dafür nach und nach auch konkrete Festsetzungsmöglichkeiten zur Klimaanpassung in den § 9 Abs. 1 BauGB integriert, der die Inhalte des Bebauungsplans regelt. Daraus ergeben sich grundsätzlich gute Möglichkeiten zur Umsetzung umfassend integrierter räumlicher Klimaschutz- und Klimaanpassungskonzepte in städte- und z. T. auch hochbaulicher Hinsicht. In der Planungspraxis wird allerdings, oftmals aufgrund fehlender Betroffenheit bzw. Unwissenheit, den klimatischen Belangen wenig Bedeutung beigemessen. Daher ist eine systematische und strukturierte Vorgehensweise von Nöten, um auf die gegenwärtigen und zukünftigen Herausforderungen reagieren und agieren zu können.

Keywords: Urban Planning, Urban Climate, Bauleitplanung, Stadtplanung, Stadtklima

2 EINLEITUNG

Die Bundesrepublik Deutschland nimmt im Rahmen des Klimaschutzes (Mitigation) und der Klimaanpassung (Adaption) im internationalen Vergleich eine vergleichsweise bedeutende Rolle ein. Bereits vor dem in Kraft treten der europäischen Richtlinie zur Nutzung erneuerbarer Energien (Richtlinie 2009/28/EG des Europäischen Parlaments) wurde in Deutschland das erneuerbare Energien Gesetz (EEG) im Jahr 2000 eingeführt. Hierin werden der Ausbau erneuerbarer, klimafreundlicher Energien sowie deren bevorzugte Einspeisung in das Stromnetz geregelt. Die Umsetzung dieser EU Richtlinie dient vornehmlich, ähnlich wie z. B. die Energieeinsparverordnung (EnEV) und das erneuerbare Energien Wärmegesetz (EEWärmeG), der Mitigation. Neben den Maßnahmen zum Klimaschutz existiert seit dem Jahr 2009 die „Deutsche Anpassungsstrategie an den Klimawandel“ (DAS). Darin sind u. a. folgende langfristigen Ziele definiert:

- Gefahren und Risiken benennen und vermitteln = Wahrscheinlichkeiten, Schadenspotentiale und Unsicherheiten transparent machen,
- Sensibilisierung der unterschiedlichen Akteure,
- Bereitstellung von Entscheidungsgrundlagen, die es den unterschiedlichen Akteuren ermöglichen Vorsorge zu treffen,
- Handlungsmöglichkeiten aufzeigen, Verantwortlichkeiten abstimmen, bzw. festlegen = entsprechende Maßnahmen formulieren und umsetzen.

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Um konkrete Aussagen über die Anfälligkeit von Deutschland gegenüber dem Klimawandel treffen zu können, wurde im Zuge der Erarbeitung der DAS die nationale Vulnerabilität ermittelt. Dafür stellte das „Behördennetzwerk Vulnerabilität“ die Betroffenheit Deutschlands durch den Klimawandel thematisch und regional differenziert dar. In die Auswertung flossen neben meteorologischen Werten auch regionale Daten (z. B. die Bevölkerungs- und Wirtschaftsstruktur) ein und wurden miteinander verknüpft. Daraus entstand eine Klimaaussage mit regionalen Bezügen. Die Ebenen der Raum-, Regional- und Bauleitplanung werden in diesem Zusammenhang als besonders relevante Querschnittsbereiche im Hinblick auf die Anpassung an den Klimawandel eingestuft.

Zur Ausarbeitung und Umsetzung der angestrebten Maßnahmen folgte auf die DAS der sogenannte „Aktionsplan Anpassung“ (APA) im Jahr 2011. Hierin wird die Zusammenarbeit zwischen den Ebenen Bund, Land und Kommune sowie den verschiedenen Akteuren aus Politik, Wirtschaft und Gesellschaft bekräftigt. Dabei definiert der APA drei strategische nationale Säulen sowie eine Säule im Hinblick auf grenzüberschreitende, internationale Maßnahmen.

Säule 1: „Wissen bereitstellen, informieren, befähigen“ = Wissensgrundlagen werden ausgebaut, Informationen bereitgestellt und vermitteln

Säule 2: „Rahmensetzung durch den Bund“ = stärkere Berücksichtigung der Klimaanpassung durch gesellschaftliche Akteure mittels entsprechender rechtlicher Rahmenbedingungen

Säule 3: „Aktivitäten in direkter Bundesverantwortung“ = klimaangepasste Gestaltung bundeseigener Flächen, Immobilien, Infrastrukturen (z. B. Bundeswasserstraßen, Schienenwege) und Bauprojekte

Säule 4: „Internationale Verantwortung“ = Informationsbereitstellung über europäische und internationale Initiativen (Entwicklungs- und Forschungszusammenarbeit) zur Adaption durch den Bund

Auf Grundlage dieser Säulen wurden bis 2015 zahlreiche Aktivitäten, wie z. B. das Modellvorhaben der Raumordnung „Raumentwicklungsstrategien zum Klimawandel“ (Säule 1), die Anpassungen rechtlicher Regelungen im BauGB oder auch die Initiierung von Förderprogrammen (Säule 2) verwirklicht.

Die obigen Ausführungen zu den nationalen Vorschriften und Regelungen in Deutschland zeigen die stetig angepassten Aktivitäten und Maßnahmen entsprechend den dynamischen Prozessen des Klimawandels. Dies spiegelt sich auch im gesetzlichen Rahmen der Bundesrepublik wieder, in den die Raumordnung sowie die Regional- und Bauleitplanung eingebunden sind. Im Bezug zur Adaption durch die räumliche Planung ist vor allem die Säule 2 hervorzuheben. So basieren z. B. die Änderungen im BauGB (Aufnahme von § 1 Abs. 5 Satz 2 – Klimaanpassung als Planungsleitsatz und entsprechenden Festsetzungsmöglichkeiten) auf der Orientierung an den Inhalten dieser Säule.

3 KLIMATISCHE BELANGE IN DER (RÄUMLICHEN) PLANUNG

Das räumliche Planungssystem in Deutschland ist in Stufen aufgebaut, die sich an den bestehenden Verwaltungsebenen orientieren. An erster Stelle steht der Bund, der vor allem Grundsätze und Leitlinien (z. B. im Raumordnungsgesetz, ROG) vorgibt und nur für besonders ausgewählte Bereiche selbst konkrete planerische Aussagen trifft.

Darunter findet sich die Ebene der Länder. Die Bundesländer stellen entsprechende landesweite Raumordnungspläne auf, die im Sinne von § 1 Abs. 3 ROG die großräumlichen Ziele für die Entwicklung, Ordnung und Sicherung des jeweiligen Teilraumes festlegen. Auf Grundlage dieser stellt anschließend die zuständige Behörde auf regionaler Ebene Regionalpläne auf, die die Aussagen der übergeordneten Ebenen konkretisieren (gemäß § 8 Abs. 2 ROG). Die Vorgaben auf Landes- und Regionalebene erfolgen insbesondere in der Form von Zielen und Grundsätzen der Raumordnung (im Sinne von § 3 Abs. 1 Nr. 2 und 3 ROG). Ziele sind dabei abgewogene und verbindliche Vorgaben, die bei nachfolgenden Planungen im Sinne einer Anpassung zu beachten sind. Die Grundsätze sind Aussagen für nachfolgende Abwägungs- und Ermessungsentscheidungen, die im Rahmen weiterer Planungen (z. B. die Bauleitplanung) einer Berücksichtigung, Konkretisierung und weiteren Abwägung bedürfen.

Demzufolge sind auf kommunaler Ebene die landesweiten und regionalen Vorgaben im Zuge der Bauleitplanung zu beachten (gemäß § 1 Abs. 4 BauGB), z. T. bestehen auch unmittelbare Anpassungspflichten. Die zuständige Gemeinde muss Bauleitpläne aufstellen, sobald und soweit es für die städtebauliche Entwicklung und Ordnung erforderlich ist, und damit die bauliche und sonstige Nutzung der

Grundstücke in der Gemeinde nach Maßgabe des BauGB vorzubereiten und zu leiten. Somit liegt das Hauptaugenmerk der räumlichen Planung auf der Entwicklung, Ordnung und Sicherung des Siedlungsraumes. Dafür ist entscheidend, dass unterschiedliche Anforderungen an einen Raum aufeinander abgestimmt, auftretende Erfordernisse aufgenommen und letztlich potentielle Konflikte präventiv vermieden werden. Daraus folgt, dass die räumliche Planung hinsichtlich des Klimaschutzes und der Klimaanpassung ein wichtiges Instrument, insbesondere aufgrund des räumlichen Charakters zahlreicher Klimafolgen (z. B. urbane Überwärmung) sowie der Vulnerabilität bestehender Raumnutzungen und Strukturen, ist.

Um die Rolle der räumlichen Planung zu stärken, sind in der Vergangenheit u. a. Novellierungen der einschlägigen gesetzlichen Grundlagen die Folge, wodurch Inhalte in Bezug auf den Klimaschutz und der Klimaanpassung integriert werden. Dies tangiert alle Planungsebenen im deutschen Planungssystem. Diese sind in Tabelle 1 exemplarisch dargestellt.

Ebene	Planung	Planungsinstrument	Maßstab	Gesetzliche Grundlage
Bund	(Bundes-) Raumordnung	Leitvorstellung und Grundsätze der Raumordnung	-	Raumordnungsgesetz
Länder	Landesplanung	Landesentwicklungs-programm/ -plan	1:200.000 bis 1:100.000	Raumordnungsgesetz
Region	Regionalplanung	Regionalpläne	1:50.000 bis 1:25.000	Raumordnungsgesetz
Kommune	Bauleitplanung	Flächennutzungs- und Bebauungspläne	1:5.000 bis 1:500	Baugesetzbuch, Baunutzungsverordnung

Tabelle 1: Exemplarische Darstellung des deutschen (Raum-)Planungssystems.

4 FESTSETZUNGSMÖGLICHKEITEN FÜR KLIMAANPASSUNG IN DER BAULEITPLANUNG

In der Bauleitplanung als Instrument der räumlichen Planung auf kommunaler Ebene werden die Voraussetzungen dafür geschaffen, bestimmte Klimaanpassungsmaßnahmen rechtlich und verbindlich zu fixieren. Dies ist im Zuge der Aufstellung von Bauleitplänen möglich, da dort auf Grundlage des BauGB flächen- und maßnahmenbezogene Festsetzungen getroffen werden können. Der Flächennutzungsplan (vorbereitender Bauleitplan) deckt das gesamte Gemeindegebiet ab. Hierbei können die, die Gesamtstadt betreffenden klimatischen Erkenntnisse (z. B. aus informellen Planungen oder der Regionalplanung) aufgenommen werden. Die Darstellungen des Flächennutzungsplans sind flächenhaft – daran orientieren sich auch die Handlungsmöglichkeiten zu Klimaschutz und Klimaanpassung. So ist im Flächennutzungsplan z. B. die Flächenvorsorge für Kaltluftentstehungsgebiete und Luftleitbahnen (Freihalten von Bebauung), die Verteilung der baulichen Nutzung im Raum und auch die bereichsweise städtebauliche Dichte darstellbar. Diese Darstellungen stellen die Basis für quartiersspezifische Festsetzungen im Bebauungsplan dar, die nochmals deutlicher und konkreter ausgestaltet sind. Da sie städtebauliche Vorkehrungen, Anforderungen an die Gebäude und sonstige Maßnahmen zur Klimaanpassung rechtsverbindlich festsetzen, kommt ihnen hinsichtlich der Umsetzung konkreter Maßnahmen zur Klimaanpassung in Quartieren besondere Bedeutung zu. Im Festsetzungskatalog des § 9 BauGB findet sich in § 9 Abs. 5 Nr. 1 die spezifische Möglichkeit, für die Bebauung besondere bauliche Vorkehrungen oder Sicherungsmaßnahmen gegen Naturgewalten anzuordnen. Dies kann z. B. für die Sicherung gegen Hochwasser- oder Sturmgefahren genutzt werden. Flächen, die nach § 9 Abs. 1 Nr. 10 BauGB von der Bebauung freizuhalten sind, sowie Leitungsrechte nach § 9 Abs. 1 Nr. 21 können zum Beispiel, auch in Kombination mit Festsetzungen nach Nr. 16 (Hochwasserschutz und Regelung des Wasserabflusses), für die Rückhaltung von Starkregen und Notwasserwege eingesetzt werden. Allgemein können auch die Grundfestsetzungen des Bebauungsplans zu Art und Maß (Dichte) der baulichen Nutzung, Bauweise und überbaubaren Flächen gezielt zur Klimaanpassung genutzt werden, z. B. um die Durchlüftung von Quartieren zu sichern. Festsetzungen nach § 9 Abs. 1 Nr. 20 BauGB lassen sich beispielsweise zur lokalen Begrünung (auch von Fassaden und Dächern) einsetzen. Den Schwerpunkt bilden an dieser Stelle die Inhalte von Bebauungsplänen, denen hinsichtlich der verbindlichen Festlegung von Maßnahmen zur Klimaanpassung in Quartieren besondere Bedeutung zukommt.

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5 BEISPIELHAFTE VORGEHENSWEISE FÜR DIE BERÜCKSICHTIGUNG ORTS- BZW. QUARTIERSSPEZIFISCHER KLIMATISCHER BELANGE BEI PLANUNG STÄDTISCHER QUARTIERE

Damit die Adaption im Rahmen der Planung städtischer Quartiere eine angemessene Berücksichtigung findet, ist ein ganzheitlicher Blick auf existierende Inhalte der verschiedenen Planungsebenen ratsam. Bereits zu einem frühen Zeitpunkt der Planung gilt es den Aspekt der Klimaanpassung aufzunehmen, um diesen möglichst nahtlos in das planerische Gesamtkonzept zu integrieren. Hierzu bietet sich eine exemplarische Vorgehensweise in Form eines zweigeteilten Prüfschemas an. Der Fokus liegt dabei auf den durch den Klimawandel indizierten Belastungen der urbanen Überwärmung, mangelnder Austauschbedingungen sowie Überschwemmungen durch Starkregenereignisse.

5.1 Vorgehensweise und Systematik

In der Realität findet das Thema Klimaanpassung häufig nur geringfügig Berücksichtigung (z. B. Pflanzungen von Bäumen, Schaffung von Ausgleichsflächen), obwohl es nach den Regelungen des BauGB umfassend zu behandeln ist. Darüber hinaus stellt bei der Planung städtischer Quartiere in der Regel ein städtebaulicher Entwurf oder ein Strukturkonzept die Grundlage für einen nachfolgenden Bebauungsplan dar, der im Sinne des § 1 Abs. 5 Satz 2 und § 1 Abs. 5 BauGB der Klimaanpassung Rechnung tragen soll. Jedoch fixiert der Bebauungsplan die Inhalte des vorgeschalteten Entwurfs im Zuge entsprechender Festsetzungen. Sofern nun letztgenannter Entwurf den Aspekt der Adaption bei der Anordnung verschiedener Nutzungen und baulicher Strukturen nicht berücksichtigt, spiegelt sich dies auch meist im darauf aufbauenden Bebauungsplan wieder. Dementsprechend ist es sinnvoll, die Thematik Klimaanpassung bei städtebaulichen Planungen bereits vor dem eigentlichen Bauleitplanverfahren zu berücksichtigen. Grundsätzlich sollte bereits im Stadium der grundlegenden Konzeptfindung bei der Beauftragung eines Planungsbüros bzw. bei eigenständiger gemeindlicher städtebaulicher Planung die Klimaanpassung aufgenommen werden.

Eine wichtige Voraussetzung ist zunächst die Feststellung, ob die jeweilige Gemeinde möglicherweise vom Klimawandel bedingten Folgen (Überwärmung, Starkregen, Sturm) betroffen ist bzw. sein könnte. Dementsprechend bedarf es einer Analyse verschiedener lokalklimatischer Informationen, die allerdings noch nicht so detailliert sein müssen. In diesem frühen Stadium gilt es lediglich, sofern vorhanden, einen Hinweis auf eine potentielle Belastung der Gemeinde zu eruieren. In diesem Zusammenhang ist es durchaus sinnvoll auf bereits existierende Quellen zurückzugreifen (z. B. den Aussagen von Planwerken verschiedener informeller und formeller Planungen).

In diesem Zusammenhang wird eine Vorgehensweise strukturiert, mit deren Hilfe ein potentieller Bedarf zur Adaption bereits zu einem frühen Zeitpunkt im Planungsprozess in der jeweiligen Gemeinde geprüft werden kann. Im Anschluss an die Überprüfung können entsprechend einem diagnostizierten Bedarf spezifische Inhalte in die grundlegenden Konzeptionen einfließen. Sollte ein grundsätzlicher Bedarf zur Klimaanpassung bestehen, würde im Rahmen der Aufstellung eines Bebauungsplanes nochmals die Behandlung der Thematik Klimaanpassung auf Grundlage der Inhalte im BauGB folgen. Neben den Regelungen in § 1 Abs. 5 Satz 2 und § 1 Abs. 5 BauGB ist dabei vor allem der Umweltprüfung im Sinne § 2 Abs. 4 BauGB Gewicht beizumessen. Im Zuge dessen sind neben Auswirkungen auf das Klima auch umweltbezogene Auswirkungen auf den Menschen und seine Gesundheit sowie die Bevölkerung gemäß § 1 Abs. 6 Nr. 7c BauGB zu berücksichtigen. Hierunter fallen die durch den Klimawandel bedingten Herausforderungen, die potentielle Gefahren für den Menschen und dessen Gesundheit darstellen. Ausgehend von dieser Problemstellung wurde daher ein Prüfschema entwickelt, das im Rahmen der Umweltprüfung Anwendung finden kann. Vergleichbare Prüfschemata existieren bereits für artenschutzrechtliche Belange. Mithilfe dieses Prüfschemas soll im Rahmen der städtebaulichen Planung ein konkreter Handlungsbedarf hinsichtlich Klimawandel bedingter Belastungen abgeleitet werden. Auf Grundlage der Identifizierung eines entsprechenden Handlungsbedarfs können nach der Verifizierung potentieller Belastungsbereiche angepasste Festsetzungen bzw. Festsetzungsvorschläge getroffen werden.

Die Struktur dieser Vorgehensweise zur Berücksichtigung orts- bzw. quartiersspezifischer klimatischer Belange bei der Planung städtischer Quartiere besteht aus zwei Modulen. Das erste Modul gibt Aufschluss über einen möglichen Bedarf zur Adaption in der jeweiligen Gemeinde. Es besitzt einen hinweisenden Charakter und sollte idealerweise bereits zu einem frühen Zeitpunkt innerhalb des Planungsprozesses, noch

vor dem eigentlichen Bauleitplanverfahren, eingesetzt werden. Die Überprüfung basiert auf bestehenden Planwerken formeller und informeller Planungen auf verschiedenen Ebenen hinsichtlich vorhandener klimatischer Inhalte und Informationen (s. Abb. 1).

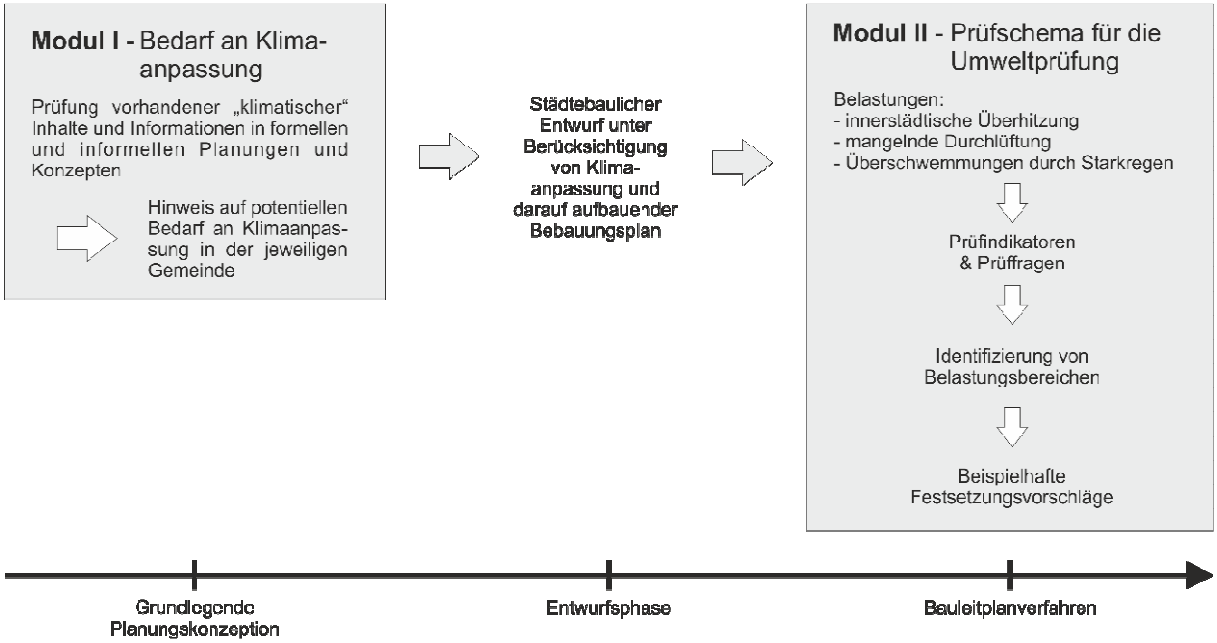

Abb. 1: Exemplarische Darstellung der Strukturierung und Systematik der analytischen Vorgehensweise zur Bewertung lokalklimatischer Belange in der Bauleitplanung.

Das zweite Modul beinhaltet ein Prüfschema zur urbanen Überwärmung, mangelnden Austauschbedingungen und Überschwemmung durch Starkregenereignisse. Die Prüfung unterschiedlicher Indikatoren und zugleich die Identifizierung potentieller Belastungsbereiche können angepasste Festsetzungsvorschläge unterbreiten. Wichtig ist, dass auch bei fehlenden Hinweisen im ersten Modul die jeweilige Gemeinde dennoch durch Klimawandel bedingte Folgen belastet sein kann. Modul 2 stellt lediglich einen Ausschnitt möglicher zu prüfender Inhalte dar. Durch die Überprüfung von Inhalten bereits vorhandener Planungen greift das Modul gewissermaßen dem Bauleitplanverfahren vor, während für dessen Durchführung ebenfalls die Inhalte übergeordneter Planungen sowie Fachplanungen Berücksichtigung finden müssen (vgl. u. a. § 1 Abs. 4 BauGB). Aufgrund der Schwerpunktsetzung des ersten Moduls auf lokalklimatische Inhalte unterschiedlicher Planungen soll dieses eine frühzeitige Beachtung von Klimawandel und -anpassung im Planungsprozess unterstützen. Das zweite Modul, als ein in die verbindliche Umweltprüfung integrierbares, kann und sollte auch unabhängig vom ersten Modul Anwendung finden (s. Abb. 1).

5.2 Modul 1

Modul 1 besteht insgesamt aus fünf verschiedenen Teilbereichen, die sich von der Ebene des Bundes bis zur kommunalen Quartiersebene erstrecken. Für jeden der Teilbereiche ist eine bestimmte Anzahl an Fragen formuliert, die mit „Ja" oder „Nein" beantwortet werden können. Dabei wird keine spezifische Gewichtung der Teilbereiche vorgenommen. Insgesamt ergeben sich somit für das gesamte Modul achtzehn Fragen. Je mehr Fragen mit „Ja" beantwortet werden, desto mehr verdichtet sich die Annahme, dass bei der angestrebten städtebaulichen Planung der Aspekt der Klimaanpassung im Hinblick auf urbane Überwärmung, mangelnde Austauschbedingungen und/ oder Überschwemmungen durch Starkregenereignisse Berücksichtigung finden sollten (s. Abb. 3). Zugleich ergibt sich daraus, dass sofern noch nicht vorhanden, detaillierte ortsspezifische Untersuchungen zu empfehlen sind. Insbesondere Gemeinden, die bisher noch keine oder kaum Ansätze zur Klimaanpassung initiiert haben, können durch die Aufnahme vorhandener lokalklimatischer Informationen im Rahmen der Durchführung des Moduls erste Hinweise auf einen möglichen Adaptionsbedarf gegeben werden.

Allerdings ist an dieser Stelle nochmal explizit darauf hinzuweisen, dass das Resultat aus diesem Modul lediglich einen hinweisenden Charakter besitzt und somit weitere ortsspezifische Untersuchungen zu Klimawandel bedingten Folgen zu empfehlen sind.

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Der erste Teilbereich des Moduls dient der großräumigen Einordnung der Gemeinde. Hierfür werden die Lage in Verdichtungsräumen und die Lage an Fließgewässern bzw. Küsten zur jeweiligen Gemeinde abgefragt. Dies erfolgt auf Grundlage der durch DAS ermittelte nationale Herausforderungen und deren thematische sowie regionale Verwundbarkeit (urbane Überwärmung in Ballungsräumen, Gefährdung durch Starkregenereignisse und Sturmfluten, Gefährdung durch Flussüberschwemmungen).

Ob die zu untersuchende Gemeinde innerhalb eines Ballungsraumes liegt, kann z. B. über den frei zugänglichen Online Kartendienst INKAR abgefragt werden. Durch die Verortung der Gemeinde hinsichtlich der Lage in Verdichtungsräumen, an Flüssen oder der Küste wird somit ein erster Anhaltspunkt für eine potentielle Belastung durch die genannten Belastungen gegeben.

Der zweite Teilbereich in Modul 1 umfasst die Angaben zu verschiedenen regionalen Klimadaten (Lufttemperatur, Luftfeuchte, Niederschlagsmenge, etc.). Frei zugängliche Klimadaten sind u. a. über den Klimaatlas des Deutschen Wetterdienstes erhältlich.

Der dritte Teilbereich in Modul 1 thematisiert die Überprüfung möglicher vorhandener Informationen bzw. Vorgaben zur Klimaanpassung auf Landes- bzw. regionaler Ebene (Abb. 2). Dabei wird geprüft, ob derartige Festlegungen im landesweiten und/ oder regionalen Raumordnungsplan existieren und, ob durch andere Fachplanungen (z. B. Landschaftsplanung, Hochwasserschutzplanung) entsprechende Aussagen vorliegen. Darüber hinaus stellen auch informelle Planungen (Klimaanpassungsstrategien), eine potentielle Informationsquelle dar. Sofern in den genannten Bereichen bereits klimabezogene Inhalte existieren, können diese für die gemeindliche Planung genutzt werden. Zudem kann eine bereits erfolgte Berücksichtigung der Klimaanpassung auf einen entsprechenden Bedarf in der Region hinweisen.

Der Aufbau des vierten Teilbereiches aus Modul 1 ist kongruent zum dritten Teilbereich. Der Unterschied liegt in der Bezugsebene. In Teilbereich 4 erfolgt eine Überprüfung des Flächennutzungsplans und anderer Fachplanungen sowie informeller Planungen auf mögliche Inhalte zur Klimaanpassung. Auch hier gilt, dass eine entsprechende Festsetzung und Inhalte eines lokalklimatischen Anpassungsbedarfs innerhalb der Gemeinde existieren.

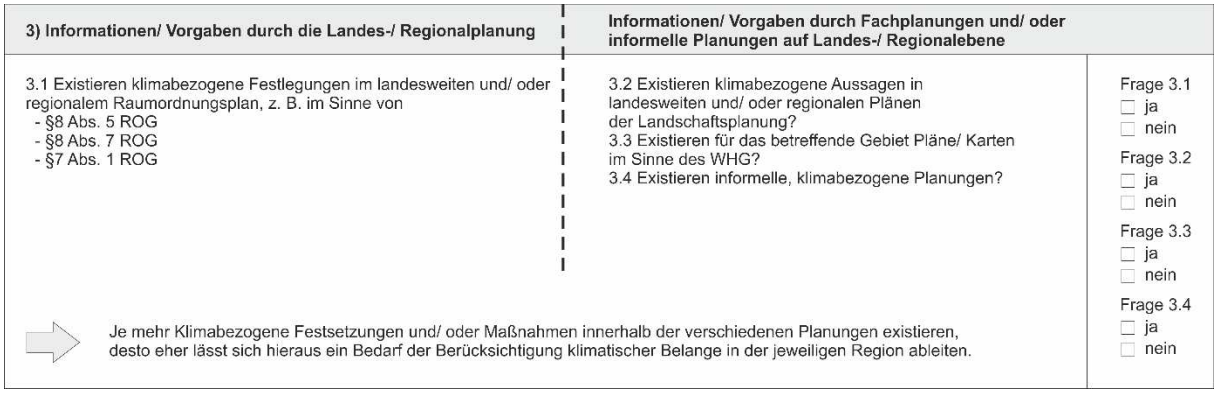

Abb. 2: Exemplarische Darstellung eines Fragenpaketes aus Teilbereich 3 „Informationen/ Vorgaben auf landesweiter und regionaler Ebene“ in Modul 1.

Der fünfte Teilbereich des Moduls 1 befasst sich mit ausgewählten Fragen direkt zum Plangebiet. Auf Grundlage der Abfrage der Lage des Gebietes innerhalb der Gemeindestruktur und ob bebaute oder versiegelte Bereiche angrenzen, kann ein Hinweis auf eine mögliche lokalklimatische Belastung geben. Das Potential der Belastung des Plangebietes kann allerdings auch durch geomorphologische Besonderheiten auftreten.

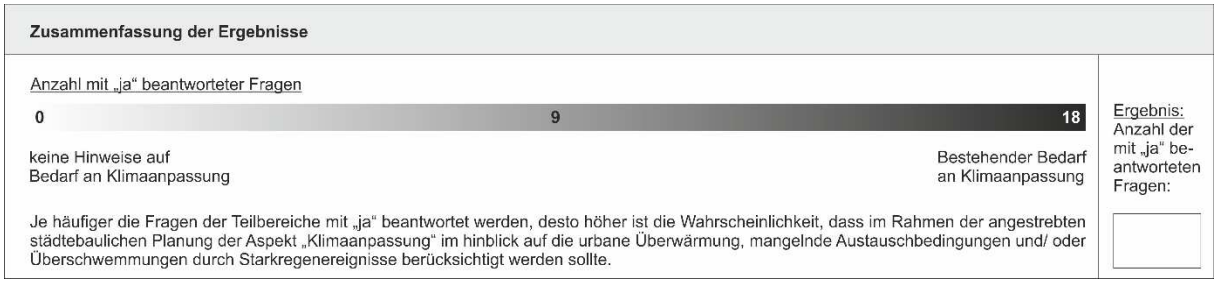

Abb. 3: Exemplarische Darstellung der Ergebnisse zur Bewertung der Inhalte aus Modul 1.

Die Bearbeitung von Modul eins mündet schließlich in der Zusammenfassung der Ergebnisse aus den einzelnen Teilbereichen (s. Abb. 3).

5.3 Modul 2

Das zweite Modul stellt ein Prüfschema dar, das im Rahmen der Umweltprüfung Anwendung finden kann. Die zentral zu überprüfenden potentiellen Belastungen sind urbane Überwärmung, mangelnde Austauschbedingungen und Überschwemmung durch Starkregenereignisse. Für jede der drei potentiellen Risikofaktoren sind entsprechende Prüfindikatoren definiert und für die entsprechende Gemeinde zu prüfen. Je nach Resultat der Analyse der Prüfindikatoren kann daraus eine Vulnerabilität des Bezugsraumes durch die überprüfte Belastung abgeleitet werden. Wichtig ist, dass durch die Bearbeitung der einzelnen Prüfpunkte eine lokale Belastung jedoch nicht abschließend und eindeutig nachgewiesen werden kann. Das Prüfschema deckt immer nur einen Teil des zu prüfenden Themenbereiches ab. Bei einer Aussage, die auf eine potentielle Belastung schließen lässt, empfehlen sich weitere ortsspezifische und detaillierte Untersuchungen. Für jede der drei Belastungspotentiale sind entsprechende Belastungsbereiche definiert, die von möglichen Auswirkungen in besonderem Maße betroffen wären. Der der Gemeinde vorliegende städtebauliche Entwurf ist dann auf diese Belastungsbereiche hin zu prüfen. Diese können letztendlich im städtebaulichen Entwurf bzw. im Bebauungsplanentwurf gekennzeichnet und darauf basierend ein Verweis auf angepasste Festsetzungen als Lösungsansätze gegeben werden.

Für eine das Lokalklima berücksichtigende Darstellung der Bestandssituation mithilfe von Prüfbögen für jede der drei genannten Belastungsbereiche wird in der Folge eine Erläuterung der definierten Prüfindikatoren dargestellt:

5.3.1 Urbane Überwärmung

Für den Belastungsbereich „Urbane Überwärmung“ sind insgesamt acht Prüfindikatoren definiert. Die durchschnittliche Jahrestemperatur und deren temporäre Entwicklung geben Aufschluss über die grundlegende lokalklimatische Situation hinsichtlich der Lufttemperatur des jeweiligen Untersuchungsraumes. Eine Überprüfung der Anzahl meteorologischer Ereignistage (warmer/ heiße Tage, Tropennächte) gibt Aufschluss darüber, ob es eine ortsspezifische Wärmebelastung gibt. Warme Tage sind gekennzeichnet durch eine maximale Lufttemperatur von mindestens 25°C. Deren Anzahl beinhaltet gleichzeitig die heißen Tage. Letztgenannte sind charakterisiert durch eine Höchsttemperatur von mindestens 30°C. Tropennächte entwickeln sich, wenn sich die während der Tagstunden „aufgebaute“ Wärmebelastung in nächtlichen Lufttemperaturwerten $\geq$ 20°C (18:00 bis 06:00 Uhr) äußert. Dieses Phänomen kann insbesondere bei länger anhaltenden sommerlichen autochthonen Wetterlagen beobachtet werden. Mithilfe der Analyse der Entwicklung der Lufttemperaturverhältnisse und einem Trend hinsichtlich der Anzahl warmer/ heißer Tage sowie Tropennächte wird eine Prognose möglich, wie sich die Belastungssituation vor Ort und zukünftig entwickeln kann.

In Bezug zur urbanen Überwärmung sind vier potentielle Belastungsbereiche definiert, die im besonderen Maße von Klimawandel bedingten Modifikationen betroffen wären. Dabei handelt es sich u. a. um Blockinnenbereiche. Durch die isolierte Lage im Bestand ist der bodennahe atmosphärische Austausch nahezu ausgeschlossen. Darüber hinaus wird die Lufttemperatur innerhalb des Blocks durch die Oberflächentemperatur der Gebäude beeinflusst. Dieser Effekt wird verstärkt durch die umliegenden versiegelten Flächen.

Öffentliche Plätze weisen meist einen hohen Versiegelungsgrad auf, wodurch sich diese Räume deutlich erwärmen, vor allem bei fehlendem Schattenwurf durch fehlende Module und Strukturen (z. B. Bäume). Jedoch stellen solche Plätze oftmals öffentliche Räume dar, die von einer Vielzahl von Menschen frequentiert werden, die in der Folge einer lokalen Wärmebelastung ausgesetzt sind.

Auch Verkehrsflächen (Straßen, Stellplätze, etc.) stellen versiegelte Flächen dar, die aufgrund der verwendeten Materialien ebenfalls zu einer lokalen Überwärmung beitragen. Vergleichbar mit dem Effekt der o. g. Verkehrsflächen zeigen sich auch versiegelte Gebäudeflächen. Je höher die Bebauungsdichte ist, desto deutlicher zeigen sich die Auswirkungen der physikalischen Eigenschaften künstliche Baumaterialien.

Nachdem eine potentielle Belastung festgestellt und identifiziert wurde, können im betroffenen Gebiet Strukturen angepasst und spezifische Festsetzungsvorschläge getroffen werden.

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5.3.2 Bodennahe atmosphärische Austauschbedingungen

Zur Überprüfung der bodennahen atmosphärischen Austauschbedingungen bedarf es zunächst der Bestimmung der übergeordneten Windrichtung. Hinzu kommt eine Analyse hinsichtlich bestehender bzw. potentieller gebietsrelevanter Kalt- bzw. Frischluftentstehungsgebiete und deren möglicher Ventilationsbahnen. Deren potentiell siedlungsrelevanter Belüftungseffekt gilt es im Hinblick auf die urbane Überwärmung zu nutzen. Zusätzlich erfolgt eine Abfrage der vorhandenen Belastung durch Luftinhaltsstoffe und existierender, den Luftaustausch behindernder Barrieren. Beide Punkte spiegeln sich nochmals in den definierten Belastungsbereichen wieder. Abschließend werden, sofern vorhanden, topographische, das Lokalklima beeinflussende Geländegegebenheiten hervorgehoben. Auch in Bezug auf die unterschiedlichen Prüfindikatoren für einen mangelnden Luftaustausch empfehlen sich bei fehlenden Kenntnisse detaillierte Untersuchungen. Dies gilt insbesondere bei einer nachgewiesenen Belastung durch Überwärmung und/ oder Luftschadstoffe (s. Abb. 4).

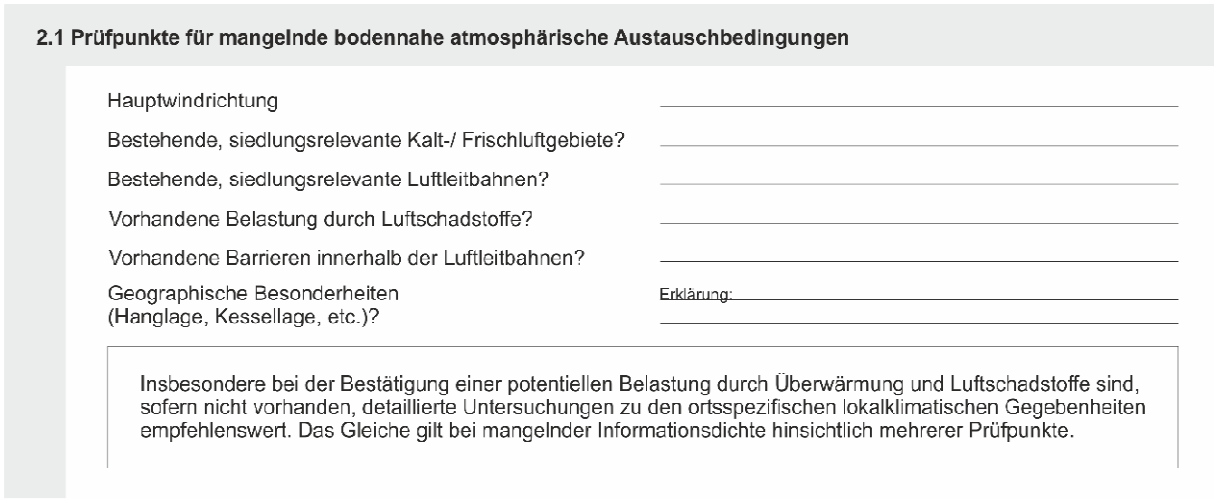


Abb. 4: Exemplarische Darstellung des Prüfschemas für potentielle Belastungsbereiche aufgrund des mangelhaften bodennahen atmosphärischen Austauschs.

Hinsichtlich der mangelnden bodennahen Austauschbedingungen sind insgesamt drei Belastungsbereiche definiert. Vor allem Räume mit potentieller Belastung durch Luftschadstoffe bedürfen entsprechender Austauschmöglichkeiten, um eine Verdünnung ebendieser zu gewährleisten.

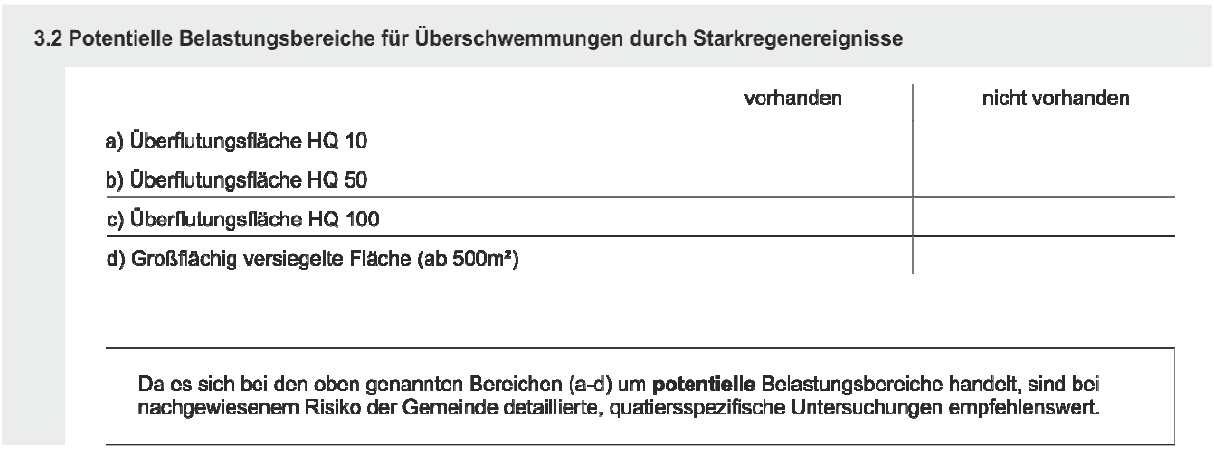
Gleichsam dem zuvor erläuterten Prüfschema „Urbane Überwärmung“ können auch hier, nachdem eine potentielle Belastung festgestellt und identifiziert wurde, die beschriebenen Belastungsbereiche im betroffenen Untersuchungsgebiet strukturell angepasst und entsprechende Festsetzungsvorschläge gemacht werden.

5.3.3 Überschwemmungen durch Starkregenereignisse

Zur Überprüfung einer potentiellen Belastung durch Überschwemmungen in Folge von Starkregenereignissen werden primär die durchschnittlichen Jahresniederschlagsmengen und die relative Feuchte sowie deren Entwicklung in den letzten zehn Jahren berücksichtigt. Zudem erfolgt eine Abfrage der Anzahl der Starkregenereignisse sowie deren voraussichtliche Entwicklung. Leider existieren für Starkregenereignisse oftmals noch keine gebietsbezogenen Statistiken. Allerdings lässt sich aus überdurchschnittlich hohen/ zunehmenden Niederschlagsmengen ein potentielles Risiko durch Starkregen ableiten. Auch hier gilt es, dass bei fehlenden Angaben ortsspezifische, detailliertere Untersuchungen zu empfehlen sind.

Bei Belastungsbereichen aufgrund von Überschwemmungen handelt es sich u. a. um Flächen, die im Rahmen der Aufstellung von Hochwassergefahrenkarten als Überflutungsflächen deklariert wurden. Dabei werden drei Kategorien unterschieden: Flächen, die statistisch einmal in zehn Jahren überflutet werden (HQ10), einmal in fünfzig Jahren (HQ50) und einmal in hundert Jahren (HQ100). Je höher dieses Zeitintervall ist, desto größer ist die potentielle Überflutung. Angezeigt werden hierbei Flächen, die durch über die Ufer getretene Gewässer überschwemmt werden (s. Abb. 5).

Darüber hinaus sind auch großflächig versiegelte Flächen durch die Überschwemmung in Folge von Starkregenereignissen gefährdet, da der anfallende Oberflächenabfluss nicht abfließen kann und die Kanalisation für derartige, kurzfristig auftretende Wassermengen oftmals unterdimensioniert ist. Nach der abschließenden Identifizierung der oben beschriebenen Belastungsbereiche, können die vorhanden Strukturen im Idealfall angepasst und entsprechende Festsetzungsvorschläge empfohlen werden.



3.2 Potentielle Belastungsbereiche für Überschwemmungen durch Starkregenereignisse

	vorhanden	nicht vorhanden
a) Überflutungsfläche HQ 10		
b) Überflutungsfläche HQ 50		
c) Überflutungsfläche HQ 100		
d) Großflächig versiegelte Fläche (ab 500m²)		

Da es sich bei den oben genannten Bereichen (a-d) um **potentielle** Belastungsbereiche handelt, sind bei nachgewiesenem Risiko der Gemeinde detaillierte, quatiersspezifische Untersuchungen empfehlenswert.

Abb. 5: Exemplarische Darstellung des Prüfschemas für potentielle Belastungsbereiche für Überschwemmung durch Starkregenereignisse.

6 FAZIT

Seit Anfang der 1990er Jahre ist der Klimawandel eine fortwährend diskutierte Thematik. Durch erste internationale Abkommen, wie z. B. die Klimarahmenkonvention, wurde die Grundlage für nachfolgende und darauf aufbauende Regelungen geschaffen. Hierbei lag der Fokus zunächst vornehmlich auf Klimaschutzmaßnahmen (Reduktion industrieller Emissionen, Förderung erneuerbarer Energien). Der Klimaschutz geht der Klimaanpassung zeitlich voraus. Somit hat sich das Thema der Klimaanpassung aus dem Klimaschutz auf der Basis verschiedener internationaler und nationaler Abkommen/ Regelungen entwickelt. In Deutschland kommt der räumlichen Planung bei der Anpassung an den Klimawandel eine entscheidende Rolle zu, da sie die unterschiedlichen Anforderungen an den Raum aufeinander abstimmt, um auf der jeweiligen Planungsebene auftretende Konflikte auszugleichen. Der Regional- und Bauleitplanung ist dabei eine besondere Bedeutung beizumessen, da sie konkrete und verbindliche Aussagen treffen. Die Voraussetzungen für derartig verbindliche Regelungen werden durch entsprechende Inhalte in den gesetzlichen Grundlagen geschaffen, die wiederum unter anderem auf die verschiedenen internationalen und nationalen Vereinbarungen zurückzuführen sind.

Da Klimawandelfolgen eine zunehmend ausgeprägte städtebauliche Dimension erreichen, steigt auch die Handlungserfordernis einer angepassten Stadtentwicklung. Diese Erkenntnis unterstreicht nochmals die Bedeutung der Bauleitplanung bei der Anpassung an den Klimawandel. Durch die nach § 2 Abs. 4 BauGB vorgeschriebene Umweltprüfung bei der Aufstellung von Bauleitplänen ist die grundlegende Voraussetzung für eine Berücksichtigung des Aspektes Klimaanpassung bei der Planung städtischer Quartiere bereits gegeben. Jedoch wird der Adaption oftmals nicht ausreichend Gewicht beigemessen – dazu trägt auch bei, dass der Gesetzgeber zur Planungsbeschleunigung mit den §§ 13a und 13b BauGB bei einer Vielzahl von Bebauungsplänen von der Pflicht zur Umweltprüfung wieder abgerückt ist. Hier besteht Optimierungsbedarf. Bei einer adäquaten Berücksichtigung der Maßnahmen zur Klimaanpassung enthält der bestehende Festsetzungskatalog des Bebauungsplans gemäß § 9 BauGB zahlreiche Möglichkeiten, um potentiellen Klimawandel bedingten Belastungen zu begegnen.

Um im Rahmen der Planung städtischer Quartiere die Adaption angemessen zu berücksichtigen, ist eine ganzheitliche Sichtweise auf existierende Inhalte auf den verschiedenen Ebenen der räumlichen Planung anzustreben. Dabei gilt es bereits zu einem sehr frühen Zeitpunkt der Planung den Aspekt der Klimaanpassung aufzunehmen, um diesen letztlich möglichst nahtlos in das planerische Gesamtkonzept zu integrieren.

Hinsichtlich der Berücksichtigung des Themas der Klimaanpassung in Regionen und Städten existieren gegenwärtig verschiedene informelle Planungen oder Programme. Diese oftmals in Form von Rahmenplänen

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ausgearbeiteten Aussagen sind jedoch häufig ohne einen konkreten Umsetzungsbezug und treffen lediglich allgemein gültige Aussagen. Darüber hinaus beschränken sich derartige Planungen häufig auf Räume, die strukturstark und bereits in besonderem Maße von Klimawandelfolgen betroffen sind. Aufgrund des rezenten Klimawandels, der zunehmenden Verdichtung/ Versiegelung sowie steigender Einwohnerzahlen in urbanen Räumen nimmt zukünftig die Zahl belasteter Bereiche zu. Folglich bedarf es angepasster Lösungsstrategien, die bestenfalls im Rahmen der bestehenden gesetzlichen Regelungen Anwendung finden können.

Mit der Erarbeitung der aus zwei Modulen bestehenden Vorgehensweise ist ein beispielhafter Ansatz aufgezeigt, wie die Klimaanpassung bei der Planung städtischer Quartiere integriert und innerhalb des herkömmlichen Planungsprozesses adäquat berücksichtigt werden kann. Entscheidend ist hierbei die Einbeziehung der Adaption zu einem frühen Zeitpunkt des Planungsprozesses. Ebenso gilt es zu gewährleisten, dass diese angemessen im Rahmen der Umweltprüfung Berücksichtigung finden. Insbesondere hinsichtlich der Bearbeitung in Bezug zur Umweltprüfung erscheint mit Blick auf die voraussichtlich lokalklimatische Entwicklung die Notwendigkeit eines Prüfschemas gegeben. Da die grundlegenden Voraussetzungen für eine angemessene Berücksichtigung lokalklimatischer Belange, insbesondere von Klimaanpassungsmaßnahmen, durch die bestehenden Inhalte im Baugesetzbuch bereits gegeben sind, ist die Integration eines strukturschaffenden Prüfschemas in die Umweltprüfung als äußerst sinnvoll einzustufen.

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reviewed paper

Ko-produktive Stadtentwicklung? Steuerungsansätze und Steuerungsprobleme mit kreativen Wertschöpfungsprozessen

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1 ABSTRACT

In den wissenschaftlichen Diskussionen über die Kulturalisierung der Ökonomie oder Kreativquartiere lässt sich erkennen, dass für raumgestaltende Prozesse die Eigenlogiken kreativer Unternehmen von grundlegender Bedeutung sind. Zur Gestaltung einer kreativen Stadt sind flexible und projektbasierte Konstellationen notwendig. Hierarchische Organisationsmodelle und formelle Instrumente der Stadtplanung verlieren in diesem Kontext an Bedeutung. Horizontale Steuerungsformen und vor allem ko-produktive Aktivitäten sind dafür geeignet. Wichtige Akteure sind dabei natürlich Stadtplanungsämter und städtische Wirtschaftsförderungsgesellschaften. Diese Akteure setzen in der Praxis die damit verbundenen Aufgaben jedoch nur selten in Beziehung zu der Frage nach adäquaten Formen der räumlichen Planung oder Steuerung.

Anhand eines bedarfsorientierten Forschungsansatzes habe ich dieses Phänomen planungswissenschaftlich untersucht und dazu die Wertschöpfungsprozesse kreativer Kleinstunternehmen in der Stadt Hamburg als Beispiel genommen. Dabei zeigen sich vielfältige Formen betrieblicher Entwicklungspfade sowie zielgruppenorientierte Unterstützungsmaßnahmen der lokalen Institutionen der Stadtplanung und Wirtschaftsförderung.

Der Artikel beschreibt Steuerungsansätze und -probleme mit kreativen Ökonomien von unterschiedlichen Akteuren der öffentlichen Hand hinsichtlich gesamtstädtischer Entwicklungsperspektiven. Möglichkeiten und Grenzen ko-produktiver Stadtentwicklung werden konkret am Beispiel der Stadt Hamburg skizziert. Der Artikel endet mit Handlungsvorschlägen für eine Qualifizierung planerischer Ko-Produktion und Übertragungsmöglichkeiten für andere Städte.

Keywords: Planungskultur, Gewerbeflächen, Kreativwirtschaft, Kooperation, Kommunikation

2 EINLEITUNG: KO-PRODUKTION ALS SPEZIFISCHE ART DER STADTGESTALTUNG

Aktuell wird in der deutschen Stadtentwicklung, die ja vor komplexen Anforderungen an die Bevölkerungs- und Wirtschaftsentwicklung sowie der städtebaulichen Erneuerung von Kommunen steht, vermehrt über Planungskulturen, akteursspezifische Interaktionsweisen und kommunikationsbasierte Zielerreichung diskutiert.[1] Über die Art des Umgangs mit gegenseitigen Erwartungen, mit Teilhabe sowie mit Vertrauensbildung können neue Formen der Kooperation erprobt und Lerneffekte generiert werden.[2] Vertreterinnen und Vertreter privatwirtschaftlicher, intermediärer oder zivilgesellschaftlicher Interessen sind nicht mehr nur Adressaten staatlicher Verfahren, Programme und Projekte. Vielmehr gestalten sie als Ko-Produzenten städtische Räume aktiv mit und werden zu relevanten Kooperationspartnern für die Stadtplanung und Wirtschaftsförderung. Sie übernehmen daher selbst Steuerungsfunktionen und Verantwortung für raumbildende Prozesse.[3]

Mit Ko-Produktion werden hier gemeinschaftliche Produktionsprozesse mit wechselseitigen Austauschbeziehungen auf überwiegend horizontaler Ebene bezeichnet. Ko-Produktion kann somit in ökonomischen Wertschöpfungsprozessen oder in der Raumentwicklung stattfinden.[4] Ko-Produktion verläuft niemals linear, sondern in vielfältigen Diskussionen und Abwägungsschritten, und beinhaltet keine zentralen Entscheidungspositionen. Daher vollziehen sich solche Prozesse jenseits der – unter anderem baugesetzlich oder finanzpolitisch verankerten – formalen Verfahren der Stadtplanung und Wirtschaftsförderung.

Der Hype um die kreative Klasse[5] und die Räume kreativer Milieus[6] als Treiber für die sozio-ökonomische Gesamtentwicklung von Städten und Regionen hält schon seit ein paar Jahren an. In kreativen

[1] Vgl. Levin-Keitel & Othengrafen 2016, BBSR & BBR 2016, Libbe 2014:55ff.
[2] Fürst 2009:23ff.
[3] Vgl. Knieling et al. 2003:4, Overmeyer 2011
[4] Vgl. Schreiner 2018:43
[5] Florida 2002

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Wertschöpfungsprozessen[7] sind ko-produktive Aktivitäten insbesondere bei Kleinstunternehmen der Kreativwirtschaft – aufgrund von deren spezifischer Alltagsbewältigung – weit verbreitet.[8] Ihre Fähigkeit schöpferischen Denkens und Handelns basiert auf individuellen, kollektiven und auch städtebaulichen (urbanen) Ressourcen.[9] Kreative Kleinstunternehmen agieren vor allem in kreativen Milieus. Sie nutzen Stadträume nicht nur als Bühne, sondern gestalten sie aktiv mit.[10] Diese Akteure müssen als Raumproduzenten beachtet werden. Für die Entwicklung einer kreativen Stadt[11] werden solche Unternehmen und ihre Wertschöpfungsprozesse daher zu wichtigen Handlungsfeldern der lokalen Stadtplanungsbehörden und Wirtschaftsförderungsorganisationen.

Vor diesem Hintergrund beschäftigt sich der Artikel mit folgenden Forschungsfragen:

- Wie agieren lokale Planungsbehörden und städtische Wirtschaftsförderungsgesellschaften in Prozessen der Quartiers- und Stadtentwicklung mit kreativen Kleinstunternehmen?
- Welche Voraussetzungen benötigt ko-produktive Stadtentwicklung?
- Welche Instrumente und Umgangsformen sind für die Stadtplanung und Wirtschaftsförderung geeignet bzw. notwendig, um kreative Wertschöpfungsprozesse in einer Stadt überhaupt zu beeinflussen oder adäquat zu unterstützen?

3 WIE REAGIEREN STADTPLANUNG UND WIRTSCHAFTSFÖRDERUNG AUF KREATIVE ORTE UND MILIEUS?

Diverse Stadtplanungsämter sowie städtische Wirtschaftsförderungsgesellschaften versuchen mittlerweile gezielt, eine spezifische Attraktivität von Stadtgebieten als Arbeitsorte für kreative Ökonomien, wie Architekten, Grafiker und Filmproduzenten, zu initiieren oder zu unterstützen.[12] Dabei setzen sie sowohl städtebauliche als auch kommunikative Steuerungsinstrumente ein. Das zeigt sich zum einen an der Ausrichtung kommunaler Flächennutzungsplanungen auf die Ansiedlung kreativer Unternehmen. Zum anderen demonstrieren das kommunikative Maßnahmen zur Vernetzung kreativer Ökonomien sowie spezifische Beratungsangebote und Öffentlichkeitsarbeit für die lokale Kreativwirtschaft.

3.1 Städtebauliche Steuerungsansätze

Strategisch eingesetzte infrastrukturelle und bauliche Restrukturierungsmaßnahmen, bei denen Kultur und Kreativwirtschaft für sozialräumliche Entwicklungsprozesse eingesetzt werden, gibt es in europäischen Großstädten seit Anfang unseres Jahrtausends. Das geschieht vor allem über die lang- oder mittelfristige Planung großer Projekte oder Kreativquartiere zur Revitalisierung ehemaliger Areale der Industrieproduktion, Hafenflächen oder Kasernen.[13] Die kommunalen Bauverwaltungen steuern solche Vorhaben strategisch mit Mitteln der Baulandvergabe, der Flächennutzungsfestlegung, der Förderung bestimmter Gewerbebauvorhaben oder der Gestaltung öffentlicher Freiflächen.

An zahlreichen Orten werden zudem Unterstützungsfonds aus öffentlichen Mitteln für „Kreativ-Immobilien“ eingerichtet oder Wirtschaftsförderungsgesellschaften damit beauftragt, Gewerbe-Immobilien an kreative Ökonomien sowie Kulturschaffende zu vermitteln. Das betrifft sowohl Zwischennutzungen als auch langfristige Nutzungen von Flächen. So werden bestimmte Grundstücke und Immobilien bevorzugt oder besonders kostengünstig an Kreativunternehmen vergeben. Die zentral organisierte Vergabe der Flächen soll dazu beitragen, Leerstand zu verringern oder kreative Unternehmen an bestimmten Orten anzusiedeln, um diese zu transformieren.[14]

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[6] Vgl. Lange 2007, Frey 2009
[7] Vgl. Schreiner 2018:70
[8] Im Vergleich zu anderen Wirtschaftsbereichen sind Kleinstunternehmen in der Kultur- und Kreativwirtschaft überproportional vertreten (Dapp & Ehmer 2011:4). Im Jahr 2016 betrug ihr Anteil fast 97% (Bertschek et al. 2019:43).
[9] Vgl. Frey 2009:36ff., Overmeyer 2011:68
[10] Vgl. Hesse 2011:40ff.
[11] Landry 2000
[12] Vgl. Hesse 2011, Kunzmann 2009
[13] Beispiele sind die IBA Hamburg 2013, die ehemalige NDSM-Werft in Amsterdam-Noord und die ehemalige Linzer Tabakfabrik.
[14] Vgl. Hesse 2011, 43ff.

Seit einigen Jahren werden verstärkt auch kurz- bis mittelfristige Unterstützungsmaßnahmen durch öffentliche Institutionen umgesetzt. Das betrifft vor allem Neubauvorhaben für Standortgemeinschaften wie Gründerzentren, Inkubatoren oder Coworking Spaces für bestimmte Teilökonomien der Kreativwirtschaft. Das erstreckt sich außerdem auf Umbauten von Bestandsimmobilien für spezifische Nutzungen durch wissensbasierte und/oder oder kreative Unternehmen sowie kulturelle Einrichtungen.[15] Solche Einzelprojekte können als direkte Eingriffe zur Herausbildung von kreativen Milieus beitragen. Sie ergänzen die strategischen, städtebaulichen Entwicklungsvorhaben von kreativen Orten und Quartieren.

3.2 Kommunikative Steuerungsinstrumente

Städtische Akteure begleiten Aufwertungsmaßnahmen urbaner und kreativer Quartiere zunehmend mit Informations- und Dialogaktivitäten. Dazu gehören Angebote zur Kooperationsförderung, gezielte Öffentlichkeitsarbeit und Standortmarketing. Sie setzen dafür Formate wie Informations-, Beratungs- und Vernetzungsveranstaltungen für kreative Unternehmen ein. Außerdem unterstützen sie die Wirtschaftskraft und Sichtbarkeit ortsansässiger Kreativökonomien durch Imagekampagnen oder Marketingstrategien auch mit Branchenhearings, Messen, Publikationen und Ausstellungen.

Die kommunikativen Angebote können einerseits eine Ansiedlung und lokale Konsolidierung von kreativen Unternehmen sowie deren potentielle Kooperationspartner unterstützen. Andererseits wird damit die Hoffnung verbunden, mit einem entsprechenden Image als erfolgreiche Stadt zur sozialen und ökonomischen Transformation von Stadtgebieten und/oder zur Neudefinition regionaler bzw. städtischer Identitäten beizutragen.[16]

Oft nutzen städtische Wirtschaftsförderungsgesellschaften bzw. -behörden oder Kammern diese kommunikativen Steuerungsinstrumente, eher selten sind es die Planungs- oder Baubehörden. Die verschiedenen Maßnahmen können dauerhaft und langfristig oder temporär und kurzfristig umgesetzt werden.

3.3 Probleme und Kritik

Problematisch sind dabei folgende Aspekte: Sogenannte kreative Orte benötigen ein gewisses Maß an Offenheit, damit sich kreative Milieus herausbilden können. Sie entstehen, indem kreative Akteure bestimmte Gebäude oder Flächen entdecken, aneignen und gestalten können.[17] Eine durch staatliche Aktivitäten forcierte oder initiierte Imageprägung als kreative Orte bzw. Quartiere geht jedoch oftmals einher mit einer Vermarktung durch die Werbebranche und die Immobilienwirtschaft. Außerdem lösen die professionellen Angebote selbstorganisierte Formen einer kollektiven Aneignung preisgünstiger Immobilien mit schlechtem Bauzustand ab. Damit schrumpfen Möglichkeiten zur kreativen Gestaltung von Stadträumen und die freie Bühne wird kommerzialisiert.

Folgen sind Preisanstiege und eine höhere Nachfrage nach den noch verfügbaren Flächen. Das führt zu Verteilungskonflikten mit angestammten Bewohnerinnen und Bewohner, Initiativen und Unternehmen – und einem Verlust offener Orte.[18] Von daraus resultierenden Abwanderungen können nicht nur kreative Kleinstunternehmen selbst betroffen sein. Es kann auch diejenigen Betriebe betreffen, die für Lerneffekte und Wertschöpfungsprozesse kreativer Milieus relevant sind, ähnliche Standortanforderungen haben und auf eine räumliche Nähe mit kreativen Kleinstbetrieben angewiesen sind. Das berührt wissensarme und wissensintensive Unternehmensdienstleistungen, kleinere Produktionsunternehmen, Künstlerinnen und Künstler, Handel und Gastronomie (vgl. Abb. 1).[19]

[15] Beispiele hierfür sind die Themenimmobilie Designxport als Vermittlungsort für Design in Hamburg sowie das Dortmunder U als Zentrum für Kunst, Kultur, Kreativität und Wissenschaft auf ehemaligen Flächen der Union-Brauerei.
[16] Vgl. Liebmann 2003:134
[17] Vgl. Frey 2009:145ff.
[18] Vgl. Overmeyer 2011:68
[19] Vgl. Kunzmann 2006:6

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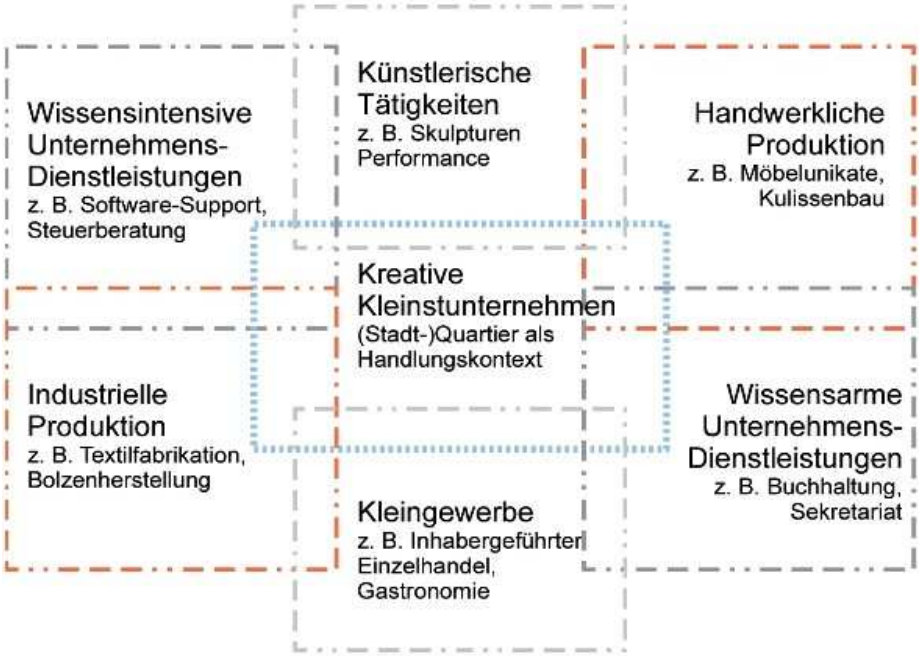

Abb. 1: Schnittstellen für Wertschöpfungsprozesse und Lerneffekte kreativer Kleinstunternehmen (Quelle: Schreiner 2018:81)

4 VERÄNDERTE ROLLEN UND STEUERUNGSFORMEN

Die Ballung kreativer Kleinstunternehmen an bestimmten Standorten vollzieht sich also überwiegend spontan und als selbstorganisierte Prozesse.[20] Daher treten Fragen der Steuerungsmöglichkeit der Kreativwirtschaft und der Planbarkeit kreativer Orte auf.[21] Für die Stadtplanung und Wirtschaftsförderung entstehen damit neue Herausforderungen: Ihre herkömmlichen Handlungstrategien sowie Verfahrens- und Regelungsarten müssen modifiziert werden, um Einfluss auf kreative Ökonomien zu erlangen.[22] Die geringe hierarchische Organisation kreativer Kleinstunternehmen erfordert kooperatives Verwaltungshandeln in netzwerkartigen Konstellationen.[23]

Die spezifischen Kommunikations- und Kooperationsformen kreativer Unternehmen erfordern also veränderte Rollen und Steuerungsformen von Vertreterinnen und Vertretern der Stadtplanungsämter und städtischen Wirtschaftsförderungsgesellschaften. Um eine Ansiedlung und Etablierung kreativer Ökonomien zu unterstützen, ist es zunächst relevant, deren Eigenlogiken und Interaktionsweisen zu verstehen. Das betrifft sowohl ihre Selbstgestaltungskräfte, als auch Formen vertikaler sowie horizontaler Kooperation bzw. Ko-Produktion.

4.1 Zielgruppenspezifische Ansprache durch Beraterinnen und Berater

Der Arbeitsalltag von Einzelselbständigen und Kleinstbetrieben der Kreativwirtschaft ist von einem hohen Maß an Selbstregulierung und Autonomiebestreben gekennzeichnet. Ökonomischen Unsicherheiten der Unternehmensorganisation wird über kulturell und sozial determinierte Arbeitszusammenhänge in temporären Kollektiven und phasenweiser Projektarbeit begegnet. Als Grundlage dienen dafür sozialräumlich verankerte Netzwerke und kreative Milieus.

Eine formalisierte Interessenvertretung ist für einen großen Teil der Erwerbstätigen innerhalb der Kreativwirtschaft nicht üblich. Zwar gibt es diverse Berufsverbände – und im Fall der Architektur auch Kammern auf der Landes- und Bundesebene. Jedoch sind viele Kleinstunternehmen anderer kreativer Tätigkeitsbereiche nicht in Berufsverbänden organisiert. Daher fehlen offizielle Ansprechpersonen oder Delegierte, wenn gemeinsame Ziele, Programme oder Projekte mit Planungsbehörden oder städtischen Wirtschaftsförderungsgesellschaften ausgearbeitet werden sollen.

[20] Vgl. Hesse 2011:45ff., Frey 2009
[21] Vgl. Lange et al. 2011:12ff., Frey 2009
[22] Vgl. Overmeyer 2011:68, Hesse 2011:46ff.
[23] Vgl. Kunzmann 2009

In diesem Kontext können staatliche Akteure mit einer offenen Ansprache bestimmter Zielgruppen (wie bspw. Existenzgründerinnen und Existenzgründer in der Kreativwirtschaft) über die in den kreativen Milieus üblichen Kommunikationsmittel agieren. Sie sollten bei Informationsveranstaltungen eine beratende Rolle einnehmen.

4.2 Dialog und Kooperationstreffen mit Moderatorinnen und Moderatoren

Außerdem treffen immer wieder individuelle Selbstorganisationsformen und Entscheidungen von kreativen Unternehmen auf kooperative Steuerungsformen innerhalb gemeinsamer Projektbearbeitung sowie Aspekte der hierarchischen Steuerung.

Beispiele für hierarchische Steuerungsformate sind Stipendien oder Messefinanzierungen für kreative Unternehmen, die von lokalen Behörden sowie staatlich eingesetzten Agenturen des Bundes oder Landes vergeben werden. Außerdem sind Förderungsvoraussetzungen bei Kredit- oder Investitionsprogrammen des Bundes für kreative Kleinstunternehmen oftmals inhaltlich unpassend oder die Beantragung kann aufgrund des hohen bürokratischen Aufwands nicht bewältigt werden. Die besonderen Rahmenbedingungen der Kreativwirtschaft oder spezifischer kreativer Teilbranchen werden dabei nicht explizit beachtet. Diese Steuerungsformen scheinen also nicht mit den Alltagspraktiken der Zielgruppe zusammen zu passen und daher nur bedingt wirksam zu sein. Hier kann es helfen, bedarfsforientierte Förderangebote mit geringerem formalem Antragsaufwand zu ermitteln und aufzustellen.

Um die Vernetzung von kreativen Kleinstunternehmen mit potentiellen Geschäftspartnern auf horizontaler Ebene zu unterstützen, sind spezifische Kooperationsveranstaltungen geeignet. Das kann erfordern, dass solche Aktivitäten nicht auf einzelne Branchen der Kreativwirtschaft begrenzt werden, sondern fallspezifisch auch Vertreterinnen und Vertreter aus Handwerk, Industrie, Handel und Wissenschaft mit einbeziehen. Dabei sollten planende und fördernde Akteure eher eine moderierende Rolle einnehmen, um auf horizontaler Ebene agieren zu können. Ihre Einflussnahme sollte sich in dem Kontext auf partnerschaftliche Zusammenarbeit konzentrieren.

4.3 Ortsspezifische Mischung

Die Herausbildung kreativer Orte vollzieht sich jeweils im Zusammenspiel der Alltagspraktiken kreativer Unternehmen mit den Planungspraktiken kommunaler/städtischer Akteure. Das verläuft in jeder Stadt etwas anders, da es dafür keine nationalen Vorgaben oder einheitliche Zuständigkeiten gibt.[24] Somit können Vorgehensweisen und Ziele der lokalen Kreativunternehmen sowie der Organisationseinheiten der öffentlichen Hand – die in diesen Bereichen raumwirksam handeln – unterschiedlich sein, sich ergänzen oder überlagern.

Die literaturbasierte Diskussion verdeutlicht: Sowohl kontextbezogene als auch direkte Steuerungsaktivitäten beeinflussen bzw. unterstützen die lokale Kreativwirtschaft, kreative Milieus und die gesamtstädtische Entwicklung. Hierfür kann eine Bandbreite an städtebaulichen und kommunikationsbasierten Steuerungsansätzen eingesetzt werden (vgl. Abb. 2).

Abb. 2: Bandbreite der Steuerungsansätze für kreative Ökonomien und Milieus (eigene Darstellung)

[24] Vgl. BBSR & BBR 2016:22f.

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Sollen diese Ansätze fruchten, sind vor allem prozessuale Formen des kooperativen Umgangs notwendig: Stadtplanung und Wirtschaftsförderung sollten die ortsspezifischen Kommunikationsarten und temporären Projektkonstellationen der handelnden Individuen respektieren und als Rahmenbedingungen für gemeinschaftliche Interaktionen akzeptieren. Die ortsspezifische Planungskultur speist sich demnach aus dem individuellen Handeln, dem Selbstverständnis, dem Vernetzungsgrad sowie der Außenwirkung der jeweiligen Delegierten aus der Stadtentwicklung.

Ansätze für eine Stadtentwicklung, die kreative Ökonomien und ihre Milieus ins Zentrum stellen, sollten sich außerdem am spezifischen Bedarf der fokussierten Gruppen orientieren. Daraus folgt, dass stadträumliche Effekte, die durch Unterstützungsmaßnahmen für Kreativorte entstehen, beachtet werden müssen, um negative Auswirkungen auf andere Gruppen, Stadtquartiere oder die Region zu begrenzen.

5 ERGEBNISSE AUS HAMBURG

Eine detaillierte Untersuchung der Wertschöpfungsprozesse von Kleinstunternehmen des Produktdesigns und der Architektur in der Stadt Hamburg zeigt:[25] Es gibt vielfältige Formen kreativwirtschaftlicher Alltagsgestaltung, deren Muster sich auf gesamtstädtischer Ebene ablesen lassen. Die lokale Stadtplanung und Wirtschaftsförderung hat dezidiert Steuerungsansätze darauf ausgerichtet, zum Beispiel die Entwicklung von Kreativquartieren und diverse Beratungsangebote.

Dennoch haben die untersuchten Unternehmen Probleme in ihrer betrieblichen Entwicklung. Abwanderungen in andere Großstädte oder Regionen sind eine Folge davon. Das ist zum Teil der fehlenden Unterstützung bzw. unzureichenden Steuerung durch unterschiedliche Akteure der öffentlichen Hand geschuldet.

Mit Bezug auf die oben genannten Forschungsfragen werden ortsspezifische Untersuchungsergebnisse im Folgenden kurz skizziert.

5.1 Konkrete Bedarfe als Voraussetzungen für ko-produktive Stadtentwicklung

Interaktionen von Hamburger Kleinstunternehmen des Produktdesign oder der Architektur verlaufen überwiegend in informellen Koordinationsmechanismen jenseits institutioneller Steuerungseingriffe.[26] Je nach Organisationsform, Entwicklungsphase und Ortsressourcen sind ihre Austausch- und Zulieferbeziehungen sowie Absatzmöglichkeiten und Innovationsfähigkeiten eingeschränkt.

Zunehmend problematisch ist für diese Betriebe der lokale Gewerbeflächenmarkt: In Hamburg favorisieren die untersuchten Kleinstunternehmen vorrangig diejenigen Stadtgebiete als Unternehmensstandorte, die von einer heterogenen und kleinteiligen Nutzungsmischung geprägt sind (vgl. Abb. 3). Das zeigt sich sowohl in temporären Raumaneignungen als auch in dauerhaften Manifestationen der kreativen Kleinstunternehmen in bestimmten Quartieren. Relevant für die Standortwahl der befragten Unternehmerinnen und Unternehmer ist, dass sie dort ideal Wohnen und Arbeiten verbinden können. Außerdem gibt es in diesen Lagen ein lebendiges Umfeld, das einerseits spannend und inspirierend ist, und andererseits persönliche Austauschbeziehungen mit Kundinnen, Kunden, Geschäftspartnerinnen und Geschäftspartnern erleichtert. Daher ist bei den untersuchten Kleinstunternehmen ein großer Bedarf zum Kauf und zur langfristigen Anmietung bzw. Erbpacht urbaner Gewerbeflächen vorhanden. Städtische Gewerbeflächen und -immobilien in geeigneten Lagen stehen jedoch de facto kaum für diese Interessenten zur Verfügung. Die vielfältigen Zuständigkeiten für einen Verkauf oder eine Erbpacht städtischer Grundstücke und Immobilien machen Abstimmungsprozesse außerdem nicht nur sehr unübersichtlich, sondern auch langwierig. Aufgrund des Fehlens übergeordneter Ansprechpersonen auf kreativwirtschaftlicher Seite sind Verhandlungen zwischen den einzelnen Akteuren nicht strukturell, sondern nur fallspezifisch zu lösen.

Außerdem werden die vorhandenen Informations- und Kooperationsangebote der staatlichen Wirtschaftsförderungsorganisationen wie der Hamburg Kreativ Gesellschaft mbH oder des Regionalberater des Kompetenzzentrum Kultur- und Kreativwirtschaft des Bundes von den untersuchten Kleinstunternehmen nur partiell genutzt. Vor allem die öffentlichen Veranstaltungen zu Themen digitaler Produktion, Vertrieb und Marketingstrategien wurden zum Zeitpunkt der Untersuchung gut besucht. Dabei ist das Interesse bzw.

[25] Vgl. Schreiner 2018:103ff.
[26] Da das typische Organisationsmerkmale in der Kreativwirtschaft darstellen, sind sie hierin mit anderen kreativen Ökonomien vergleichbar.

der Bedarf von Existenzgründerinnen und Existenzgründern aus den Kreativökonomien größer als von den etablierteren Unternehmerinnen und Unternehmern. Insgesamt ist die Wahrnehmung des Angebots sowie die Teilnahme von Produktdesignerinnen, Produktdesignern, Architektinnen und Architekten jedoch eher gering, was auf ein nicht ausreichendes bzw. bedingt geeignetes Angebot an Informations-, Kooperations- und Beratungsangeboten schließen lässt.

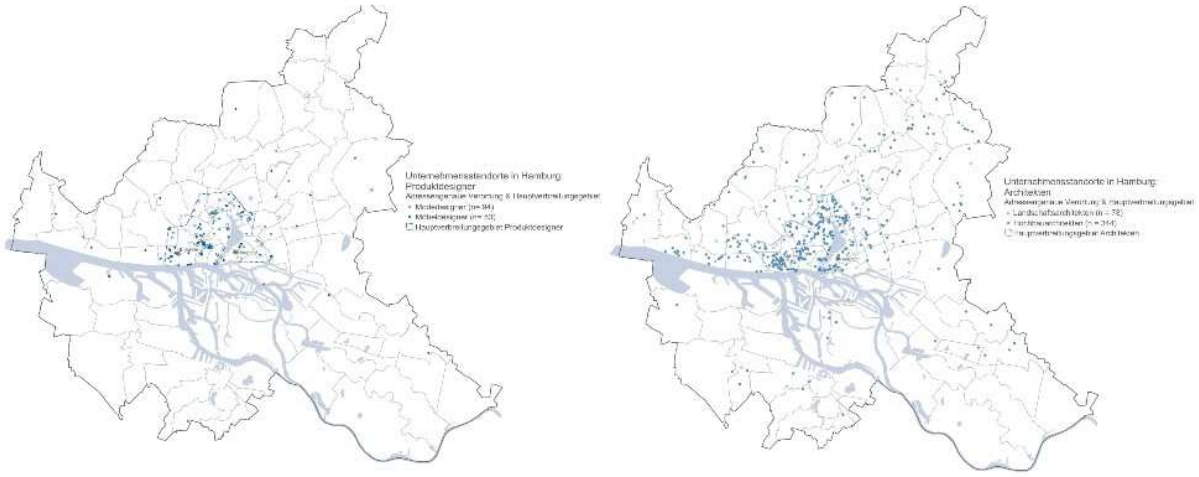

Abb. 3: Unternehmensstandorte und Hauptverbreitungsgebiete von Produktdesign- und Architekturbüros in Hamburg (Quelle: Schreiner 2018:107, 109)

Dass die Hamburger Kleinstunternehmen des Produktdesigns und der Architektur bedarfsgerechte Unterstützungsangebote benötigen, ist eine logische Schlussfolgerung aus den Forschungsbefunden.

5.2 Steuerungsansätze der lokalen Stadtplanung und Wirtschaftsförderung

Die Stadtplanungs- und Wirtschaftsbehörden führen kaum kontextbezogene und direkte, städtebauliche und kommunikative Steuerungsaktivitäten für Produktdesign und Architektur in Hamburg durch. Jedoch bieten verschiedene stadteigene Wirtschaftsförderungs-, Quartiersentwicklungs- und Immobiliengesellschaften sowie die Architekten- und Handelskammer an, kreative Unternehmen zu standort- und betriebsrelevanten Themen zu informieren, zu beraten oder zu vernetzen.

Ausgehend von den internationalen Diskussionen über den Wettbewerb von kreativen Städten wird auch in Hamburg seit einiger Zeit die Entwicklung von Kreativquartieren zur Vitalisierung von Stadtgebieten in Betracht gezogen. Dabei versuchen Quartiersentwicklungs- und Wirtschaftsförderungsgesellschaften wie die HafenCity Hamburg GmbH oder die Hamburg Kreativ Gesellschaft mbH, kreative Aktivitäten und Unternehmen in den Stadtgebieten anzusiedeln, die für Gewerbe, Freizeit- und Wohnnutzungen qualifiziert werden sollen. Das wird über die Vermittlung temporärer Gewerbeflächen für bestimmte Kreativunternehmen oder entsprechende Kriterien bei Konzeptvergaben für Immobilienverkäufe durchgeführt. Bei diesen formalisierten Verfahren kommt es für kreative Kleinstunternehmerinnen und Kleinstunternehmer darauf an, die richtigen Ansprechpartnerinnen und Ansprechpartner der städtischen Institutionen sowie die relevanten Fristen, Gelegenheiten, Voraussetzungen und Abläufe zu kennen.

Die eingesetzten Kommunikationsmaßnahmen sind durchaus vielfältig. Sie zielen auf betriebswirtschaftliche Unternehmensentwicklung, Vernetzung von kreativen Unternehmen sowie Marketing von Hamburg als kreative Stadt. Insgesamt erweisen sich die allgemeinen dialogorientierten Aktivitäten auch für Unternehmen des Produktdesigns und der Architektur als ausreichend. Die gefundenen Lücken betreffen spezifische und direkte Formate zur Stärkung transdisziplinärer Kooperationen zwischen diversen Unternehmen, von Existenzgründerinnen und Existenzgründern bis zu etablierten Unternehmen, sowie Öffentlichkeitsarbeit für bestimmte Tätigkeitsfelder und den dazugehörigen Wertschöpfungsprozessen.

Die lokal vorhandenen Steuerungsansätze der Planungsbehörden und Wirtschaftsförderungsgesellschaften zur Förderung von Produktdesign und Architektur in Hamburg sind – unterm Strich – eher hierarchisch aufgestellt, stark sektoral ausgerichtet, selten bedarfsgerecht und basieren auf "behördlichen" Umgangsweisen staatlicher Institutionen. Daher sind sie für die untersuchten Kleinstunternehmen, die vorrangig in kreativen Milieus mit funktionalen Wertschöpfungsprozessen und persönlichen

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Kooperationsbeziehungen agieren, wenig geeignet. Die auf sie angewendeten Instrumente sind also hinsichtlich einer ko-produktiven Stadtentwicklung kaum wirksam.

5.3 Anpassungsbedarf für lokale Steuerungsformen

Von ko-produktiver Stadtentwicklung sind staatliche Organistaionseinheiten in Hamburg, sofern es um kreative Wertschöpfungsprozesse der fokussierten Ökonomien geht, noch weit entfernt. Viele Akteure der öffentlichen Hand tun sich schwer damit, für die kreativen Kleinstunternehmen als Partnerinnen und Partner auf Augenhöhe und mit adäquaten Unterstützungsformen zu agieren. Die existierenden Aktivitäten zur Unterstützung kreativer Ökonomien in Hamburg bergen jedoch großes Potenzial, genauer auf die lokalen Charakteristika konkreter Tätigkeitsfelder und -formen ausgerichtet zu werden.

Um Einfluss auf die Ansiedlung und Etablierung kreativer Unternehmen des Produktdesigns und der Architektur nehmen zu können, sollten die staatlichen Delegierten der öffentlichen Organisationen stärker auf die zugrundeliegenden, spezifischen Anforderungen und Umgangsweisen eingehen. Ganz grundsätzlich erscheint dafür eine stärker zielgruppenorientierte Adressierung mittels der richtigen Sprache als enorm förderlich und möglich. Das trifft ebenso auf eine flexible, inhaltliche und heterarchische Koordination zwischen den Unternehmen sowie den Stadtplanungsämtern, Wirtschaftsbehörden, städtischen Entwicklungsgesellschaften und Kammern zu.

Weniger institutionalisierte und hierarchische Strategien können sektorübergreifende Impulse für Stadtquartiere bringen und durch offene Angebote umgesetzt werden. Als Impulsgeberinnen, Impulsgeber, Vermittlerinnen, Vermittler, Moderatorinnen oder Moderatoren zwischen den unterschiedlichen Sprachen und Sphären kommen hierfür fachlich versierte und gut vernetzte Personen, zum Beispiel aus einer der zahlreichen Kulturstiftungen, Baugenossenschaften, Unternehmervereinigungen oder Fachverbänden, in Frage.

Konkret sollten flächennutzungsbezogene Steuerungsformen dahingehend modifiziert werden, dass dynamisierte Festlegungen und Vergaben kommunaler Gewerbeflächen stattfinden, die frühzeitig öffentlich bekannt gemacht werden und die hybride Flächennutzungen zulassen. Auch sollten dringend Aktivitäten zur Potenzialerkennung und Sicherung von urbanen Gewerbeflächen stadtweit koordiniert durchgeführt werden.

Ein weiterer adäquater Steuerungsansatz ist, Dialogformate für bestimmte kreative Wertschöpfungsprozesse stärker branchenübergreifend auszurichten. Damit können Informationsaustausch und Kooperationsanbahnungen auch über die Stadtgrenzen hinaus gefördert werden und somit lokal-regionale Unternehmensbeziehungen gestärkt werden.

6 FAZIT

Allgemein gibt es für die Stadtentwicklung und Wirtschaftsförderung verschiedene Optionen, kreative Orte, Ökonomien und Milieus in Großstädten zu unterstützen – und zu behindern. Welche Eingriffsmöglichkeiten bestehen und welche Rolle dabei staatlichen Organen zukommt, hängt von den jeweiligen Kooperations- und Koordinationsformen der relevanten Akteursgruppen ab. Wenn kreative Kleinstunternehmen für städtische Gestaltungsprozesse fokussiert werden, sollten die recht spezifischen Umgangsweisen sowie Standortanforderungen der entsprechenden Teilökonomien beachtet werden.

Urbane Standorte und lokal verankerte Interaktionen stellen, wie am Hamburger Beispiel ersichtlich ist, Aushandlungsarenen kreativer Ökonomien dar. Soziokulturelle Gemeinsamkeiten, Vertrauen sowie das Verständnis unterschiedlicher Rollen und Sprachen bilden eine Grundlage des betrieblichen und somit des alltäglichen Handelns in kreativen Milieus. Kreative Kleinstunternehmen kooperieren und koordinieren ihre Beziehungen auf horizontaler und vertikaler Ebene. Staatliche Organisationen können, neben Produktions- und Vertriebspartnern, in diese kreativen Wertschöpfungsprozesse integriert sein, müssen es aber nicht.

Die Bindeglieder zwischen kreativen Unternehmen und den Vertreterinnen und Vertretern der öffentlichen Hand sind die ökonomischen, sozialen und kulturellen Erwerbs- und Entwicklungsziele, die über das Medium der Kommunikation gegenseitig vermittelt und über die Methode der Kooperation erreicht werden. Je besser die jeweiligen Wünsche und Bedürfnisse, Möglichkeiten und Restriktionen, Ziele und Vorlieben einander bekannt sind und respektiert werden, umso genauer gelingen Aktivitäten, die die Beteiligten in ihren Gemeinsamkeiten und Unterschieden voranbringen. Mit dialogorientierten Prozessen raumbezogener Steuerung bieten sich also Möglichkeiten für gemeinschaftliches, temporäres Handeln und für

projektorientierte Konsensfindung verschiedener Akteure. So können städtische Entwicklungsvorhaben prozessual umgesetzt werden, deren Ziele und Ergebnisse inkrementell sind.

Für eine ko-produktive Stadtentwicklung sind also – in dem hier dargestellten Handlungsfeld – vielfältige Fachkenntnisse zu den jeweiligen kreativen Wertschöpfungsprozessen, gegenseitiges Vertrauen und Offenheit für Neues bei allen Beteiligten notwendig. Hierfür bedarf es einer spezifischen Planungskultur, die örtliche Eigenheiten reflektiert, auf einer gemeinsamen Sprache aufbaut sowie sich ständig fortentwickelt.

Insgesamt betrachtet kommt es jeweils auf das projekt- und ortsabhängige Zusammenspiel von formeller und informeller, hierarchischer und heterarchischer Koordination zwischen den staatlichen und privatwirtschaftlichen Akteuren an. Planungsaktivitäten mit Top-down-Ansätzen sowie kontextbezogene Steuerung sind dafür weniger geeignet als Bottom-up-Prozesse und direkte Unterstützungsaktivitäten. Steuerungsinstrumente sollten zwar dynamisch, aber auch komplementär eingesetzt werden und zu gemeinsamen Entscheidungen führen. Das bringt allerdings einen intensiven, ressort- und themenübergreifenden Abstimmungsaufwand mit sich. Außerdem ist dafür notwendig, dass die Vertreterinnen und Vertreter der öffentlichen Hand ihre Handlungsfähigkeit hinsichtlich ihrer Stadtentwicklungsziele hinterfragen und adäquate Rollen als Vermittlerinnen, Vermittler, Moderatorinnen, Moderatoren, Kooperationspartnerinnen oder Kooperationspartner einnehmen bzw. diese Aufgaben an geeignete Akteure delegieren.

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🏆 *reviewed paper*

Kommunale Profile zur Prüfung möglicher Übertragbarkeiten von lokalen Entwicklungskonzepten

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1 ABSTRACT

Können an unterschiedlichen Orten angesetzte Reallabore anhand ihrer Rahmenbedingungen verglichen werden? Lassen sich aus einer Umfeldanalyse sogar generalisierbare Faktoren extrahieren, die helfen können für eine in der spezifischen Situation eines Reallabors erfolgreich getesteten Konzeption Randbedingungen zur erfolgreichen Übertragbarkeit des Ansatzes an andere Orte zu definieren? Diese Fragen stehen im Ausgangspunkt eines Forschungsvorhabens, das sich mit dem Aufheben der dogmatischen Trennung von scheinbar gegensätzlichen urbanen und ländlichen Planungssichten beschäftigt. Gemeinsame Methodik der von unterschiedlichen Projektpartnern angesetzten Konzepte an verteilten Orten bildet ein Fokus auf die Bevölkerung(sstruktur) sowie gesellschaftliche Veränderungsprozesse als verbindendes Element zwischen den traditionell isoliert behandelten Planungsräumen Stadt und Land.

Anhand von Analysemethoden aus abgeschlossenen Forschungsprojekten, die sich mit Konzepten zur energieeffizienten Stadtentwicklung mehrerer räumlich verteilten Kommunen befassten, werden in einem laufenden Vorhaben hierfür räumliche Kontexte erfasst und deren nur auf die „dem Land“ oder „der Stadt“ zugeordneten gesellschaftlichen Veränderungsprozesse auf Gemeinsamkeiten hin überprüft. Dabei wird das Ziel verfolgt die Projektpartner methodisch zu unterstützen, die an verschiedenen Orten lokale Konzepte gemäß eines Konstrukts der Transformativen Zelle zur Untersuchung von Projekten und Vorhaben mit transformativer Wirkung umsetzen. Der Beitrag stellt entwickelte Methoden sowie ihre Veranschaulichung an generellen Randbedingungen der lokalen Situationen vor, die den Partnern ein Instrument zur Umfeldanalyse bereitstellten.

Keywords: Kommunale Vergleichbarkeit, Übertragbarkeit lokaler Konzepte, Integrale Planung, Umfeldanalyse, Stadtentwicklung

2 EINLEITUNG

Eine verstärkte Tendenz zur Förderung der Übertragbarkeit von Forschungsergebnissen in die Praxis kann derzeit festgestellt werden. Dabei werden unter dem Begriff eines Reallabors oftmals das Erforschen von Fragestellungen im realen Umfeld eines Areals, Quartiers oder einer ganzen Stadt verstanden. Lassen sich Reallabore durch Rahmenbedingungen vergleichen? Können mittels Umfeldanalyse sogar generalisierbare Faktoren extrahiert werden, die helfen können lokal spezifische Lösungen an andere Orte zu übertragen? Dies steht im Ausgangspunkt eines Forschungsvorhabens, das tradierte, scheinbar gegensätzliche urbane bzw. ländliche Planungssichten zu Überwinden versucht. An verschiedenen Orten angesetzte Quartierskonzepte unterliegt eine auf Bevölkerung(sstruktur) sowie gesellschaftliche Veränderungsprozesse zielende Methodik als verbindendes Element zwischen traditionell isoliert behandelten Planungsräumen Stadt und Land.

Unter dem Begriff der Transformative Zelle (TZ) wird in einem laufenden Forschungsprojekt ein Konstrukt untersucht, um Projekte, Vorhaben und Gemeinschaften mit transformativer Wirkung besser verstehen zu können. Das Modell der TZ dient hierbei selbst als Untersuchungsgegenstand und gleichzeitig als strategisches Hilfsmittel für Transformationsakteure. Prinzipiell wird mit der TZ die Erarbeitung eines methodischen Planungsinstruments auf kommunaler Ebene verfolgt. Einerseits geht es dabei um die Entwicklung methodischer Ansätze einer TZ, die dann andererseits praktisch an verschiedenen lokalen Quartierskonzepten in Reallaboren mit verschiedenen Handlungsfeldern (Ernährung, Bildungslandschaften, etc.) angewendet und evaluiert werden (vgl. LandStadt 2019 sowie Graf 2019).

Im Beitrag wird ein methodischer Teil des untersuchten Gegenstandes der TZ vorgestellt, der den Partnern Instrumente einer Umfeldanalyse zur Untersuchung der Orte ihrer Reallabore an die Hand gibt. Diese dienen dabei zum einen dazu die lokale Situation vor dem Hintergrund der konzeptionell fokussierten Handlungsfelder zu durchleuchten. Zum anderen sollen sie im Sinne einer Generalisierbarkeit des Prinzips einer TZ eine Vergleichbarkeit bzw. mögliche Übertragbarkeit lokal angesetzter Quartierskonzepte ermöglichen. Der der Entwicklung der zusammengestellten Untersuchungsmethoden zugrundeliegende

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Ansatz, zielt auf das Aufzeigen von gesellschaftlichen Veränderungen als ein wichtiges Charakteristikum der lokalen Situation ab. Es wird damit versucht tradierten Planungssichten entgegenzuwirken, die noch den Kontext starr wahrnehmen und das Umfeld vornehmlich gemäß der Lage innerhalb einer Stadt als „urban“ bzw. auf dem Land als „rural“ einteilen und damit oftmals bei sich immer weiter angleichenden Lebenswelten zu kurz greifen. Zur bedeutungsvollen Umfeldmessung setzt der im Beitrag vorgestellte Lösungsansatz auf eine Überwindung dieser eingeschränkten Planungssichten. Anhand von Analysemethoden aus abgeschlossenen Forschungsprojekten, die sich mit Konzepten zur energieeffizienten Stadtentwicklung mehrerer räumlich verteilten Kommunen befassten, werden dann gemäß dem vorgeschlagenen Lösungsansatz räumliche Kontexte erfasst und deren bisher vornehmlich auf die „dem Land“ oder „der Stadt“ zugeordneten gesellschaftlichen Veränderungsprozesse auf Gemeinsamkeiten hin überprüft.

3 METHODIK

Wie können eigendynamische Entwicklungen, beispielsweise bezüglich kultureller, sozialer, wirtschaftlicher oder baulicher Veränderungen, im lokalen, kommunalen oder regionalen Maßstab analysiert werden?

Zunächst bedarf es hierfür der fallbezogenen Identifikation und Qualifikation der lokalen Rahmenbedingungen, welche die Entwicklung und den Fortbestand möglicher Konzepte zur Stadtentwicklung unterstützen oder auch hemmen können. Durch Vergleich zu ähnlich veranlagten Orten können die Rahmenbedingungen dann iterativ auf ihre Generalisierbarkeit weiter untersucht werden. Eine praxisnahe Rückkopplung ermöglicht es entsprechend angesetzte Untersuchungsmethoden schrittweise zu erproben. Daher steht der Untersuchungsgegenstand vor dem Hintergrund konkreter Fallbeispiele zu den im Forschungsprojekt angesetzten Reallaboren, in denen jeweils ein Quartierskonzept von den Projektpartnern umgesetzt wird. Der Beitrag behandelt drei der vier Städte, in denen die Reallabore ansässig sind und untersucht deren unterschiedliche Rahmenbedingungen. Kennzahlen und Informationen zu Handlungsfeldern beleuchten kommunale äußere sowie innere Entwicklungsbedingungen. Ziel ist es ein einheitliches strukturiertes Vorgehen in Form einer Erstellungsmethode sowie Umfeldanalysen als entsprechende exemplifizierte kommunale Profile für die drei Städte bereitzustellen, mit denen grundlegend zum entwickeln lokaler Konzeptionen die im Kontext wirkenden Herausforderungen und Potentiale der Entwicklung aufgezeigt werden. Anderen Kommunen soll damit eine Beurteilung der möglichen Übertragbarkeit von Strategien oder Strategiebausteinen auf den eigenen Kontext erleichtert werden, die im Rahmen des Forschungsvorhabens von den Projektpartnern für die lokale Situation gemäß dem Leitziel zum Aufbrechen der starren Trennung von Land- und Stadtsicht auf die Planung entwickelt werden. Als eine Vorlage zur Anwendung auf die lokale Situation werden im Beitrag Methoden an den Fallbeispielen exemplifiziert, die den Untersuchungsgegenstand im (regionalen) Kontext an gängigen soziodemografischen Kennwerten durchleuchten. Dabei werden zunächst die (regional) wirksamen Rahmenbedingungen untersucht, um darin dann die folgend weiteruntersuchten Randbedingungen der lokalen Situationen einordnen zu können. Die somit generell als Handlungsanleitung zu lesende methodische Hilfestellung des Beitrags soll es den Projektpartenern im konkreten Anwendungsfall ermöglichen, über die im Beitrag allein zur Veranschaulichungszwecken anhand genereller Randbedingungen erfassten kommunalen Profile hinausgehend, in weiterführenden Detaillierungen ihres lokalen Profils die aufgegriffenen Handlungsfelder im angesetzten Quartierkonzept situationsspezifisch auszuleuchten. Mittels geeigneter Kennwerte kann dazu der Bezugsrahmen inhaltlich weiter an die lokal spezifischen Entwicklungskonzepte angepasst werden. Ein Abschätzen der Übertragbarkeit lokaler Strategien kann darauf aufbauend dann durch den Abgleich dieser im Profil thematisch auf das Handlungsfeld abgegrenzten bzw. konkretiserten, spezifischen Randbedingungen mit den entsprechenden Werten am Zielort ermöglicht werden. Im Rahmen der Umfeldanalysen geht es um das Betrachten von Randbedingungen der lokalen Situation sowie das Herausarbeiten charakteristischer Kriteren, die einerseits Entwicklungen in skaleneübergreifende Zusammenhängen vor dem Hintergrund gesellschaftlicher Veränderungsprozesse miteinbeziehen. Und die andererseits derart aufgeschlüsselt sind, damit ähnliche (Referenz-) Situationen vergleichend hinzugezogen werden können. Die Fallbeispiele werden daher skalenbasiert „von außen nach innen“ durchleuchtet. dabei werden iterativ, ausgehend von den äusseren Randbedingungen der übergeordneten Ebene, jeweils die Kennwerte der inneren Maßstabsebene tiefergehend untersucht und eingeordnet. Dieser Schritt zeigt für die Methodenanwendung an, wie eine thematische Zusammensetzung lokal angesetzter Quartierskonzepte in den einzelnen Reallaboren als Beitrag zur Definition einer TZ dann in eine (generalisiert) untersuchte Umfeldbedingung eingeordnet werden kann.

4 UMSETZUNG

Von einer Skalenebene der Region bis zur lokalen Situation werden im Folgenden als Fallbeispiele die Reallaborstandorte untersucht. Diese übergeordnete Untersuchungsebene bezieht sich dabei auf eine prinzipielle Verortungs- bzw. Vergleichsmöglichkeit der Standorte. Die im Kapitel zusammengestellten Analysen bilden die Basis der im Kapitel 5 dann anschliessend bezüglich der konreten inneren Randbedingungen weiterführend untersuchten und zusammengestellten lokalen Profile.

4.1 Großmaßstäbliche Betrachtung

Für eine generelle Einordnung der tiefergehend untersuchten Orte ist die Betrachtung der regionalen Kontexte wichtig, in denen sie sich befinden. Insbesondere die (relative) Nähe zu Metropolen, die sichtbare direkte wie auch indirekte Wechselwirkungen auf die Orte ausüben, wird dabei a priori der kleinräumlichen Analyse gegenübergestellt. Dies ermöglicht es auch die vor Ort erkennbaren Gegebenheiten besser den anderen Orten vergleichend gegenüber zu stellen. Im Folgenden werden daher zunächst die drei Agglomerationszonen betrachtet in denen bzw. in deren Einzugsgebiet sich die Fallbeispiele einordnen.

4.1.1 Ostdeutschland – Metropolregion Berlin

Charakteristisch für die Umfeldbeziehung der Metropole Berlin erscheint die Sogwirkung ihrer wirtschaftlichen Stärke in einer ansonsten recht wirtschaftsschwachen Region. Am deutlichsten wird diese Anziehungskraft an Pendlerströmen, die beispielsweise für die Beziehung zum Berlin umgebenden Bundesland Brandenburg in der Studie „Pendleratlas“ des RBB auf Basis statistischer Daten von 2015 aufbereitet wurden . Diese Wechselbeziehung auf sein Umfeld hat sich in den letzten Jahren weiter verstärkt. Neben den sichtbaren Faktoren wie den Pendlerströmen, die nicht zuletzt auch auf die sich stetig verteuernden Mieten in Berlin zurückgehen, können in den Detailanalysen zu den Fallbeispielen auch indirekte Wirkungen wie die Bildungswanderung der jungen Bevölkerung nach Berlin aufgezeigt werden.

In Abbildung 1 wird schematisch die großmaßstäbliche Beziehung der Metropolregion Berlin zu den im Umfeld liegenden Gemeinden der Fallbeispiele dargestellt (Abbildung 1). Aufgrund seiner räumlichen Nähe wirken auf Angermünde dabei starke Anziehungskräfte. Dies äußert sich neben den oben angedeuteten Pendlerzahlen in einer breiteren Palette an entwicklungsbedeutsamen Faktoren, wie Bildungswanderung etc.. Beim Betrachten der lokalen Situationen von Gemeinden im (größeren) Umfeld der Metropole Berlin, sollten die großräumlich wirkenden Rahmenbedingungen mit einbezogen werden. Hieraus lassen sich bereits im Vergleich der in unterschiedlicher Entfernung liegenden Fallbeispiele erste Differenzierungen der Metropolwirkungen auf die „anziehenden“ Entwicklungstendenzen erkennen, die bei den Analysen vorort wertvolle Erläuterungsansätze bieten können.

4.1.2 Metropolregion Zürich

Die Metropolregion Zürich ist eine der am dichtesten besiedelten Agglomerationszonen in der Schweiz. Mit einer Bevölkerungsdichte von über 4400 Einwohner pro Quadratkilometer stehen dabei die 12 Kreise der Stadt Zürich im Kern dieser Zone. Davon ausgehend dehnt sich das Ballungsgebiet flächig in nördlicher Richtung sowie nach Süden lediglich durch die Zäsur der Topografie und dem Zürichsee unterbrochen in das weitere Umfeld aus. Im Vergleich zu Berlin ist der einfließende Pendlerstrom mit 213000 (Stadt Zürich 2013) in Bezug auf die Bevölkerungszahl mehr als 50% gegenüber unbedeutend erscheinenden 7%. (Stadt Zürich 2013).

Das heißt die Bevölkerungszahl in Zürich verändert sich täglich um knapp die Hälfte gegenüber der ansässigen (Wohn-) Bevölkerung. Diese Dynamik bildet somit einen der charakteristischen Wesenszüge der Stadtgesellschaft in der das Reallabor Zürich ansetzt, das sich von dort ausgehend über verschiedene Standorte in das nähere Umfeld erstreckt. Die großräumigen Rahmenbedingungen der Metropolregion wirken durch das Ansetzen dieses Fallbeispiels in dessen Kern direkt auf das Reallabor. Bezüglich einer Übertragbarkeit sollten daher die Entwicklungstendenzen der Stadt Zürich in ihrem Zusammenspiel mit der Metropolregion mit betrachtet werden. Durch die Lage innerhalb einer in sein Umfeld wirkendes urbanes Gefüge ist zu erwarten, dass eine Übertragung eher schwierig sein dürfte, da die Rahmenbedingungen mit den lokal spezifischen Situationsmerkmalen übereineinstimmen und das vorhandene Gefüge die untersuchten Lösungsansätze prägen dürfte.(vgl. Abbildung 1)

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4.1.3 Metropolregion Ruhrgebiet

Der umgangssprachlich kurz als „Pott“ bezeichnete Agglomerationsbereich des Ruhrgebietes ist das größte und zusammenhängend am dichtesten besiedelte Gebiet innerhalb Deutschlands. An seinem Rand schließt das Rheinland mit dem Raum Köln an, zusammen bilden sie die nördliche Einflusszone des Fallbeispiels in der Stadt Bonn. Diese durch zahlreiche dicht aneinander liegende Großstädte geprägte Region stellt aufgrund der guten Erreichbarkeit ein beim Betrachten der lokalen Situation Bonn’s gewichtigen, einzubeziehenden Faktor dar. Zur nördlichen Seite ebenfalls gut per Bahn bzw. Autobahnen erschlossen liegt die Agglomerationszone Rhein-Main mit Frankfurt als gewichtigem Kern. Auch hiervon sind Wechselwirkungen bezüglich großräumiger Randbedingungen von Bonn zu erwarten (vgl. Abbildung 1).

4.1.4 Zusammenfassung

Die in diesem Kapitel beleuchteten großmaßstäblichen Rahmenbedingungen haben sich für die einzelnen Fallbeispiele als sehr unterschiedlich dargestellt. Generell erscheint die Lage in Bezug zu den umliegenden Metropolen dabei ein für die Untersuchung wichtiges Merkmal darzustellen (vgl. Abbildung 1).

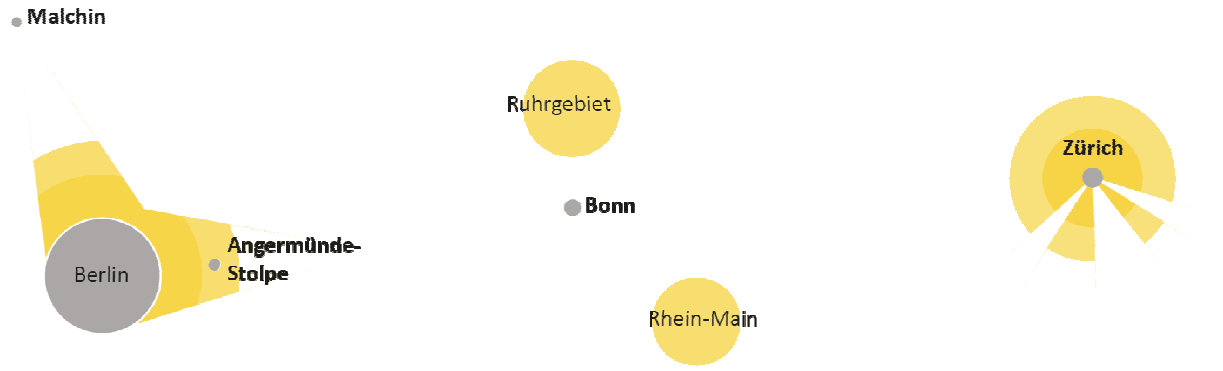

Abbildung 1: Metropolregionen im grafischen Vergleich; eigene Darstellung.

Tabelle 1 zeigt die weiteren unterschiedlichen Arten an identifizierten Rahmenbedingen. Ähnlich zur Situation Berlins, ist allerdings anstelle eines einzelnen Anziehungspunktes die Stadt Bonn von polyzentrischen Agglomerationszonen umgeben. Dadurch sind diffuse Wirkungen zu erwarten, die nicht direkt mit einem Zentrum in Verbindung gebracht werden können. Hinzu kommt, dass die Stadt Bonn selbst als Großstadt in dieses großräumige Gefüge mit ihren Randbedingung. eingreift und dieses mit beeinflusst. Gesteigert wird dies im Fall der Stadt Zürich, in dem sich ihre Randbedingungen als Kern der Metropolregion mit den großräumigen Rahmenbedingungen der Region direkt überlagern.

Bezugnehmend auf den Aspekt möglicher Übertragbarkeit (ggf. als Vorstufe einer Generalisierbarkeit der in den Reallaboren untersuchten lokalen Gegebenheiten) lokaler Quartierskonzepte sollte ein Augenmerk bei der Betrachtung auf die großmaßstäblichen Rahmenbedingungen gelegt werden. Eine Fokussierung auf die lokalen Randbedingung allein könnte wichtige (großräumige) Wirkungen sonst außer Acht lassen, die für das Gelingen einer Übertragung in andere lokale Situationen unabdingbar sind.

Einordnung in großräumliche Abhängigkeiten	Magnet	Im Zentrum des Magneten	Polymagnetismus
Fallbeispiele	Angermünde	Zürich	Bonn

Tabelle 1: Clustereinteilung

4.2 Statistische Einordnung der Entwicklungen

Die unterschiedliche Ausgangssituation und die Rahmenbedingungen der regionalräumlichen Entwicklung der drei Fallbeispiele. unterliegen der Fragestellung, welche relativen Unterschiede in der Entwicklungsdynamik zwischen den Standorten der einzelnen Reallabore bestehen. Mit Darstellung entsprechender sozio-räumlicher Entwicklung(stendenzen) kann ein Bezugspunkt für die Abschätzung einer

Übertragbarkeit (und somit Anhaltspunkte bezüglich einer möglichen Generalisierbarkeit) darin angesetzter Stadtentwicklungskonzepte geschaffen werden.

Da gängige sozialdemografische Klassifizierungen über Bevölkerungsgröße (Klein-, Mittel- oder Großstadt) oder zentralörtliche Funktionen (Unter-, Mittel-, Oberzentrum) keinen Aufschluss über standorttypischen Entwicklung geben, müssen mehrere Perspektiven zu den Standorten der Reallabore eingenommen werden um ein vielschichtiges Bild der Region zu erzeugen. Dabei steht die Bevölkerung durch ihre Schlüsselstellung bei sämtlicher Entwicklung immer im Brennpunkt der Betrachtungen. Als Ausgangspunkt und Orientierungsrahmen der Untersuchung dient die Empfehlung des „Wegweiser Kommune" der Bertelsmann Stiftung [BER2018]. Auf Basis der darin umfangreich zusammengestellten kommunalen Daten sind durch clusteranalytische Ableitungen verschiedene (generalisierte) Demographie-Typen bestimmt und jeweils mit eigenen Profilen beschrieben worden. Die Hinweise zu den demographischen Herausforderungen wurden den Fallbeispielen zugeordnet (siehe Tabelle 2). Da im Wegweiser Kommune jedoch nur Daten zu deutschen Städten erfasst werden, nimmt hinsichtlich der Datenerfassung (sowie deren in Bezug setzen zu den deutschen Reallaboren), das sich im Großraum Zürich befindliche Reallabor eine Sonderstellung ein. Durch Hinzuziehen verschiedener artverwandter Untersuchungen zur schweizerischen Demografie konnte Zürich gemäß dem Bertelsmann Demographietyp 2 „Zentren der Wissensgesellschaft" als prosperierendes Wirtschaftszentrum von den Verfassern plausibel zugeordnet werden.

Die Gegenüberstellung der einzelnen Standorte zeigt den gesamtgesellschaftlichen Trend einer alternden und schrumpfenden Bevölkerung. In den Typ-2-Städten wird diese Entwicklung durch die Zuwanderung junger Bevölkerungsgruppen überlagert, wohingegen dieser Trend in den Typ-9-Kommunen durch die Abwanderung der jungen Bildungsbevölkerung sogar noch verstärkt wird. Die Bevölkerungsentwicklungen in den Fallbeispielen weisen somit konträre Entwicklungstendenzen auf. Dies impliziert die Annahme, dass die jeweiligen Entwicklungen so zu unterschiedlichen Auswirkungen auf die soziokulturellen und räumlichen Strukturen führen.

Kommune	Demographietyp	Merkmale	Herausforderungen
Bonn Zürich	Typ 2: Zentren der Wissensgesellschaft	sozial heterogenes Zentrum der Wissensgesellschaft ökonomischer + demographischer Wachstumsraum funktional verflochtene Stadtregion	negativer Familienwanderungssaldo bezahlbarer und qualitativer Wohnraum familiengerechte Quartiere soziale Exklusion und Polarisierung regionale Betrachtung der Entwicklung
Angermünde-Stolpe	Typ 9: Stark anpassende Kommunen mit Anpassungsdruck	stark schrumpfende Kommune mit besonderem Anpassungsdruck	tiefgreifende sozioökonomische Verwerfungen radikale Neupositionierung in vielen Bereichen ehrliche Einschätzung der Leistungsfähigkeit der öffentlichen Hand neue Formen der Beteiligung initiieren

Tabelle 2: Kommunen geordnet nach Demografie-Typen. Quelle. Bertelsmann Stiftung; eigene Darstellung.

4.3 Klassifizierung der Standorte

Zur weiteren Verdeutlichung der räumlichen und soziokulturellen Unterschiede sowie zur besseren Differenzierung der sich abzeichnenden verschiedenen Entwicklungstendenzen (vgl. Kap. 4) der Fallbeispiele, werden sie im Weiteren spezifischer klassifiziert. Dazu sind in einem Kennzahlenvergleich die Daten zur Bildungswanderung (18-24jährige) mit Indikatoren zum wirtschaftlichen Wohlstand der Bevölkerung (Kaufkraft) und zur regionalen Dynamik (Pendlersaldo, Gesamtpendleraufkommen) zusammengeführt. Die Kennwerte zur Bildungswanderung und zur Kaufkraft sind den Daten des Wegweiser Kommune entnommen, und über einen Zeitraum von 2012-2017 gemittelt [BER2018]. Die Pendlerdaten entstammen der Regionaldatenbank Deutschland der Statistischen Ämter des Bundes und der Länder mit dem Bezugsjahr 2011 [REG2012]. Die entsprechenden Zahlen für die Stadt Zürich sind dabei basierend auf den Stadtstatistiken [STA2018] aufbereitet worden.

Zur besseren Einordnung der Entwicklungstendenzen in den Fallbeispielen untereinander sind diese durch eine vereinfachte Clusteranalyse anhand einheitlicher Merkmale tiefergehend charakterisiert. Die Grundlage ihrer Einordnung bilden dabei die 5 Cluster, die in ihren wesentlichen Merkmalsausprägungen an der Vorarbeit von Rexroth [REX2016] angelehnt sind (vgl. Tabelle 3). Die ursprünglichen Charakteristika der einzelnen Cluster sind auf einer breiteren Basis an Fallbeispielen aufgebaut, die somit in die Betrachtung einbezogen und gemäß den lokalen Spezifika der drei Kommunen weiter geschärft werden konnten.

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Cluster nach Rexroth	1	3	4	2	5
	Stadt in vitaler Region	Hochschulstandort	Stadt in stagnierender Region	Wohnstadt in angeschlagener Region	Wohnstadt in stagnierender Region
Charakteristika	hoher Lebensstandard, Zuwanderung junger Bevölkerung, starke regionale Vernetzung	mittlerer Lebensstandard, hohe Zuwanderung junger Bevölkerung, geringe regionale Vernetzung	einfacher Lebensstandard, geringe Wanderungsdynamik, geringe regionale Vernetzung	Einfacher Lebensstandard, Abwanderung junger Bevölkerung, wirtschaftlich unselbstständig	hoher Lebensstandard, Abwanderung junger Bevölkerung, wirtschaftlich unselbstständig
Neue Typisierung	I	II	III	Zusammengefasst zu IV	

Tabelle 3: Clustereinteilung. Quelle Rexroth; eigene Darstellung.

Als Ergebnis stellte sich trotz einer Reduzierung auf wesentliche Charakteristika (vgl. Tabelle 4) heraus, dass die Fallbeispiele jeweils in einem eigenen Cluster lagen. Damit kann vor dem Hintergrund dieser Analyse bezüglich der Randbedingungen nicht auf ähnliche Entwicklungstendenzen geschlossen werden. Diese Einordnung anhand der lokal spezifischen Charakteristika, die insbesondere die Bevölkerung durchleuchten, weist auf stark abweichende regionale Dynamiken der einzelnen Fallbeispiele hin.

Cluster	Kommune	Kaufkraft	Pendlersaldo	Gesamtpendler	Bildungs-wanderung
I	Zürich	1,5	1,27	-0,49	0,15
II	Bonn	0,85	0,19	-0,43	1,40
III	Angermünde-Stolpe	0,31	-1,10	1,50	-0,84

Tabelle 4: Cluster der Kommunen (Kennwerte normalisiert). Quelle: Bertelsmann Stiftung, Stadt Zürich; eigene Berechnung.

Aus den Charakteristika der Cluster lassen sich Merkmalsausprägungen herauslesen, die im Spektrum der Reallabore eigenständige räumliche und wirtschaftliche Profile erkennen lassen. Diese können folgendermaßen interpretiert werden:

Die Stadt Zürich als Vertreter des Cluster I zeigt eine hohe Kaufkraft der Bevölkerung und eine hohe Bildungszuwanderung. Der hohe (positive) Pendlersaldo weist auf die Bedeutung der Stadt als bedeutendes Wirtschaftszentrum hin und lässt auf einen regen Austausch und eine hohe Mobilität der Bevölkerung in der Region schließen. Es handelt sich um eine dynamische und prosperierende Region, in der eine hohe Wertschöpfung durch die Bevölkerung möglich ist.

Bonn repräsentiert im Cluster II eine Kommune mit hoher Bildungszuwanderung. Die Kaufkraft ist geringer ausgeprägt als in Kommunen des Clusters I, jedoch immer noch verhältnismäßig hoch. Der Pendlersaldo ist relativ gering. Es handelt sich um eine attraktive Kommune für junge, aufsteigende Bevölkerungsgruppen, die jedoch nur temporär an die Stadt gebunden werden, was sich in der negativen Gesamtpendlerzahl ausdrückt. Insgesamt verbleibt die Merkmalsausprägung in einem homogenen Wertebereich.

Im Cluster III findet sich mit Angermünde-Stolpe eine Stadt, deren örtliche Kaufkraft gering ausgeprägt ist. Die insgesamt noch positive Kaufkraft weist möglicherweise auf eine regionale Verflechtung mit Zentren der Umgebung hin. Die Orientierung zu externen Arbeitsmärkten zeigt sich an einem negativen Pendlersaldo. Junge Bevölkerungsgruppen wandern ab. Es handelt sich um eine Stadt mit überwiegend Wohnfunktion und geringer lokaler Wertschöpfung durch die ansässige Bevölkerung.

Bei der Standortcharakterisierung zeigen sich (1) Die Attraktivität für junge Bevölkerung und (2) die Wertschöpfung der Bevölkerung als Grundlage einer langfristigen Bindung an den Ort als besonders prägend. Anhand dieser Dimensionen wird eine Klassifizierung der Kommunen vorgenommen. Als stellvertretende Indikatoren wurden verwendet: zu (1) der Kennwert „Bildungswanderung“ und zu (2) der Kennwert „Anteil der Sozialleistungsbezieher“ als negative Indikation. Die Klassifizierung erfolgt über drei Wertungsstufen bezogen auf den Wertebereich der Stichprobe (Tabelle 5):

Stadt	Wertschöpfung der Bevölkerung Sozialleistungsbezieher [% der Bevölkerung <65J.]	x-Wert	Attraktivität für junge Bevölkerung Bildungswanderungen [1/1000 EW]	y-Wert
Angermünde-Stolpe	20,4	1	-55,9	1
Bonn	10,9	2	88,8	3
Zürich	-	3	93	2
Maximum	21,2		93	
Minimum	10,9		-55,9	

Tabelle 5: Kennwerte der Kommunen. Quelle: Bertelsmann Stiftung, Stadt Zürich; eigene Darstellung.

Bei der Übertragung in eine zweidimensionale Matrix ergibt sich die in Tabelle 6 dargestellte Klassifizierung der Kommunen:

Attraktivität f. junge Bevölkerung	Wertschöpfung der Bevölkerung: gering (1)	mittel (2)	hoch (3)
hoch (3)		Bonn	Zürich
mittel (2)			
gering (1)	Angermünde-Stolpe		

Tabelle 6: Klassifizierte Kommunen. Quelle: Bertelsmann Stiftung, Stadt Zürich; eigene Darstellung.

4.4 Entwicklungsbedingungen der Reallabore

Wie bereits in der Zuweisung der Demographietypen und der Clusteranalyse sichtbar, besetzen die Standorte der Reallabore in Zürich sowie Angermünde-Stolpe, die am stärksten konträren Randbereiche der Klassifikationsmatrix (vgl.Tabelle 6). Zwischen diesen beiden Extrempunkten siedelt sich der Standort in Bonn im Mittelfeld des durch die Matrix aufgespannten Feldes an.

Methodisch werden im Weiteren aufbauend auf den Einordnungen in der Matrix die Randbedingungen der Standorte weiterführend interpretiert. Zunächst werden hierzu die relativen Unterschiede der Kommunen in ihren dynamischen Entwicklungsbedingungen gegenübergestellt. Daraus kann sodann auf die räumlichen und soziokulturellen Herausforderungen geschlossen werden, mit denen die kommunalen Akteure konfrontiert sind.

4.4.1 Äußere Entwicklungsbedingungen

Im ersten Schritt werden die Kommunen in ihrer Ausprägung städtischer Merkmale und ihrer räumlichen Lage gegenübergestellt. Für die Ausprägung städtischer Merkmale werden zwei Parameter der physischen Urbanisierung herangezogen: die Bevölkerungsgröße und die Bevölkerungsdichte. Die Kennwerte werden nachfolgend grafisch ausgewertet (Abbildung 2). Unter der vereinfachenden Annahme, dass beide Parameter zu gleichen Teilen einfließen, kann aus der Grafik in vertikaler Richtung der relative (physische) Urbanisierungsgrad und in horizontaler Richtung dessen Zusammensetzung entnommen werden. In Abbildung 2 wurden weitere Städte aus der Vorgängeruntersuchung mit einbezogen, um ein breiteres Spektrum möglicher kommunaler Werte abzugleichen.

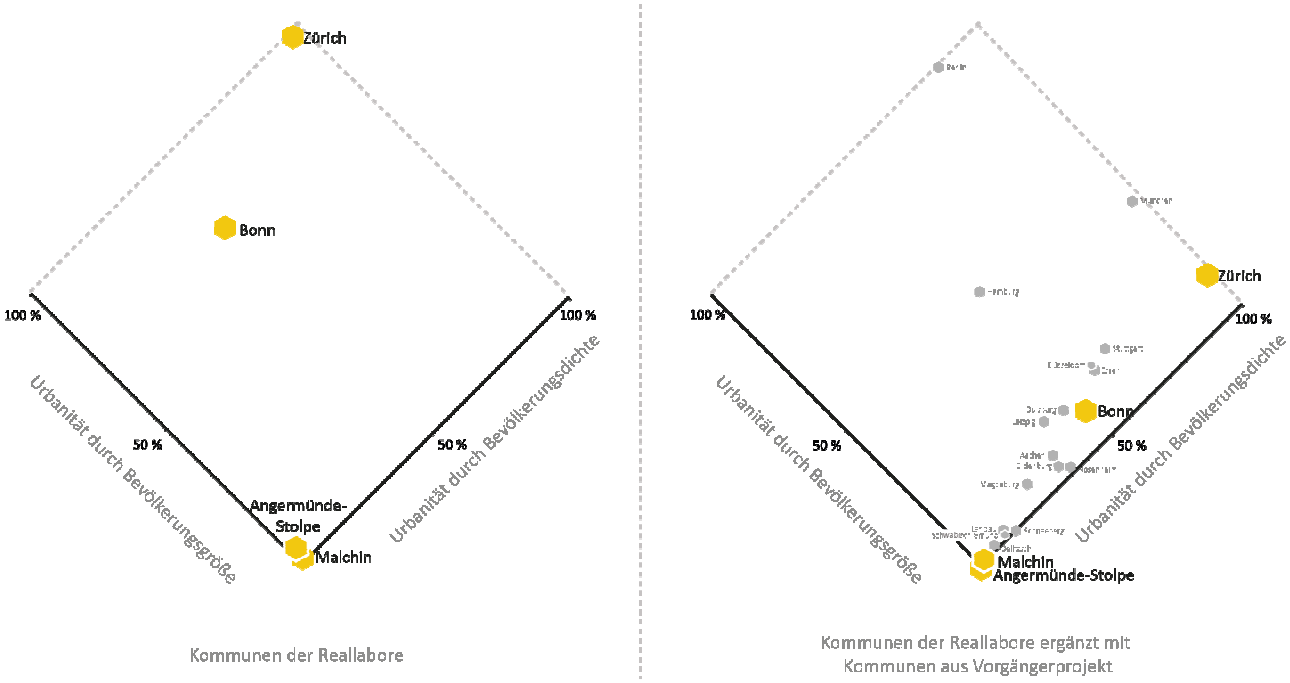

Abbildung 2: Relativer Urbanisierungsgrad

4.4.2 Innere Entwicklungsbedingungen

Der oben eingeführten These folgend, lassen sich Wachstumskräfte einer Kommune entsprechend ihrer funktionalen Eigenheit als eine Resultierende aus zwei Dimensionen herausstellen: (1) den Möglichkeiten

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eine junge Bevölkerung nachzuziehen (stellvertretender Indikator: Bildungswanderung) und (2) den Möglichkeiten der Bevölkerung eine adäquate Wertschöpfung zu erzielen (stellvertretender Indikator: SGB II-Quote). Zur Veranschaulichung wurden die Kennwerte aus Tabelle 5 im Spektrum der Standorte nachfolgend grafisch ausgewertet (Abbildung 3). Aus der Grafik lässt sich das relative Entwicklungsniveau in vertikaler Richtung und die Zusammensetzung der Entwicklungskräfte in horizontaler Richtung ablesen. Zur Orientierung wurde auf der Attraktivitätsachse eine positive Bildungswanderung ab etwa 38% und auf der Wertschöpfungsachse eine SGB II-Quote kleiner 10,1% ab etwa 77% markiert (gültig für diese Stichprobe; STB2013).

Überschlägig kann interpretiert werden, dass eine ausgeglichene Entwicklung über ein ausgewogenes Verhältnis von Attraktivität und Wertschöpfungsmöglichkeit und über ein ausgewogenes Niveau der Entwicklungsdynamik des städtischen Transformationsprozesses erreicht wird. Kommunen im oberen und unteren Sektor stehen tendenziell unter materiellen Transformationszwängen durch: (1) Wachstumsdruck (Zürich) - Herausforderungen Wohnraumversorgung, Infrastrukturkapazität, Lebenshaltungskosten und Gentrifizierung; (2) Beschäftigungsdruck (Bonn) - Herausforderungen Wirtschaftsansiedlung, -förderung und Wahrnehmung als Investitionsstandort für Unternehmen; (3) Visionszwang (Angermünde-Stolpe) - Herausforderungen in Neubestimmung des eigenen Wesens sowie in Öffnung hin zu neuen Lebensformen.

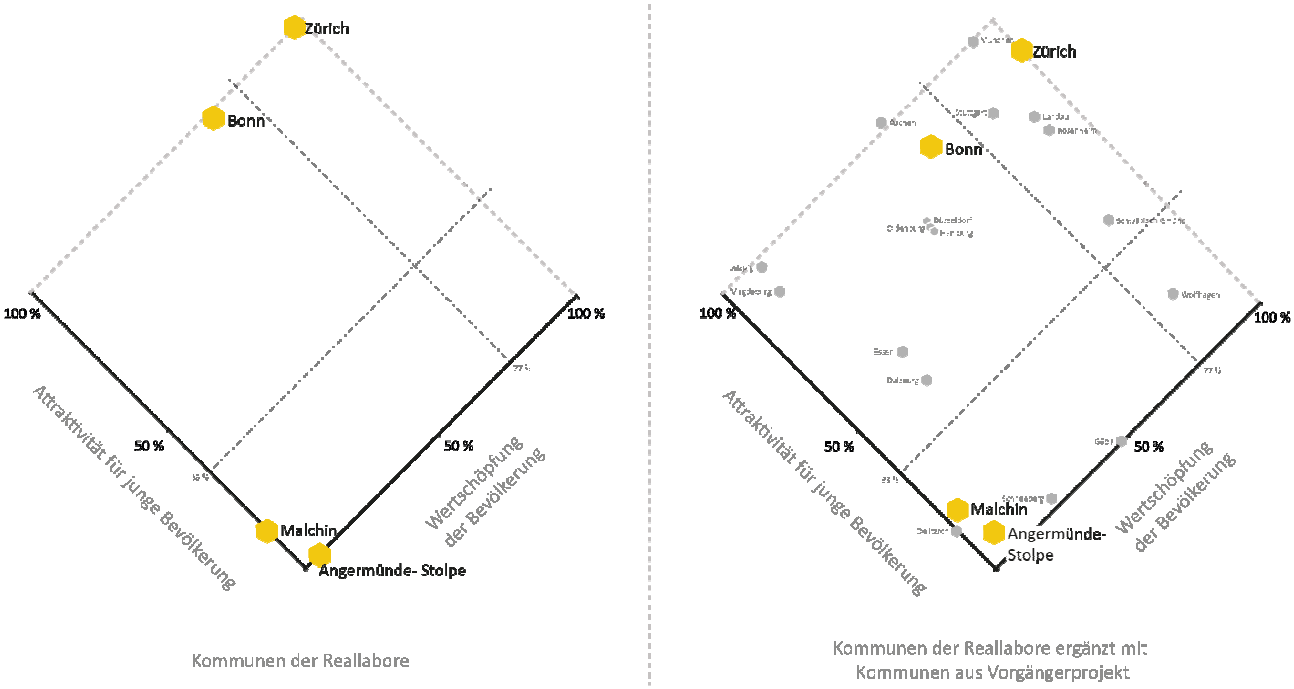

Abbildung 3: Relative Entwicklungsdynamik

4.5 Herausforderungen und Potentiale in der Entwicklungsdynamik

Die nachfolgende Ableitung von Herausforderungen aus den bisher differenzierten Entwicklungsbedingungen der Fallbeispiele können als relative Gewichtung im Portfolio weiterer, nicht explizit benannter Handlungsfelder verstanden werden.

ANGERMÜNDE-STOLPE kann zwar auf einen regional erreichbaren Arbeitsmarkt und durch gute Anbindung von Schiene und Autobahn auf überregionale Funktionen in Berlin zugreifen, dennoch stellt die Daseinsversorge für ältere und immobile Bevölkerung eine große Herausforderung dar. Durch die gute Anbindung an Berlin, nimmt für Angermünde die Funktionsfähigkeit als Wohnort und attraktiver Lebensmittelpunkt für Senioren und zunehmend auch für junge Familien eine wichtige Rolle ein, was einen Angebotsmarkt für bezahlbaren Wohnraum, Kinderbetreuung, Freizeitgestaltung und gute Integrationsmöglichkeiten neuer Bevölkerung erfordert. Die Herausforderung ist, für junge Familien in Zukunft noch attraktiver zu werden. Hierbei steht eine Stärkung einzigartiger Merkmale im Vordergrund um gegenüber anderen Kommunen im Berliner Umland konkurrenzfähig zu bleiben. Die öffentliche Verkehrsanbindung stellt hierbei ein Hemmnis dar, dass verstärkt durch die Tendenz von Schrumpfung und Überalterung der Bevölkerung verstärkt wird.

BONN als Stadt im großen polyzentrischem Raum wird auch in Zukunft weiterhin Zuwanderung haben. Neben der Sicherung des Arbeitsangebots und Arbeitskräfteangebots, tragen die vielfältige und hoch entwickelte Struktur und der facettenreiche Arbeitsmarkt zum Erfolg der Stadt bei. Qualifizierte Fachkräfte werdem somit auch zukünftig am Standort benötigt. Der alternden Gesellschaft wird sich Bonn stellen müssen, wie die anderen Städte auch. Eine der größten Herausforderungen wird dabei die Schaffung von bezahlbaren und bedarfsgerechten Wohnungen sein. Dies wird u.a. durch erforderliche Unterbringung und Integration sozialer Randgruppen auch in dicht besiedelten Regionen verstärkt. Hinzu kommen zusätzliche Herausforderungen wachsender urbaner Räume, wie Gentrifizierung, Segregation, steigende Lebenshaltungskosten oder steigende Boden- und Immobilienpreise. Einer sozialen Polarisierung sollte entgegen gewirkt und diesbezüglich einer stärkere Einbindung der einzelnen Bürger gefördert werden.

ZÜRICH ist das urbane Zentrum einer prosperierenden und dicht besiedelten Region. Für Zürich ist der große Arbeits- und Finanzmarkt der Erfolgsfaktor. Dieser Erfolg beruht nicht nur auf der Einbettung des Wissenszentrums in den vorhanden Wirtschaftsraum, sondern gelingt durch die vielfältig funktionalen und arbeitsteiligen Verflechtungen zum Umland. Dennoch ist die Sicherung von hochqualifiziertem Fachpersonal in der Stadt und vor allem in Zusammenarbeit mit dem Umland, bis weit über die Schweizer Grenze hinaus, als Wohn- und Rückzugsort, der in Zürich arbeitenden Bevölkerung, die wichtigste (infrastrukturelle) Herausforderung. Diese Herausforderung liegt im Gegensatz zu den andere Fallbeispielen in der Steuerung und Kanalisierung des Wachstumsprozesses bei begrenzten räumlichen Kapazitäten. Damit gehen Entwicklungen einher, wie Gentrifizierung, Segregation, steigende Lebenshaltungskosten, steigende Boden- und Immobilienpreise. Die Bereitstellung von bezahlbarem und bedarfsgerechtem Wohnraum stellt Zürich in den nächsten Jahren vor eine große Herausforderung. Hohe Verkehrsbelastungen und verminderte Luftqualität erfordern zudem Investitionen in eine effiziente, emissionsarme und leistungsfähige Infrastruktur.

5 ZUSAMMENFASSUNG ZU REGIONALEN STECKBRIEFEN

Zur Verdichtung und Ergänzung der zuvor erarbeiteten Entwicklungsbedingungen sind für die Kommunen kommunale Profile zusammengestellt worden, die in vergleichbarer Form einen Überblick verschaffen können. Diese bieten weiteren Kommunen eine erste Orientierung(smöglichkeit) zur Übertragbarkeit von Vorgehensweisen, Konzepten oder Maßnahmen. Ergänzende Informationen werden den Vergleichskennwerten zum kommunalen und regionalen Kontext begefügt. Soweit es nicht anders in den Fußnoten angegeben wurde, entstammen die Kennwerte der Datenbasis Wegweiser-Kommune [BER2018]. Die Kennwerte wurden auf eine für diesen Vergleich praktikable Größenordnung gerundet. Die oberen und unteren Benchmarks sind zur gesamtheitlichen Einordungsmöglichkeit aus dem gesamten Spektrum der Fallbeispiele und den Kommunen des Vorläuferprojektes gebildet. Extreme Ausreißer wurden nicht einbezogen. Zur besseren Lesbarkeit werden ergänzende Hinweise in Fußnoten – beispielsweise zu Berechnungsgrundlagen – nur einmalig gegeben und gelten dann für alle anschließenden Vergleichswerte und Tabellen.

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5.1 Fallbeispiel Angermünde-Stolpe

		Benchmark (u./o.)	Wert	n	Wertung
Haushalt	Steuereinnahmen in €/EW	465/487	465	3	gering
	Gewerbesteueranteil in %	29/121	29	3	gering
	Schlüsselzuweisung in €/EW	199/471	471	3	hoch
Bevölkerung	Medianalter in Jahren	40,5/53,8	51,9	4	hoch
	Kaufkraft[1] in €	35.892/76.652	36.307	4	gering
	Mietpreis[2] in €/m²	5,13/17,13	5,20	4	gering
	Arbeitslosenquote[3] in %	3,0/21,4	18,9	4	hoch
	Leistungsbez. SGB II in %	5,5/21,2	20,4	4	hoch
Mobilität	Pendlersaldo[4]	-140/275	-85	4	negativ
	Gesamtpendlerquote[5]	234/530	357	4	mittel
	Kraftfahrzeugdichte[5]	369/608	484	4	mittel
	Bildungszuwanderung[5]	-70/114	-45	4	negativ
	Familienabwanderung	-18/0	-10	4	Mittel
Beschäftigte	Im 1. Sektor	0,1/6,5	6,5	4	hoch
	Im 2. Sektor	9/27	18	4	mittel
	Im 3. Sektor	71,15/93,41	76	4	gering
	Anteil Hochbegabter (Arbeitsort)	10,3/25,6	10,3	3	gering
	Anteil Hochbegabter (Wohnort)	8/30,1	9,8	3	gering

Tabelle 7: Kennwerte zu Angermünde-Stolpe10

5.2 Fallbeispiel Bonn

		Benchmark (u./o.)	Wert	n	Wertung
Haushalt	Steuereinnahmen in €/EW	465/487	486	3	hoch
	Gewerbesteueranteil in %	29/121	121	3	hoch
	Schlüsselzuweisung in €/EW	199/471	241	3	gering
Bevölkerung	Medianalter in Jahren	40,5/53,8	40,5	4	gering
	Kaufkraft in €	35.892/76.652	47.600	4	gering
	Mietpreis in €/m²	5,13/17,13	9,1	4	mittel
	Arbeitslosenquote in %	3,0/21,4	9,7	4	mittel
	Leistungsbez. SGB II in %	5,5/21,2	10,9	4	mittel
Mobilität	Pendlersaldo	-140/275	-85	4	negativ
	Gesamtpendlerquote	234/530	357	4	mittel
	Kraftfahrzeugdichte	369/608	484	4	mittel
	Bildungszuwanderung	-70/114	-45	4	negativ
	Familienabwanderung	-18/0	-10	4	mittel
Beschäftigte	Im 1. Sektor	0,1/6,5	0,1	4	gering
	Im 2. Sektor	9/27	9	4	gering
	Im 3. Sektor	71,15/93,41	91,37	4	hoch
	Anteil Hochbegabter (Arbeitsort)	10,3/25,6	25,6	3	hoch
	Anteil Hochbegabter (Wohnort)	8/30,1	30,1	3	hoch

Tabelle 8: Kennwerte zu Bonn

[1] Haushaltsnettoeinkommen
[2] Mittelwert Wohnraum im Stadtzentrum. Quelle: ImmobilienScout24. [IMM2018]
[3] bezogen auf sozialversicherungspflichtig Beschäftigte
[4] pro 1000 EW. Regionalstatistik des Statistischen Bundesamtes für 2017 [STB2018]
[5] Personen pro 1000 EW

5.3 Fallbeispiel Zürich

		Benchmark (u./o.)	Wert	n	Wertung
Haushalt	Steuereinnahmen in €/EW	465/487	k.A.	3	k.A.
	Gewerbesteueranteil in %	29/121	k.A.	3	k.A.
	Schlüsselzuweisung in €/EW	199/471	k.A.	3	k.A.
Bevölkerung	Medianalter in Jahren	40,5/53,8	37,7	4	gering
	Kaufkraft[6] in €	35.892/76.652	76.652	4	hoch
	Mietpreis[7] in €/m^2	5,13/17,13	17,13	4	hoch
	Arbeitslosenquote[8] in %	3,0/21,4	3,0	4	gering
	Leistungsbez. SGB II in %	5,5/21,2	5,5	4	gering
Mobilität	Pendlersaldo[9]	-140/275	-85	4	negativ
	Gesamtpendlerquote[10]	234/530	357	4	mittel
	Kraftfahrzeugdichte[10]	369/608	484	4	mittel
	Bildungszuwanderung[11]	-70/114	-45	4	negativ
	Familienabwanderung	-18/0	-10	4	mittel
Beschäftigte	Im 1. Sektor	0,1/6,5	0,1	4	gering
	Im 2. Sektor	9/27	7	4	gering
	Im 3. Sektor	71,15/93,41	93,41	4	hoch
	Anteil Hochbegabter (Arbeitsort)	10,3/25,6	k.A.	3	k.A.
	Anteil Hochbegabter (Wohnort)	8/30,1	k.A.	3	k.A.

Tabelle 9: Kennwerte zu Zürich

6 QUELLEN

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[6] Haushaltsnettoeinkommen. Quelle: https://www.ub.unibas.ch/digi/a125/sachdok/2016/BAU_1_2762817_4_2015.pdf [STZ2016]

[7] Mittelwert Wohnraum im Stadtzentrum. Quelle: https://www.stadt-zuerich.ch/prd/de/index/statistik/themen/bauen-wohnen/mietpreise/mietpreise-strukturerhebung.html [STZ2018]

[8] bezogen auf sozialversicherungspflichtig Beschäftigte. Quelle: https://www.seco.admin.ch/seco/de/home/Arbeit/Arbeitslosenversicherung/arbeitslosenzahlen.html [STW2018]

[9] Quelle: https://www.bfs.admin.ch/bfs/de/home/statistiken/kataloge-datenbanken/tabellen.assetdetail.7686118.html [BFS2018]

[10] pro 1000 EW. Quelle: https://de.statista.com/statistik/daten/studie/514039/umfrage/pkw-bestand-im-kanton-zuerich/ [STA2018]

[11] Personen pro 1000 EW . Quelle: https://jugendstrafrechtspflege.zh.ch/internet/de/aktuell/news/medienmitteilungen/2017/kanton-zuerich-zieht-junge-leute-an/_jcr_content/contentPar/downloadlist/downloaditems/statistik_info_09_20.spooler.download.1513755458033.pdf/si_2017_09_wanderungen [JUG2018]

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🏆 *reviewed paper*

Läuft mit GIS?! Erhebung von Fußgängerfreundlichkeit mittels mobiler GIS

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1 ABSTRACT

Die Synergien von Gesundheit und räumlicher Planung sind insbesondere dann relevant, wenn man berücksichtigt, dass das Mobilitätsverhalten und die alltägliche körperliche Betätigung auch durch die baulichen Gegebenheiten im Quartier beeinflusst werden. Alltägliche Wege, wie zum nächstgelegenen Bäcker, werden mit dem PKW zurückgelegt, da der Weg zu Fuß oder mit dem Fahrrad in autoorientierten Umwelten unsicher und unkomfortabel erscheint. Zusätzlich wird die Förderung der Gesundheit im Städtebau immer bedeutsamer. Dies ist allerdings in vielen bereits existierenden baulichen Strukturen nicht zu erkennen. Um gesund zu sein und zu bleiben, bedarf es einer ausreichenden täglichen Bewegung, welche leicht in den Alltag zu integrieren sein sollte – in fußgängerunfreundlichen Strukturen ist das allerdings schwer zu bewältigen. Aufgrund dieser Problematik ist die Entwicklung von Methoden zur Identifizierung ebendieser fußgängerunfreundlichen Strukturen ein sehr aktuelles Thema in der räumlichen Planung, um daraus Handlungsmöglichkeiten ableiten zu können. Das vorliegende Paper knüpft an diese gegenwärtige Thematik an, indem anhand eines konkreten Beispiels die Erörterung der Fragestellung im Mittelpunkt steht, ob und inwiefern die Erhebung von Fußgängerfreundlichkeit zu gesundheitsörderlichen Strukturen beitragen kann.

Bei dem konkreten Beispiel handelt es sich um das Projekt Walkability in der Praxis, welches vom Institut für Stadtplanung + Städtebau (ISS) der Universität Duisburg-Essen für das Landeszentrum für Gesundheit NRW (LZG.NRW) von Februar bis November 2018 durchgeführt wurde. Innerhalb des Projekts stand die Durchführung von drei Aktionstagen mit dem Schwerpunkt Walkability im Fokus, mit dem Ziel die Fußgängerfreundlichkeit von ausgewählten Routen zu berechnen. Die Aktionstage bestanden aus Walk-Audits (Begehungen) von zuvor festgelegten Routen in drei verschiedenen Quartieren in Nordrhein-Westfalen, die zusammen mit Bewohnenden der Quartiere durchgeführt wurden. In einzelne Segmente unterteilt, konnte mit Hilfe der App ArcGIS Collector die Walkability der verschiedenen Strecken ermittelt werden. Zusätzlich konnte das Projekt die Teilnehmenden für die Chancen und Herausforderungen des Fußverkehrs sensibilisieren. Der Aufbau des vorliegenden Papers gliedert sich wie folgt: Zunächst wird in einer kurzen Einleitung in die Thematik und die Verknüpfung von gesundheitlichen Belangen und räumlicher Planung eingeführt. Der Stand der Forschung behandelt verschiedene Methoden zur Erhebung von Walkability und schafft die Grundlage für die anknüpfende Vorstellung des genutzten Tools für das Projekt Walkability in der Praxis. Darauf aufbauend sind die praktische Umsetzung und der Ablauf der Aktionstage dargestellt. In einem letzten Schritt folgt die Darstellung der Ergebnisse und eine Reflexion zum Projekt und dem genutzten Tool.

Keywords: Walkability, Gesundheit, Räumliche Planung, Mobilitätsverhalten, GIS

2 EINLEITUNG

Der „Health in All Policies“-Ansatz, eine Strategie der WHO, verfolgt die Absicht das Themenfeld Gesundheit in alle Ressorts und Ebenen des öffentlichen Dienstes zu integrieren. Infolgedessen sind gesundheitliche Belange wie beispielsweise Prävention, Gesundheitsförderung und gesundheitliche Versorgung in die Disziplinen der Mobilitäts- und Stadtplanung eingebunden und darüber auch in das Setting (Lebenswelt) der Kommune. (Köckler, Fehr, 2018) Die Notwendigkeit der Verknüpfung von gesundheitlichen Belangen und räumlicher Planung wird dementsprechend auch auf der normativen Ebene in § 1 Abs. 6, Nr. 1 BauGB ersichtlich: „Bei der Aufstellung der Bauleitpläne sind insbesondere zu berücksichtigen: die allgemeinen Anforderungen an gesunde Wohn- und Arbeitsverhältnisse und die Sicherheit der Wohn- und Arbeitsbevölkerung“ (BauGB, 2018).

„Stadtplanung und Gesundheit sind seit jeher eng miteinander verbunden; darin liegt der Ursprung des stadtplanerischen Berufsstandes. Die Zusammenhänge sind allerdings in Vergessenheit geraten und die Sektoren von Planung, Entwicklung und Gesundheit sind heute weitaus weniger eng miteinander vernetzt, als sie es in der Vergangenheit einmal waren“ (Baumeister et al., 2016).

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Das Zitat aus dem Leitfaden Gesunde Stadt, herausgegeben vom LZG.NRW, hebt sehr präzise und auf einen Blick die heutige unzureichende Verknüpfung des Städtebaus mit dem Gesundheitswesen hervor. In der Vergangenheit nahmen gesundheitliche Ziele in der Stadtplanung immer eine wichtige Stellung ein. So wurden bereits in der mittelalterlichen Stadt auf Grund der dichten Bebauung Regelungen für den Brandschutz getroffen und Nutzungsrestriktionen für Gerbereien vorgenommen. (Baumgart, 2018) Als weiteres Beispiel für die Zusammenhänge zwischen Stadtplanung und Gesundheit sei an dieser Stelle die Charta von Athen genannt, welche zur Zeit der Industrialisierung durch die Funktionsteilung von Arbeiten und Wohnen vor allem auf eine bessere Belüftung und Beleuchtung der Quartiere abzielte, um die hygienischen Umstände zu verbessern. (Kistemann, Ritzinger, 2018) Heutzutage erfolgt die Einbringung der Belange des Gesundheitswesens in den Planungsprozess viel zu spät, bisweilen findet sie sogar überhaupt nicht statt (Frinken, 2018). Somit sind viele bereits gebaute Strukturen nicht gesundheitsfördernd. Dies heißt konkret, dass viele Menschen keinen Zugang zu niedrigschwelligen und attraktiven Angeboten zur körperlichen Ertüchtigung haben. Dazu zählt auch die einfachste von allen Bewegungsarten: das Zufußgehen. (Schmidt et al., 2018) Durch autoorientierte Straßenwelten ist selbst diese oftmals nur eingeschränkt möglich (Gehl, 2016). Auf Grund dieser Vernachlässigung der Gesundheitsaspekte in der Stadtplanung ist also keine Chancengleichheit bezüglich der Möglichkeiten auf ein gesundes Leben und ein gesundheitsförderndes Umfeld gegeben (AFOOT-Projektteam, 2018).

Durch den ganzheitlichen Ansatz der nachhaltigen Stadtentwicklung ist vor allem die Förderung alternativer und umweltfreundlicher Verkehrsmittel zum MIV in den Vordergrund gerückt. Der Umweltverbund hebt somit vor allem auch wieder das Zufußgehen als die einfachste Form der Fortbewegung hervor. Lange Zeit waren die Beine das einzige Fortbewegungsmittel für den Menschen, darüber hinaus musste Nahrung aus eigener Kraft erbeutet werden (Microsoft Encarta 2005). Auch bei näherer Betrachtung der Anatomie des Menschen ist deutlich zu erkennen, dass der Körper zum Laufen konzipiert ist (Werthern 2005). Heutzutage überwiegt allerdings eine bequeme Lebensweise, die Fortbewegung findet größtenteils motorisiert ohne körperliche Anstrengung statt (Bauer et al., 2018). Jedoch braucht der Mensch Bewegung, um den Kreislauf und die Organe mit genügend Sauerstoff zu versorgen. Verschiedene Studien haben bestätigt, dass tägliche Bewegung die Lebenserwartung erhöht und das Risiko von Übergewicht und Herz-Kreislauf-Erkrankungen verringert. (Powell et al., 2011)

Obwohl das Zufußgehen nur positive Auswirkungen auf die Umwelt generiert, unterstützt die heutige Lebensweise diese Form der Fortbewegung nicht. Da die Walkability als ganzheitlicher Ansatz zu betrachten ist, profitieren viele weitere Bereiche durch die Förderung der Fußgängerfreundlichkeit. Die Kosten für das Gesundheitswesen könnten gesenkt werden, wenn eine aktivere Lebensweise bevorzugt wird (Bauer et al., 2018). Durch diese Aktivitätssteigerung verringert sich die Anzahl der Erkrankungen mit nicht übertragbaren Krankheiten, wie zum Beispiel Herzleiden und Adipositas (WHO, 2018). Darüber hinaus führen eine aktivere Lebensweise und eine höhere Lebenserwartung zu einer produktiveren Volkswirtschaft, somit entstehen vor allem auch für die Wirtschaft positive Impulse. In der Fußverkehrsstrategie des Deutschen Instituts für Urbanistik heißt es beispielsweise: „Berufstätige, die zu Fuß oder mit dem Fahrrad zur Arbeit kommen, haben ein Drittel weniger Krankheitstage pro Jahr und einen deutlich niedrigeren Body-Mass-Index“ (Bauer et al., 2018). Überdies kann vor allem die Umwelt großen Nutzen aus der Förderung des Fußverkehrs ziehen. Fußverkehr nimmt weniger Platz in Anspruch als der MIV, daher können viele Flächen wie Straßen oder Parkplätze umgestaltet und beispielsweise zu Grünflächen mit Aufenthaltscharakter umgestaltet werden, wenn mehr Menschen zu Fuß gehen. Die Begrünung von Flächen und die Verringerung des MIV trägt ebenfalls zur Verbesserung des Klimas und der Luftqualität bei. (Tran, 2016) Eine gut ausgebaute Fußgängerinfrastruktur in der Innenstadt kann zu mehr Laufkundschaft führen und die Kaufkraft erhöhen. Innenstädte wirken attraktiver und sicherer auf Menschen, wenn sie belebt sind. Die Fußgängerzonen werden als Verweilort oder zum Flanieren genutzt (Gehl, 2016). Jan Gehl formulierte hierzu sehr passend „Der Mensch ist des Menschen größte Freude“ (Gehl, 2016).

3 STAND DER FORSCHUNG

Das folgende Kapitel stellt den aktuellen Stand der Forschung bezüglich der Einbeziehung von gesundheitlichen Belangen in der räumlichen Planung dar. Darüber hinaus erfolgt eine Darstellung der technischen Methoden, um Walkability zu erheben.

3.1 Gesundheitliche Belange in der räumlichen Planung

Die Erforschung des Zusammenhangs von gebauter Umwelt und Gesundheit ist in den letzten Jahren immer weiter vorangeschritten. Es existiert bereits eine Vielzahl an Publikationen, welche diesen Zusammenhang bestätigen und erläutern (Baumeister et al., 2016). Unter anderem ist dieser Zusammenhang Thema der Arbeitshilfe Aktive Mobilität im Alter fördern. Diese wurde von Mitarbeitenden des Institutes für Public Health und Pflegeforschung der Universität Bremen und der Fakultät Raumplanung der TU Dortmund verfasst und durch das Bundesministerium für Bildung und Forschung (BMBF) gefördert. In dieser Publikation wird darauf aufmerksam gemacht, dass unter anderem auch „[…] der Einfluss der gebauten Wohnumwelt auf gesundheitsbezogene Verhaltensweisen, wie z. B. die körperliche Aktivität“ (AFOOT-Projektteam, 2018) relevant ist. Ebenso ist in dem Buch Walkability – Das Handbuch zu Bewegungsförderung in der Kommune, herausgegeben von Jens Bucksch und Sven Schneider, nachzulesen: „Wissenschaftlich ist belegt, dass Gesundheitsbelastungen infolge von Bewegungsmangel im Zusammenhang mit der Stadtentwicklung der letzten Jahrzehnte stehen und Risiken wie Bluthochdruck oder Übergewicht und Fettleibigkeit mit sich bringen, einhergehend mit modernen inaktiven Lebensweisen“ (Bucksch, 2014). Durch die vermehrte Thematisierung dieses Zusammenhangs in Fachkreisen wird die Wichtigkeit und Aktualität dieser Synergieeffekte deutlich. Die zuvor genannten Publikationen sind nur wenige Beispiele aus vielen.

Auch im englischsprachigen Raum wird dieses Themenfeld schon länger diskutiert und erforscht. Das Forschungsprojekt Identifying and Measuring Urban Design Qualities Related to Walkability baut ebenfalls auf dem Grundsatz auf, dass mehrere Forschungsergebnisse Beweise dafür liefern, dass es eine Verbindung zwischen der gebauten Umwelt und aktiver Bewegung gibt (Ewing et al., 2006). Diese Studie bildet außerdem den konzeptionellen Rahmen für das genutzte IWAM-Tool (s. Kap. 4).

Die WHO rief bereits 1986 in der Ottawa-Charta zur Gesundheitsförderung zum aktiven Handeln für das Ziel Gesundheit für alle auf und schon hier wurde die Stadtentwicklung als wichtiger Faktor für die Gesundheit thematisiert (WHO, 1986). In Einklang mit diesen Zielen und Grundsätzen der WHO wurde in Deutschland das Präventionsgesetz (PrävG) verabschiedet (Kolip, 2014). Durch das 2015 in Kraft getretene Gesetz sollen Prävention und Gesundheitsförderung in den Ländern und den Kommunen verstärkt als gemeinsame Aufgabe mit den Sozialversicherungsträgern gestaltet werden (Bundesministerium für Gesundheit, 2018). Minh-Chau Tran fand zu dieser Verknüpfung in einem Aufsatz aus dem Jahre 2016 eine sehr passende Formulierung. So dürfe die gesundheitsförderliche Stadt „nicht nur ein Ziel des Gesundheitssektors“ bleiben, sondern müsse „auch zu einem Leitbild nachhaltiger Stadtentwicklung gehören“ (Tran, 2016).

3.2 Erhebung von Walkability

Aus einer Studie des Bundesministeriums für Umwelt, Naturschutz, Bau und Reaktorsicherheit (BMUB) aus dem Jahre 2016 mit dem Thema Umweltbewusstsein in Deutschland geht hervor, dass drei Viertel aller befragten Autofahrer häufiger kurze Strecken zu Fuß zurücklegen würden, wenn die Bedingungen für das Zufußgehen verbessert werden würden (BMUB, 2017). Um das Zufußgehen zu fördern und die Bedingungen zu verbessern, müssen allerdings zunächst die vorherrschenden Strukturen erhoben und gemessen werden. Dies gestaltet sich jedoch kompliziert, da keine Daten für den Fußverkehr vorhanden sind und somit erst erhoben werden müssen. Darüber hinaus wird das Zufußgehen in Verkehrserhebungen häufig nicht als eigenständiges Fortbewegungsmittel angesehen, da diese Erhebungen die Wege nach dem überwiegend genutzten Verkehrsmittel betrachten. Somit wird der Weg zu Fuß bei intermodaler Fortbewegung beispielsweise nicht aufgenommen. (Bauer et al., 2018) Um das Zufußgehen zu fördern, sollten also mehr Informationen von Fußgängern für Fußgänger verfügbar sein.

Diese Problematik wird in Fachkreisen schon länger diskutiert, daher wurden bereits diverse Methoden entwickelt, um die Walkability zu erheben und zu messen. Durch das sogenannte Crowdmapping oder andere Online-Tools existieren bereits viele Plattformen, welche die Fußgängerfreundlichkeit in bestimmten Gebieten bewerten. Bei den Online-Tools handelt es sich dabei zumeist um einen automatisierten Algorithmus, welcher bestimmte Parameter der Makroebene aufnimmt und auf Grundlage dieser einen Walkability-Index erhebt. Eine solche Plattform ist beispielsweise die Internetseite https://www.walkscore.com/. Diese berechnet für jede Adresse einen Walk Score, Bike Score sowie Transit-Score auf einer Skala von 0 (schlechteste Bewertung) bis 99 (beste Bewertung). (Walk Score, 2019b) Die

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Webseite wirbt vor allem damit, die sicherste und fußgängerfreundlichste Nachbarschaft zu finden (Walk Score, 2019a). Jedoch ist der Walk-Score nur für die USA konzipiert und funktioniert in ländlichen Bereichen nur bedingt.

Die Durchführung und Entwicklung von Forschungsprojekten, um Walkability messbar zu machen, fanden größtenteils im außereuropäischen Raum statt (Buck, Tkaczick, 2014). Dabei konzentrieren sich die Arbeiten auf unterschiedlichste Betrachtungsräume und -ebenen mit verschiedensten räumlichen Gegebenheiten. Daher beschreibt jede Studie eine auf die vorherrschende Situation individuell angepasste Vorgehensweise und Methode, die Walkability zu erheben. Damit diese Erhebung messbar ist, werden sogenannte Walkability-Indizes errechnet. Diese setzen sich aus verschiedensten erhobenen Parametern zusammen und machen es mithilfe einer skalierten Zahl möglich, die Walkability in einem Untersuchungsgebiet zu bewerten. (Buck, Tkaczick, 2014) Eine solche quantitative Methodik bedarf jedoch einer Interpretation durch qualitative Methoden und ein solcher Methodenmix ist in der Praxis bereits weit verbreitet. Eine reine quantitative Bewertung der Fußgängerfreundlichkeit ist nicht geeignet und möglich, da somit der Bezug zur Realität entfällt, welche nicht durch die alleinige Nutzung von quantitativen Methoden erfassbar ist. (Benz, 1998) In der der räumlichen Planung ist die Anwendung von qualitativen Methoden wie Szenarien oder Karteninterpretationen eine zielführende Methode, um „[…] Erkenntnisse über die Struktur und die Funktionsweise der Realität zu gewinnen sowie zu rationalen Urteilen und Entscheidungen zu gelangen“ (Benz, 1998).

Die quantitativen Methoden zur Erhebung der Walkability lassen sich in zwei verschiedene räumliche Betrachtungsebenen einteilen: Zum einen in die Makroebene und zum anderen in die Mikroebene. Die Makroebene betrachtet ganze Viertel oder sogar Städte, die Mikroebene hingegen betrachtet sehr detailliert einzelne Straßenzüge. Nicht selten werden beide Ebenen miteinander verknüpft, um einen aussagekräftigen Walkability-Index zu berechnen. In diesem Fall erweitert sich auch das angewandte Methodengeflecht der Studie. Exemplarisch wurden zehn Studien genauer betrachtet und miteinander verglichen. Die meisten der näher betrachteten Studien nutzen als Grundlage bereits bestehende Fragebögen, Indikatoren oder Parameter und passen diese nach den eigenen Bedürfnissen an. In den seltensten Fällen ist in den Studien die Entwicklung einer gänzlich neuen Methode gegeben, viel mehr ist die Literatur zur Walkability als ein aufeinander aufbauendes Gerüst mit jeweils kleinen Ergänzungen oder neuen Aspekten zu betrachten. In diesen Kontext kann auch das Projekt Walkability in der Praxis, welches im Fokus dieses Papers steht, eingebettet werden. Die Messungen zur Walkability können darüber hinaus auch Zielgruppenorientiert vorgenommen werden. Vor allem Senioren, Erwachsene oder Schulkinder werden in den Fokus der Studien gestellt (Titze, Reimers, 2014).

In den zehn Forschungsprojekten wurden vor allem Fragebögen, Walk-Audits und GIS-Analysen genutzt, um die Fußgängerfreundlichkeit zu erheben. Die GIS-Analysen konzentrieren sich überwiegend auf die Makroebene und bewerten großmaßstäbliche Parameter wie Kreuzungsdichte (Brownson et al., 2009), während Walk-Audits ausschließlich die Mikroebene betrachten und dabei sowohl qualitative als auch quantitative Parameter erheben (Titze, Reimers, 2014). Fragebögen können sowohl auf Mikro- als auch auf Makroebene angewendet werden. Da jede Studie an die gegebenen Umstände angepasst werden muss, ist jedes angewendete Tool verschieden und die Literatur zur Erhebung der Walkability stellt eine „unüberschaubare Vielfalt“ (Titze, Reimers, 2014) dar.

Auf dem Gebiet der Verknüpfung zwischen der gebauten Umwelt und aktiven Lebensweisen ist vor allem Reid Ewing ein populärer Autor. Die meisten Studien zitieren seine Werke oder nehmen seine Erkenntnisse als konzeptionellen Rahmen. Auch das Projekt Messung und Erfassung der Fussgängerfreundlichkeit von Stadträumen nutzt als Grundlage für die Studie das Konzept von Ewing und Clemente aus dem Jahre 2013 (Manz et al., 2017).

4 INTEGRIERTER WALKABILITY AUDIT AUF MIKROEBENE (IWAM)

Zur Erhebung der Fußgängerfreundlichkeit in dem Projekt Walkability in der Praxis wurde das Tool IWAM genutzt, die Abkürzung steht für Integrierter Walkability Audit auf Mikroebene. Die Entwicklung des IWAM-Tools fand bereits 2017 am ISS der Uni Duisburg-Essen durch das Projekt Messung und Erfassung der Fussgängerfreundlichkeit von Stadträumen statt. Innerhalb des Projektes wurde eine GIS-basierte Analyse gemischt genutzter Quartiersgebiete mit Hilfe von IWAM am Fallbeispiel Essen durchgeführt. Die Studie untersuchte die Fußgängerfreundlichkeit für verschiedene Stadtteile der Stadt Essen. Dabei wurden

sowohl Methoden für die Makro- als auch für die Mikroebene angewandt. Für die Mikroebene wurden sieben Stadtteile ausgewählt, in welchen die Untersuchung mit IWAM erfolgte. So wurden insgesamt 99 Straßensegmente erfasst und erhoben. (Manz et al., 2017) Das Unterscheidungsmerkmal des IWAM-Tools im Vergleich zu anderen Audit-Tools besteht darin, dass IWAM einen digitalen Fragebogen enthält. Mittels ArcGIS Collector, einer App für mobile Endgeräte, ist die Erfassung der Kriterien des Fragenkataloges innerhalb der Walk-Audits kurzerhand digital möglich. Dies ermöglicht die Einbeziehung der Werte in die weitere Bearbeitung mit GIS und die Berechnung des Integrierten Walkability Index (IWI). Da der ArcGIS Collector mit ArcGIS der Firma ESRI verknüpft ist, muss ArcGIS für die Durchführung des Audit-Tools genutzt werden. (Schmidt et al., 2018) Wie bereits in Kapitel 3.2 Erhebung von Walkability angesprochen, fungiert als konzeptioneller Rahmen für das Projekt Messung und Erfassung der Fussgängerfreundlichkeit von Stadträumen das Konzept von Ewing und Clemente aus dem Jahre 2013. In ihrer Veröffentlichung Measuring Urban Design. Metrics for Livable Places, wie auch schon in vorherigen Studien, gehen sie darauf ein, dass die gebaute Umwelt einen maßgeblichen Einfluss auf die Aktivität der Menschen hat und untermauern diese Aussage mit Ergebnissen aus durchgeführten Forschungsprojekten. Auf Grundlage dieser Literatur wurde der genutzte Fragenkatalog entworfen, mit welchem die Walkability in den sieben Essener Stadtteilen erhoben wurde (Manz et al., 2017). Für das Projekt Walkability in der Praxis, welches ebenfalls das IWAM-Tool nutzte, wurde der Aufbau des Fragenkataloges übernommen und angepasst. Die größte Herausforderung bei der Adaption von IWAM für das Projekt Walkability in der Praxis lag darin, den Fragenkatalog anzupassen und für mehrere Personen gleichzeitig auf unterschiedlichen Tablets zur Verfügung zu stellen, sowie die erhobenen Werte von mehreren Personen zu einem Index zusammenzufassen.

Gehweg Formel
(([Gehwegbreite] * 32,6) + ([Trennung zwischen Gehweh und Fahrbahn] * 25,4) + ([Hindernisse auf Gehweg] * 22,2) +
([Verhältnis von Gehweg zu Fahrbahn] * 19,8)) / 100

Straße Formel
(([Kreuzungssituation] * 33,2) + ([Fußgängerüberweg] * 25,9) + ([Geschwindigkeitsbegrenzung] * 25,9) + ([Parkende Autos] * 15)) / 100

Grün Formel
(([Bäume] * 62,3) + ([Weiteres Grün] * 37,7)) / 100

Öffentliche Anlagen und Infrastruktur Formel
(([Sitzmöglichkeiten] * 31,7) + ([Fahrradständer] + 28) + ([Haltestellen] * 40,3)) / 100

Physical Features Index Formel (PFI)
(([Gehweg] * 30) + ([Straße] * 35) + ([Grün] * 15,625) + ([ÖAI] * 19,375)) / 100

Urban Qualities Index (UQI)
(([Landmarken] * 5,4) + ([Zustand des Straßenraums) * 8,1) + ([Verschmutzung] * 5,2) + ([Einzelhandelsgeschäfte] * 6,6) +
([Geschäftsbereiche] * 5,4) + ([Gastronomie] * 6,6) + ([Gastronomie mit Außenbereich] * 7,3 + ([Platz] * 8) + ([Leerstand] * 4,8) +
([Kunstobjekte] * 4,2)) / 61,6

Integrierter Walkability Index Formel
(([PFI] * 59,5) + ([UQI] * 40,5)) / 100

Abb. 1: Formel des IWI (eigene Darstellung nach Manz et al. 2017)

Der Kriterienkatalog beinhaltet jene Fragen, welche für das IWAM-Tool während des Walk-Audits beantwortet werden. Jeder Frage sind zwei bis fünf Antwortmöglichkeiten vorgegeben, diesen Antworten sind jeweils Punkte mit der Wertung 1 bis 5 zugeordnet. Aus den beantworteten Fragen und dem Einfügen der Punkte in eine eigens entwickelte Formel ergibt sich somit der IWI. Der Kriterienkatalog ist mittels der App ArcGIS Collector auf Tablets während des Walk-Audits abrufbar, um somit das Ausfüllen während der Begehung zu ermöglichen. Wie bereits angesprochen, orientieren sich die Fragen des Projektes Walkability in der Praxis an dem Projekt in Essen. Da im Fokus des Projektes Walkability in der Praxis jedoch drei verschiedene Quartiere stehen (Ahlen-Ost, Selm Bork und Höhe in Wuppertal), welche sich grundlegend von Essen unterscheiden, war eine Anpassung der Fragen notwendig. Viele Kriterien wurden entfernt und durch neue ersetzt. Beispielsweise ist die Frage der Erhebung nach einer aktiven Tramlinie auf der Straße in allen drei untersuchten Quartieren überflüssig, da dort keine Trams fahren (siehe Projektbericht Walkability in der Praxis, Abbildung 2). Zur Ergänzung und Erstellung eines auf die Gegebenheiten angepassten Kriterienkatalogs wurden zunächst bereits bestehende Audit-Tools untersucht. Wie bereits in Kapitel 3.2. Erhebung von Walkability herausgestellt, verhält es sich für den Kriterienkatalog des Projektes Walkability in der Praxis ebenfalls so, dass der Katalog auf anderen Studien aufbaut und an die jeweilige Umgebung angepasst wurde.

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Der Aufbau der Kriterienkataloge für Essen, Ahlen-Ost, Selm Bork und Höhe in Wuppertal orientiert sich an dem konzeptionellen Rahmen von Ewing und Clemente. Dieser besagt unter anderem, dass Walkability auf kleinmaßstäblicher Ebene, also auf der Mikroebene, erhoben werden muss. Die Makroebene spiegelt zu undetaillierte Ergebnisse wider, welche keine aussagekräftigen Rückschlüsse auf die Fußgängerstruktur zulassen. Ewing und Clemente betrachten die gebaute Umwelt auf drei verschiedenen Ebenen und haben auf Grund dessen ebenfalls drei verschiedene Indizes zur Erhebung der Fußgängerfreundlichkeit entwickelt. Darüber hinaus werden die subjektive und die objektive Wahrnehmung in diesen Ebenen berücksichtigt. Die objektiven und messbaren Gegebenheiten der Umwelt, wie beispielsweise die Breite des Gehwegs, werden in die Ebene der physischen Eigenschaften gegliedert. Diese sind in den Studien durch den Physical Features Index (PFI) ausgedrückt. Da es sich auf dieser Ebene jedoch nur um die rein objektive Betrachtung des Straßenraumes handelt und die Qualität nicht berücksichtigt wird, sondern nur das Vorhandensein von Merkmalen, werden in einer weiteren Ebene qualitative und zum Teil subjektive Merkmale aufgenommen. Diese Ebene spiegelt sich in dem Urban Design Quality Index (UQI) wider, also den städtebaulichen Qualitäten. Anhand dieses Index kann ein Gesamteindruck des Straßenraums aufgenommen werden, indem Merkmale wie Leerstand oder Attraktivität aufgenommen werden. In der dritten Ebene, der individuellen Wahrnehmung wird die subjektive Betrachtung des Straßenraumes aufgenommen und somit werden Gefühle, wie zum Beispiel Sicherheit oder Unbehagen, in die Bewertung mit aufgenommen. Die individuelle Wahrnehmung wurde in beiden Studien durch einen weiteren analogen Fragebogen, unabhängig von ArcGIS Collector, aufgenommen. Der individuellen Wahrnehmung liegen keine Werte zugrunde, da die subjektive Einschätzung nicht quantifiziert wurde und somit nicht in die Berechnung des IWI mit einfloss. Daher ist diese als ergänzende Befragung anzusehen. (Manz et al., 2017) Infolgedessen bilden der PFI und der UQI den IWI (s. Abb. 1). Da UQI und PFI jedoch Objektivität und Quantität ausdrücken, müssen die Kriterien dieser Ebenen untereinander und gegeneinander gewichtet werden, um eine reliable Berechnung des IWI zu gewährleisten. Diese Gewichtung führte ein Expertenpanel aus den Bereichen Raumplanung, Stadtplanung und Architektur durch (siehe Abbildung 2). Diese Bewertung wurde prozentual errechnet und ebenfalls in die Formel zur Berechnung des IWI miteinbezogen. Der vollständige Kriterienkatalog für das Projekt Walkability in der Praxis findet sich im Projektbericht, dieser ist abrufbar auf der Internetseite des Instituts für Mobilitäts- und Stadtplanung (imobis) unter dem Reiter abgeschlossene Projekte (siehe Abbildung 2). Die Fragen für Ahlen-Ost, Selm Bork und Höhe in Wuppertal sind größtenteils identisch. Der Kriterienkatalog besteht insgesamt aus dreiundzwanzig Fragen, dabei sind dreizehn Fragen den physischen Eigenschaften und zehn Fragen den städtebaulichen Qualitäten zuzuordnen (Schmidt et al., 2018). In Selm Bork wurde die Frage nach Kunstobjekten aus den städtebaulichen Qualitäten entfernt, da auf der Route keine Kunstobjekte vorhanden waren. In Höhe fielen drei Fragen weg, dies waren die Kriterien Verhältnis zwischen Gehweg und Fahrbahn der physischen Eigenschaften und Kunstobjekte sowie Leerstand aus der Kategorie der städtebaulichen Qualitäten.

Abb. 2: QR-Code zum Projektbericht Walkability in der Praxis mit vollständigem Fragenkatalog https://www.uni-due.de/imperia/md/content/imobis/walkability_in_der_praxis_gesamtbericht.pdf

5 AKTIONSTAGE

Durch einen Vortrag über das Projekt Messung und Erfassung der Fussgängerfreundlichkeit von Stadträumen von Frau Dr.-Ing. Minh-Chau Tran wurde das LZG.NRW auf das IWAM-Tool (s. Kap. 3) aufmerksam. Das LZG.NRW beschäftigt sich unter anderem mit Gesundheitsprävention und -förderung. Diese richtet sich nach dem sogenannten Setting-Ansatz, also den Umgebungen, in denen Menschen den

Großteil ihres Lebens verbringen (LZG.NRW, 2012). Dies betrifft auch die gebaute Umwelt: ist diese fußgängerfreundlich gestaltet, kann dies zu einem aktiveren Lebensstil führen (s. Kap. 2). Daher hat das LZG.NRW eine Kooperation mit dem ISS in Form des Projektes Walkability in der Praxis durchgeführt. Somit kann die Brücke zu Kapitel 2 dieses Papers geschlagen werden. Gesundheitsförderung muss in allen Bereichen mitgedacht und eingebunden werden, das Projekt Walkability in der Praxis aus dem Jahr 2018 ist ein anschauliches Beispiel für die Zusammenarbeit zwischen dem Gesundheitssektor (LZG.NRW) und der Stadtplanung (ISS), um die Umwelt nachhaltig und nach gesundheitsfördernden Gesichtspunkten zu gestalten.

Für die Anwendung des IWAM-Tools hat das LZG.NRW drei Projektpartner der Altengerechte Quartiere NRW ausgewählt. Das Konzept der Altengerechten Quartiere NRW besteht darin, eine auf den demografischen Wandel orientierte Quartiersentwicklung zu gestalten und zu fördern. Vor allem Nordrhein-Westfalen als Bundesland mit der größten Einwohnerzahl Deutschlands hat sehr unterschiedlich geprägte Regionen und jede Region und jedes Quartier hat andere Bedürfnisse und benötigen eine individuell angepasste Entwicklungssteuerung. (Landesbüro altengerechte Quartiere.NRW, 2018)

Die Durchführung der Aktionstage fand in den drei Quartieren Ahlen Ost, Selm Bork und Höhe in Wuppertal Vohwinkel statt. Diese drei Quartiere sind jeweils in ihrer Beschaffenheit völlig unterschiedlich. Aus diesem Grund unterscheiden sich auch alle drei Kriterienkataloge der Walk-Audits.

5.1 Praktische Umsetzung

Die Durchführung des Aktionstages gestaltete sich wie folgt: zunächst wurden alle Teilnehmende und Beteiligte begrüßt und vorgestellt. Zusätzlich wurde auf das Team des ISS hingewiesen, welches mit dem Umgang der Tablets vertraut ist und bei Bedarf Hilfestellung leisten kann. Vor allem für ältere und mobilitätseingeschränkte Personen ist diese Unterstützung unerlässlich. Nach der Begrüßung folgte ein kurzer Vortrag zum Anlass des Projektes und um die Teilnehmenden für das Thema der Fußgängerfreundlichkeit zu sensibilisieren. Dies wurde unter anderem durch gelungene Beispiele von umgestalteten Straßenräumen erreicht. Die Präsentation wurde darüber hinaus genutzt, um die Funktionsweise der Tablets zu erklären. Auf die Einführung folgte die Vergabe der Tablets. An jedem Aktionstag konnten alle Teilnehmenden und Interessierten der Walk-Audits mit Tablets ausgestattet werden. Viele der Teilnehmenden griffen auf das Hilfspersonal des ISS zurück und es bildeten sich während des Walk-Audits überwiegend Gruppen aus zwei Personen. Durch eine Quick-Auswertung des Walk-Audits nach der Begehung war eine anschließende Diskussion über die Ergebnisse mit allen Beteiligten möglich. Außerdem konnte somit sofort Feedback zur genutzten Methode eingeholt werden. Nach der Diskussionsrunde zu den ersten Ergebnissen endete der Aktionstag. Die detaillierte Auswertung der Ergebnisse wurde ebenfalls durch das Erhebungspersonal des ISS vorgenommen und in dem Bericht Walkability in der Praxis von Schmidt et al. dokumentiert.

5.2 Ergebnisse der Walk-Audits

Die Berechnung der Ergebnisse der Walk-Audits wurde mit GIS durchgeführt und anschließend in eine Excel-Tabelle übertragen. Für eine detaillierte und aussagekräftige Bewertung im Rahmen des Abschlussberichtes Walkability in der Praxis (Schmidt et al., 2018) wurden fünf Personengruppen aus den Teilnehmenden für die Auswertung gebildet: Gesamte, weibliche, männliche, 18-59-Jährige und 60-79-Jährige Teilnehmende. Die Altersgruppen sowie die Geschlechter wurden mit den gesamten Teilnehmenden verglichen, um mögliche Problemfelder und somit Handlungsbedarf für die begangenen Routen aufzudecken und Erkenntnisse für die Stadtplanung zu generieren. (Schmidt et al., 2018) Abbildung 2 bezieht sich auf die Mittelwerte der IWI verschiedener Personengruppen sowie auf die Kriterien. Der IWI stellt einen Wert im Bereich von 1 bis 5 dar, 1 ist die schlechteste und 5 die beste Bewertung. In Abbildung 2 sind die verschiedenen Bewertungen der Personengruppen abgebildet. Hier gibt es augenscheinlich nur geringe Abweichungen zwischen der gesamten Bewertung und den weiblichen, männlichen, 18-59-jährigen und den 60-79-jährigen Teilnehmenden. Auffällig ist außerdem, dass kein Segment und kein Kriterium mit der höchsten Punktzahl von 5 bewertet wurden. Die schlechteste Bewertung von 1 wurde in Höhe im Rahmen der Kriterien (Fußgängerüberwege an Kreuzungen) vergeben. Der angegebene IWI stellt die Walkability für die gesamte Route dar. Daher ist es unabdingbar, auf die einzelnen Segmente und Kriterien einzugehen; in Abbildung 2 sind diese Unterschiede erkennbar. Zur ausführlichen Darstellung der Auswertung der

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Ergebnisse fungiert der Walk-Audit in Selm Bork als Fallbeispiel. Nach erster Rücksprache mit den Akteuren der Stadt Selm konnte bestätigt werden, dass die Ergebnisse des Walk-Audits mit den Erkenntnissen und Zielen der Stadt Selm für Bork übereinstimmen.

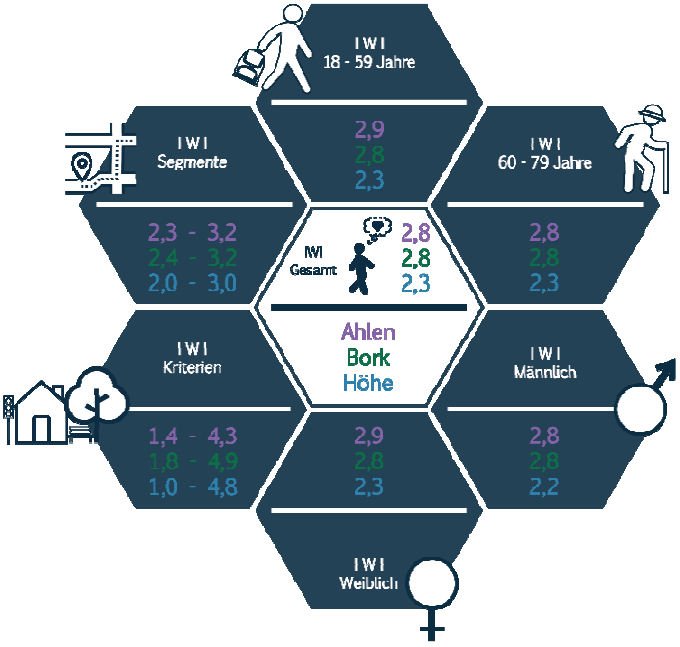

Abb. 3: Ergebnisse der Walk-Audits (eigene Darstellung nach Schmidt et al. 2018)

6 POTENZIALE DER DATENSÄTZE

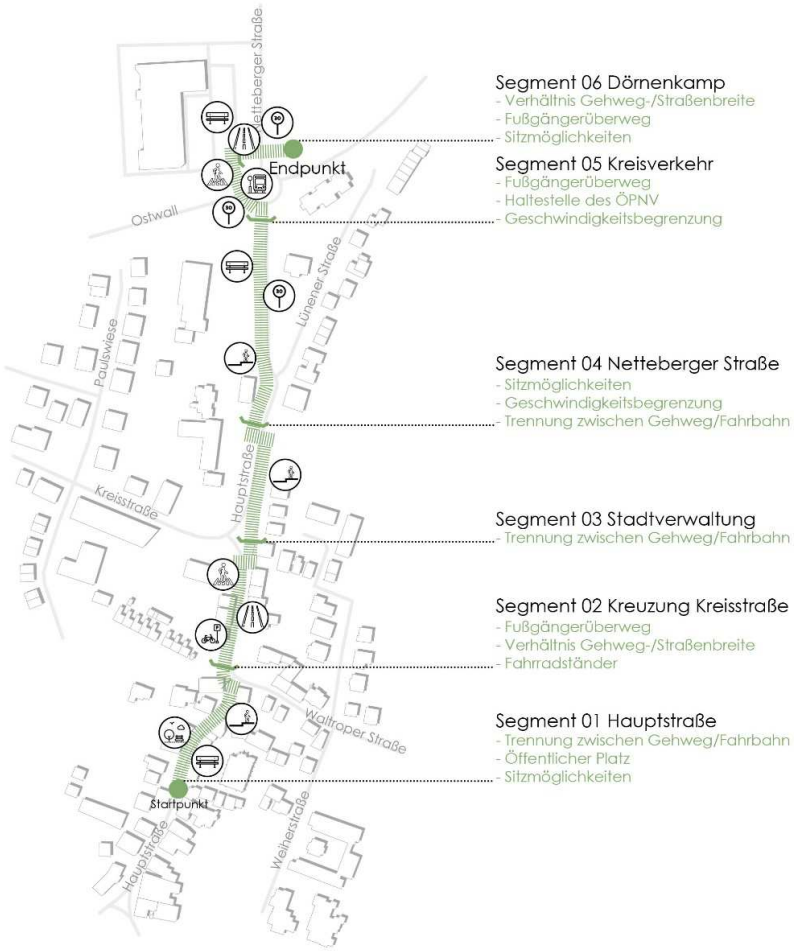

Abb. 4: Maßnahmenvorschläge für Selm-Bork (Schmidt et al. 2018)

Der Walk-Audit stellte heraus, dass die Fußgängerfreundlichkeit in Bork etwas über dem Durchschnitt mit einem Wert von 2,8 ausfällt. Auf Grundlage der Berechnungen für die Strecke und die einzelnen Segmente wurden Maßnahmen für die Route entwickelt. Die Maßnahmen konzentrieren sich jedoch nicht nur auf die schlechtesten Segmente, sondern auf die drei Kriterien eines jeden Segmentes, welche am schlechtesten abgeschnitten haben. Somit wurden für jedes Segment drei Maßnahmen entwickelt. Abbildung 3 ist aus dem Bericht Walkability in der Praxis entnommen. In dem Bericht ist jeder Maßnahme ein Symbol zugeordnet, welche die angedachte Planung und die Notwendigkeit dieser Maßnahme erläutern. Darüber hinaus sind Einschätzungen zu Kosten und Dauer der Umsetzung angegeben. (Schmidt et al., 2018) Wie bereits erwähnt, stimmen die im Rahmen des Aktionstages festgestellten Defizite der Fußgängerfreundlichkeit mit den bereits im Fokus stehenden städtebaulichen Entwicklungen der Stadt Selm überein. Hierzu wurde schon 2016 ein Integriertes Handlungskonzept (IHK) von dem Büro Schulten Stadt- und Raumentwicklung entwickelt. Die Maßnahmen des IHK wurden bereits teilweise umgesetzt oder befinden sich zurzeit in der Planungs- bzw. Realisierungsphase. (Schulten Stadt- und Raumentwicklung, 2016)

7 REFLEXION UND FAZIT

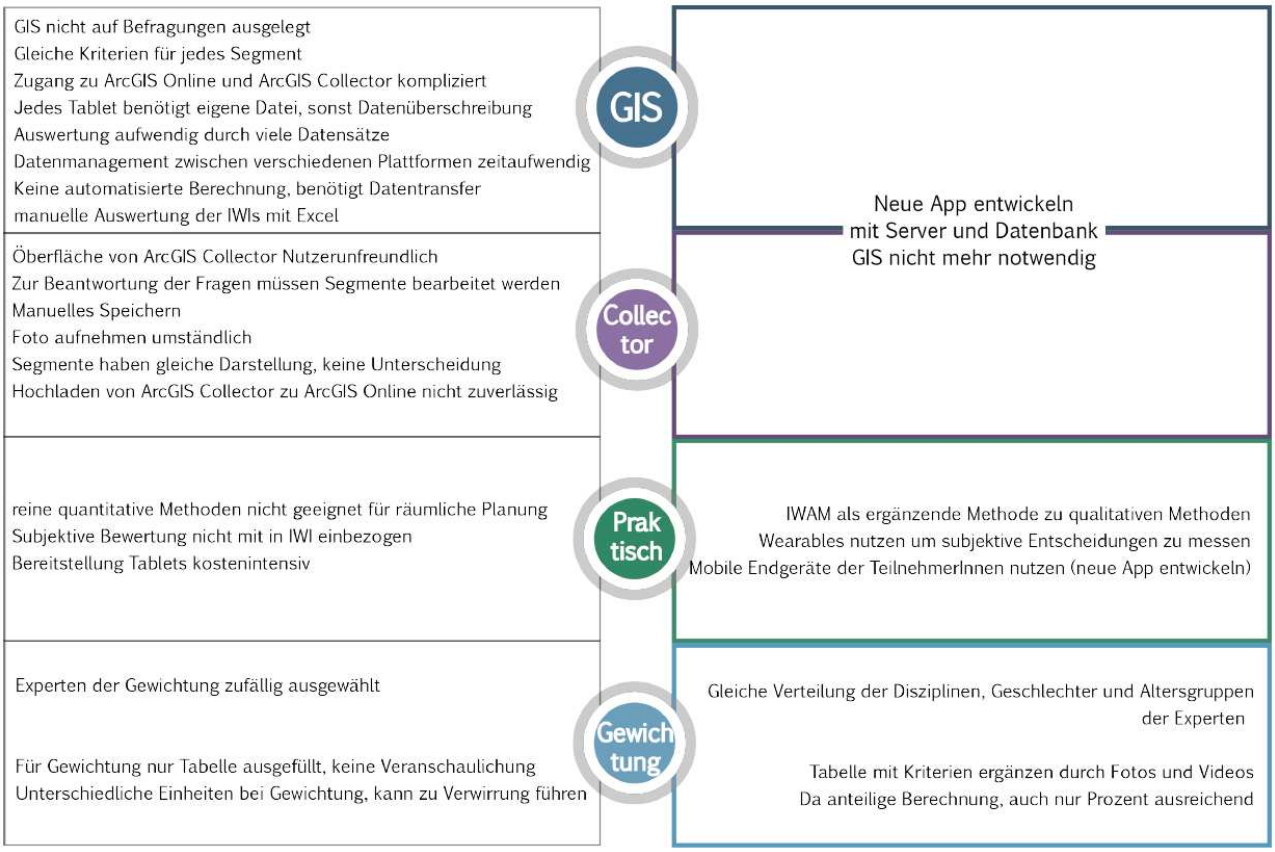

Abb. 5: Probleme und Lösungsansätze IWAM

Durch die nähere Betrachtung dieser komplett GIS-basierten Methodik konnte herausgestellt werden, dass die Methodik einerseits zukunftsfähig ist und andererseits als quantitative Methodik die räumliche Planung sowie die Prävention im Gesundheitssektor sinnbringend ergänzen kann. Für die künftige Nutzung der Methodik sind jedoch Anpassungen notwendig, um die partizipative Nutzung zu sichern und darüber hinaus die Verhaltensprävention zu fördern sowie die Datenverarbeitung und die Berechnung der Walkability zu erleichtern. Denn aktuell wird mittels IWAM ein Datensatz pro teilnehmende Person generiert. Da IWAM während der ersten Ausführung in Essen in jedem Quartier nur von einem Auditor durchgeführt wurde, erhielt das Projekt in Essen pro Quartier einen Datensatz (Manz et al., 2017). Mehrere Teilnehmende pro Walk-Audit wie in dem Projekt Walkability in der Praxis generieren also auch mehrere Datensätze. Die Verwaltung dieser Datensätze hat sich im Projekt Walkability in der Praxis als eine Herausforderung herausgestellt. Jedoch sind weitere Modifikationen zur Umsetzung des Tools in mehr Bereichen notwendig als nur in der Datenverwaltung. Beispielsweise ist für die Verarbeitung und Berechnung der gesammelten Datensätze der Walk-Audits ein Datentransfer zwischen verschiedenen Programmen und Plattformen

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notwendig. Dies ist sehr zeitaufwendig und umständlich. Darüber hinaus müsste die genutzte App ArcGIS Collector für eine partizipative Nutzung angepasst werden, um den Teilnehmenden das selbstständige Ausfüllen des Audits zu ermöglichen und zu erleichtern. Die App ist für Zwecke der räumlichen Planung gut geeignet. Mit der App können beispielsweise Bestandsaufnahmen, Planungsvorhaben oder Analysen durchgeführt werden. Die Oberfläche der App ist jedoch nicht auf die Beantwortung von Fragen ausgelegt. Da die App einen sehr fachlichen Bezug aufweist, sowohl inhaltlich als auch in der Handhabung, ist sie im partizipativen Kontext nur bedingt einsetzbar. Dies wurde an allen drei Aktionstagen deutlich, da viele der Teilnehmenden konstante Hilfe bei der Nutzung der App benötigten. Darüber hinaus kamen während der Walk-Audits viele Fragen, auch bei erfahrenen Tablet-Nutzenden, zur Handhabung der App auf. Des Weiteren ist es nicht möglich, mit dem genutzten Tool Segmenten unterschiedliche Fragen zuzuordnen. Jedoch hat die Abfrage eines gleichen Kriterienkataloges für alle Segmente erhebliche Folgen auf den Walkability-Index. Beispielsweise ist das Vorhandensein von Einzelhandel und Gastronomie nicht in jedem Segment nötig, aber ein wichtiges für die Walkability aufzunehmendes Kriterium. Somit schneiden Segmente, in denen keine Dienstleistung oder Einkaufsmöglichkeiten vorhanden sind und auch nicht benötigt werden, schlecht ab, auch wenn die Infrastruktur für Zufußgehende in dem Segment sonst keine Mängel aufweist. Für die Gewichtung des Kriterienkataloges, auf welchem die Berechnung beruht, sind ebenfalls Änderungen in der Methodik denkbar. Die durchgeführte Gewichtung im Projekt Walkability in der Praxis wurde von wenigen Experten durchgeführt. Außerdem beinhaltet die Gruppe der Experten sehr unterschiedliche Disziplinen und gibt somit möglicherweise keine fachgerechte Gewichtung wieder. Zur Gewichtung der Kriterien wurde von den Experten lediglich eine Tabelle ausgefüllt. Diese Vorgehensweise sollte durch andere Visualisierungen von konkreten Sachverhalten, wie beispielsweise Kreuzungssituationen, unterstützt werden. Darüber hinaus ist die Bereitstellung von Tablets sehr kostenintensiv. Im Rahmen der drei durchgeführten Aktionstage konnten jeweils zwölf Tablets eingesetzt werden, für zuverlässige Ergebnisse sollten jedoch mehr Personen teilnehmen. Diese angeschnittenen Problematiken sind detailliert in Abbildung 5 aufgezeigt und gleichzeitig werden mögliche Lösungsansätze vermerkt. Wie in Abbildung 5 ersichtlich, ist die Entwicklung einer neuen App ein umfassender Lösungsansatz. Zugeschnitten auf die Anforderungen von IWAM und die Bedürfnisse der partizipativen Stadtplanung würde eine neue App die Walk-Audits effizienter und zuverlässiger gestalten.

Darüber hinaus könnte die Bereitstellung eines Servers und einer Datenbank für die App die Nutzung von GIS und die Vorbereitung der Routen am stationären Computer überflüssig machen (s. Abb. 5) sowie das Datenmanagement und die Berechnung vereinfachen. Die Berechnung sowie Zusammenfassung aller Ergebnisse wären durch eine hinterlegte Datenbank automatisch in der App durchführbar und als Datei verfügbar. Durch eine App, welche nicht an ein Unternehmen gebunden ist, wäre es darüber hinaus problemlos möglich, die App den teilnehmenden Personen der Walk-Audits für eigene mobile Endgeräte zur Verfügung zu stellen. Somit würde ebenfalls die kostenintensive Bereitstellung von Tablets entfallen.

Trotz dieser technischen Probleme und Umsetzungsschwierigkeiten ist ersichtlich, dass die Ergebnisse aus Selm Bork übertragbar sind. Auf Grundlage der Ergebnisse des Walk-Audits wurden Maßnahmen für die Route in Bork generiert, viele dieser Maßnahmen stimmen mit dem seit 2016 bestehenden IHK für Bork überein. Diese Verknüpfung belegt, dass IWAM als ergänzende quantitative Methodik zu qualitativen Methoden genutzt werden kann. Dennoch ist eine Anpassung von IWAM unabdingbar, um die Berechnung der Walkability anpassungsfähiger und somit breitflächiger einsetzbar zu gestalten.

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🏆 *reviewed paper*

Land as a Scarce Resource, Work and Workspaces as a Common. The Case of the Metropolitan Region Amsterdam

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1 ABSTRACT

"The city needs work, work needs the city" (Bobbe, CEO Housing Corporation De Key, Amsterdam 2018).

One could argue that since urban designers took a critical stance towards modernism and functional zoning, mixed use became one of the most advocated success factors for thriving urban developments. Yet, how to approach mixed use at different scales of the city and its metropolitan region is still a challenge for all actors of the quadruple helix. This is the case, for instance, for several recent Dutch urban developments.

Since 2014 the Dutch economy ranks among the fast-growing economies in Western Europe, driven by a sturdy consumer trust and steady growing domestic expenditures (Statistics Netherlands CBS). Around 2016, the housing market started expelling work activities from city boundaries as if it were a hinder to its growing demand for room. Our urge to counteract was driven by two main assumptions. On the one hand, urban livelihood cannot solely rely on housing - workspace is essential just as much; on the other hand, "work landscapes" are currently changing at incredible speed and there is lack of vision about future spatial impact. This led to a design research MensenWerk (People's Work) focused on the Metropolitan Region of Amsterdam (MRA), carried out through qualitative methodology, based on archiving, interviews, study of best practises, and workshops on site.

The claim of the research is that the current transition of work is not only of social and economic relevance, but also an urban spatial matter, strictly entwined between scarcity of room, land use efficiency and complementarity of urban activities.

First, we analysed current situations and next possible developments. Then, we sought for urban strategies, tools and typologies to keep and integrate most of the working activities (production as well as services) in the city in order to contribute its urban resilience. It all revolved around the question: how do we now create urban frameworks for future mixed used living environments? As a provisional epilogue and opening of a new phase of the research we would like to introduce a new understanding of work and workspaces as a Commons.

Keywords: Mixed Use Urban Development, Housing Market vs Work Activities, Transition of Work, Metropolitan Region

2 THE CITY NEEDS WORK, WORK NEEDS THE CITY

2.1 Raison d'être

"The idea of working areas with workers is out of date. We must think into working milieus and inhabitants: workforce are the inhabitants of a working milieu." (van Antwerpen, Schiphol Area Development Company 2017)

When the Netherlands came out of the 2008 economic crisis, financial euforia swept the country - easying transactions that had been on hold for almost 8 years, especially in the building sector. The housing market started swelling and, as an immediate aftermath, working activities began facing difficulties finding room or staying within the city close to their clients and networks.

This trend is still ongoing. In 2019, the Metropolitan Region Amsterdam set its goal to achieve 230.000 housing units until 2040. Overall, 100.000 units are due between 2018 en 2025, half of which within the municipality of Amsterdam (Metropoolregio Amsterdam, 2019). Pressure on scarcity of land use within the metropolitan region is high and is complex to relieve. Land use allocation has become an urban battlefield between housing and any other activity of collective relevance, including work.

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Yet spatial plans are being settled for several coming decades. So, already in 2016, we felt the urge to counteract the overarching forces of the housing market. The reasearch we initiated was driven by two main assumptions.

On the one hand, this new stance has no precendents in urbanistics history. Whilst in the past working activities often created the city (Benevolo, 1963), or left it finding room elsewhere to relocate (Abrahamse 2003); nowadays transformation areas for expansions of the city (both inward and outward) come to grip with existing and functioning working areas. Besides the tangible aspect that there is no more available land for new developments of working areas, relocation is hard to organize and might not benefit the entrepreneurs, nor can it be dealt without causing a huge impact on local economy (Plabeka, 2018). Moreover, entrepreneurs and civil movements are raising attention to how urban livelihood cannot solely rely on housing; workspace is essential as well (ORAM, 2018). Under such crimcumstances, the Metropolitan Region of Amsterdam, in short the MRA, can be taken as a paradigmatic case.

On the other hand, if the XX century has been considered as the "fast century" (Hobsbawm, 1994), the XXI has been already categorized as the "accelerating" one (Kurzweil, 2001). From renewable energies to circular economy or logistics, actual transitions in many fields are suddenly faster and have a heavy impact on spatial planning (REOS 2017). "Work landscapes" are currently changing at incredible speed too. However, despite the long-held interest in the transition of work in the social and economic field (Went et al., 2015; 2017), it has until now received very little attention from a spatial planning point of view.

Thus, "How do we now create urban frameworks for future mixed used living environments?" became our basic research question.

2.2 Methodology

The investigation has been carried out through qualitative research based on facts and data finding, archiving, interviews, study of best practises – in and outside the MRA. Eventually the results of the first part have been tested with workshops on site at four locations spread across the MRA. The four locations are: The main shopping street of IJmuiden, a small town at the North Sea edge of the MRA; Achtersluispolder in Zaandam, an industrial area that is due to be transformed into a work-living mixed use area; Zeeburgereiland in Amsterdam, a future housing area (from scratch) with room for the creative sector; and the Flight District 1, within the future Lelystad Airport Business Park. The research and workshops have been used as an integral investigation over the entire metropolitan area and gathered a multidisciplinary group of diverse sponsors and collaborators ranging from local authorities to different private actors.

The results of the research deliver a series of specific local advices, as well as insights that could be applicable in similar contexts of other European metropolitan regions (MensenWerk 2018).

3 HIGHLIGHTS FROM THE ANALYSIS OF THE LOCAL SITUATION IN THE METROPOLITAN REGION OF AMSTERDAM

"As a consequence of its triumph the city is letting its own social divisions grow wider. That confronts us with the question if we want to remain an inclusive city. Can you keep up being an innovative, successful, and socially sustainable metropolitan region?" (Karlshoven, De Argumentenfabriek, Amsterdam 2017)

3.1 State of affairs

As previously mentioned, the amount of new housing forecasted to fulfill the need until 2040 (in some documents sketched till 2050) purports impressive figures compared to the size of the metropolitan region, which is 2,580.26 km2, and its actual density of 900/km2 with a population of about 2,332,773 inhabitants.

However, seen from a broader perspective, the MRA can hardly compete with other relevant European urban cores such as the London Metropolitan Region of 8,9 million inhabitants, or Greater Paris of 7,2 million inhabitants. A more suited reference term for the Netherlands is the Randstad region with 8,2 million inhabitants.

Bluntly put, the city of Amsterdam and its region are growing fast depending on Global trends such as demografic changes, as well as, for instance, specific circumstances as the Brexit influence on local economy (Het Financiele Dagblad 12-06-2019). Yet, the comparison with other European metropolises also shows how governance and legal frameworks in the Netherlands might not be up to date for such an unprecendeted

situation. In fact, areas already in use demand for innovative forms of land use with higher density and technical solutions in which housing and work can be combined. The Dutch government only recently started adressing this issue (REOS 2017-2018). On top of this, housing production has traditionally been a sector with a big influence on the general economy (De Vlettter, 2004), having a strong impact also on policies, overshadowing the needs of working areas and their relation to urban fabric (ORAM, 2018).

Additional issues emerged from the research are of very differente nature. The first is about compartimented professions: The modernistic division of housing and working has shaped education and professions through decades and still endures. In other words: municipal officers, developers, real estate agents and many peers alike revolve their expertise either on housing or working, very seldom on both. The second one is strictly immediate and relates to the lack of overview due to complexity and speed of the process. On the one hand it is difficult for the local government to keep real-time track and formal trace of land use of work spaces, especially concerning informal work (e.g. the amount of free lancers has grown exponentially in the last years in the region). On the other hand, establishing a relocation plan across the metropolitan region entails several governement levels to agree and exchange information which requires a governance structure that is still being put in place (MRA, Plabeka, 2018).

Despite all controversialities, already in the time span between 2016 and 2018, initial positive signs potentially leading to a future change in policies could be noticed. Since then, the way to apprehend and approach an urban mix of housing and working at different levels across the region is becoming a sensible issue, scrutinesed by all stakeolders. Clear evidence for this is for instance stated in the new spatial policy document (Omgevingsvisies NH2050) of the Province North Holland, which is partially included into the MRA. The document states the following guidelines to which all municipalities have to abide and contribute: Acknowledging the region as a great city, including sustainable economy and innovation as relevant factors, and supporting area related work (gebiedsgericht). However, during the research time span we could identify what we categorised as persistent challenges to guarantee resilient spatial planning for the future of work in a metropolitan region.

4 SPATIAL PLANNING CHALLENGES FOR THE FUTURE OF WORK

The following five challenges - along with potential guidelines or instruments how to adress them - might appear basic, and they actually are. Nevertheless, the true discrepancy between the abstract planning realm of research and daily practice for instance of the four case study workshops, made evident that these challenges yet need to be more clearly outlined in order to find efficient solutions throughout practice.

4.1 Organising a diverse range of living and working milieus

“Mixed programme is the ideal breeding ground for the (new) economy, attracts plenty of talented people and keeps inhabitants within the city. Mixed programme turn the city into an emancipation machine, strenghtens agglomeration forces and offers people the chance to benifit from its thriving economy. Above all mixed programme reduces spatial segregation.” (Municipality of Amsterdam, 2016)

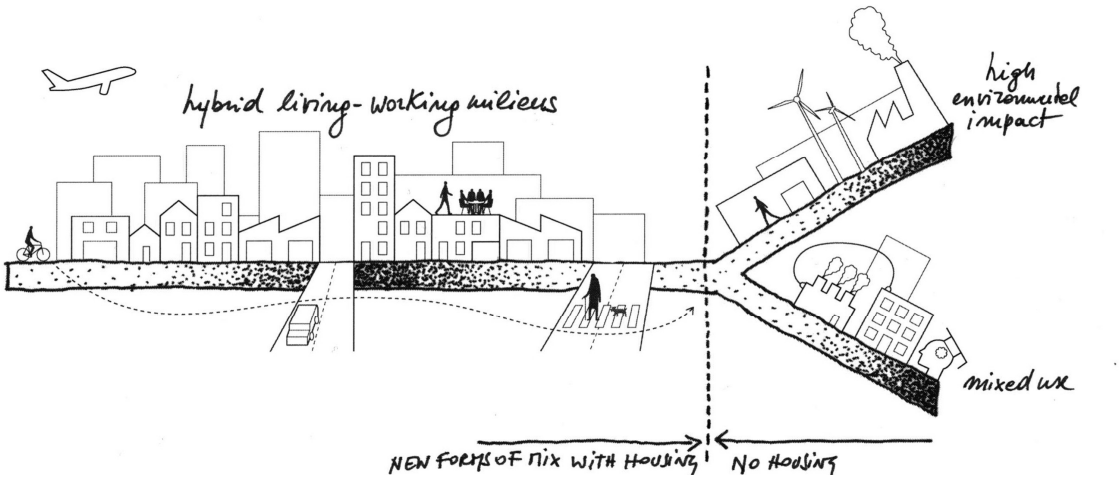

Fig. 1: Paradigm shift, “Y” model: Hybrid Forms of Urban mix of living and working are increasing. On the opposite special kind of non-mixed areas have to be maintained. (SPcitI, 2018).

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"Traditional monofunctional industrial areas will disappear (except the ones with extremely high environmental impact). Multifunctional areas with also educational premises are the future." (Spork Municipality of Amsterdam, Economic Affairs, 2017)

In the last years the division between working and living has entered an epochal shift: from the modernistic linear dichotomy to a new model shaped in three branches like a "Y" (see Fig.1). In modernistic zoning plans, the cut between living and working was sharp until later local circumstances disrupted the standard design abstraction of life. What can be now discerned is that the urban development trend is moving towards a dichotomy between a broad possibility of hybrid milieus ranging from "living-working" to "working-living" on the one hand; and, on the other, working milieus that cannot be mixed with housing, but with either other activities (e.g. research clusters), or cannot be mixed at all. The whole "Y" creates and sustains a regional spatial-economic ecosystem.

4.1.1 Hybrid living and working milieus (Left half "Y" Fig.1)

Current hybridisation of living and working is stimulated firstly by last years' spurt of free lancers - not only creative class, also small entrepreneurs- who need urban proximity to clients and their network (Priestley, 2013), and secondly by the increasing environmental friendliness of production technologies becoming more compatible with living.

Challenges related to hybrid milieus are for instance: 1. Preserving affordable working space; 2. Organising logistics and mobility; 3. Differentiating programme and related urban typology for the hybrid milieus of a whole region; 4. Steering clear from "false friends" such as the wrong perception of the circular economy land use footprint, which is larger than expected.

The workshops on IJmuiden Centrum and the Sluisbuurt in Amsterdam were both representative for new hybrid milieus, living with a complementary mix of working. Yet, the starting conditions and future outcome are extremely different. In IJmuiden the municipality and local housing corporation have decided for the theme of health and care. Sluisbuurt will become a "creative district". IJmuiden is a secondary city and will keep density to a medium FSI, Sluisbuurt will become the first highrise district of Amsterdam from scratch. Concerning work spaces in both plans (that are now at different stages) the intention is to keep human scale by developing ranges of small working units, mostly at street level and spread through housing units. Despite both plans aim for urban mix, it is evident that the two areas are fairly dissimilar and therefore strategies, processes and results will be utterly different. IJmuiden will have to brand itself and not overestimate its potential, while the Sluisbuurt needs to keep housing market at bay and organise an entrepreneurs platform to pioneer work in the area.

At the other end of the spectrum of possible diversity of hybrid milieus is the plan for Achtersluispolder in Zaanstad. In contrast to the situation in Amsterdam, here, the municipality owns little land. Yet, they foresee new transformation development for a part of the area from only work to work-living. Present entrepreneurs may continue their businesses there, while the municipality has opened up a dialogue with them about different densification strategies at the level of the plot, block, as well as the entire area. They are experimenting with plot exchanges and incentives such as air rights, alliances and associations. The planning ambition is to keep maritime activities as well as SMEs and few bigger companies. The area is already under pressure because it will form a relevant connection between Amsterdam, the harbour and Zaanstad. Despite this, the FSI is not yet determined: the municipality wishes to first understand what are the minimum and maximum capacity increase the site can stand in a all-around approach.

An important finding is that, within the infinite possible variation of the new hybrid milieus, transparency concerning local qualities and potentials paired with a clear coordination within the metropolitan region is key. This would help municipalities and all actors of the quadruple helix to avoid envisioning wrong investments for programme mixes that are not suitable for the area and would result in failure. Also, reinforcing an efficient mobility system based on new technologies, and promoting business models as sharing economy, are a potential asset to invest in (van Huffelen, CEO GVB)(ORAM).

4.1.2 Special working environment, no mix with housing (Right half "Y" Fig.1)

The other branches of the "Y" are either intrisically needed infrastructures, such has logistis hubs, harbour, powerplants, heavy industry, or special regional assets as knowledge campuses (see also Föllings, 2017).

Here mixing with housing is not allowed nor desirable, it would not benefit neither housing nor work, rather the opposite. Monofunctional working areas deserve special care and land use certainty.

It is about areas that have a specific focus, often clusters of compatible activities, based on a certain production ecosystem or special kind of services. On a regional perspective such areas are economical and technical engines on which the region heavily depends. The obvious reason why not to mix is not only the heavy environmental footprint, but also logistics and amount of people working in the area (e.g. further development the Internet of Things), and safety.

As an example, the case study of Lelystad Airport Businesspark (LAB) and the Flight District I is an area of development that represents both right arms of "Y" model. The green field development is lead by the setting of the future second touristic airport of the region. Due to the airport, living is forbidden, except for hotels. Part of the area is being developed for a mix of medium, large and XL companies, such as the distribution center Inditex (170.000m2 on a 35ha plot). The whole development focusses not only on logistics, but also ICT, hospitality en agrofood. Around the three latter programmes, the Flight District I will host a cluster of companies, hotels and knwoledge institution related to the airport and big companies from inside and outside the area. The highlights of this case study is the collaboration between different interested stakeholders from the beginning on, its regional relevance and the complex mix without housing.

4.2 Optimizing the mix of mutually strengthening activities

The second challenge is to maintain balance and inclusivenss in the mix of housing and working, as well as between different kinds of work. Possible solutions rely on seeking consistent added values. Added values could be generated by supporting weak ties, as well as exploring new blends of typologies.

4.2.1 Weak ties and affordable rent

Same as inhabitants looking for a house, workers - and their companies - seek for added value in their job and its environment. Various statistics combined with interviews we made (e.g. Ten Hoonte, CEO Labour Market, Randstad/Trendrapport Stad) confirm that the added value of an area are key factors for choosing a job position. Following the basics of experience economy, it is commonly acknowledged that the added value is mostly perceived by the amount of likelyhood to meet, both formally or informally, in the open or public spaces, services and so on. These are the places where "weak ties" occur, connecting acquaintances while bearing the highest potential for people to make turns in their life, career, education (Kremer, 2017). It is not only catering, sport venues, public services or shops; it is about all kind of activities that are less profitable, but help consitute social networks. However, such "third places" (Oldenburg, 1989) are not the only vehicle of weak ties. Leaving room for affordable workspace for small entrepreneurs or other groups that do not have full access to the market is essential to contribute to urban livelihood, local economy and characterize the identity of neighbourhoods, as well as the overall metropolitan region.

Interviews and investigations revealed how far such activities are not only vital for the vibrancy of a city, but also more corporate profitable companies partially rely on them and benefit of their proximity.

Key factors are multifunctionality of spaces, an integral approach (space, strategy, business models), flexibility through time especially for contracts, and last but not least "open gaps" to enable later annexes or changes.

As an example, the future learning and working cluster of the LAB in Lelystad is meant to be of high standards and relevance. The goal is to attract highly educated workers and researchers. The outstanding location in proximity of the airport is not enough to induce urban life on a green field area. During the workshop the involved stakeholders agreed that to achieve their goal, they need to engage more small entrepreneurs and other initiative takers that could bring in the added value and enhance a vibrant contrast.

Also municipalities have a role to play in guaranteeing affordable working space. Possible implementation tools are: 1. smart tendering where the developers have to be consulted already during formulation in order to make it feasible 2. "social rent" for working, as in social housing; though this one is not yet elaborated how to implement such an instrument, and many regard it sceptically because of subsidies dependency 3. more complex forms of land lease according to the mixed programme, and/or shifts in the result value 4. incentives at area and regional level. Special business models with differentiated rent can be stimulated within the market itself developing a win-win situation, in Dutch called "social-business case". An example

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is Contact in Amsterdam, a joint venture of a creative hub of small start-ups entrepreneurs of makers (from carpenter, to taylor or 3-D printer) and the corporate engineers office Royal Haskoning. Together they rent a whole groundfloor of a building in a working area soon to be densified with additional housing. They share facilities, amenities, and the "flow". The large company financially backs the smaller ones, and at the same time they all benefit from mutual influence.

4.2.2 New blend typologies

Housing with high ceilings at the ground floor for commercial use, live-and-work units, are well known typologies where living and working can be combined. Nevetheless, this field is still green: design, combined with financial strategies and technologic development can bear plenty of innovation in the way to combine not only living and working, but especially living and being productive. In other words living and working can be combined in new blends, as well as with new means of earning or spending less. This issue it twofold. Firstly, as referred to earlier, recent technological developments allow for a wide range of working activities that before were incompatible to move closer and be combined with housing (at area, block or building level). This opens up a new creative era for typologies of the city of the future (e.g. Casco by Dedato architects in Houthavens, Amsterdam). Secondly there are technologies that can turn housings, or buildings in general, in value generating assets. The most common options are energy production and water or warmth retainment. During Ijmuiden workshop; in order to add other groups to live and work in the small city centre, we discussed about promoting DIY housing for cooperatives interested in high sustainability standards, energy production and water retainment. That could pay-off the new inhabitants, as well as partially serve the surroudings. Besides being sustainable, such interventions are not only value generating, but also community building. In such way, living and producing are blended and locally bound.

4.3 Tackling the trasition of work integrally with other transitions

Transition is anyways about continuous becoming. The actual challenge relates to how to approach the unprecented speed rate and the entangling of the transiton of work with countless other transitions of which none can predict, or even attempt having, the overview of the overall outcome. Most of the four helix sectors plan future based on today's urge and knowledge, if not with a rear-view mirror (McLuhan, 1967). In any of the workshops, we observed little awareness of this challenge.

Obsolescent legal frameworks and long term investments or contracts that are not easy to break are partially to be blamed for such short-sightedness. In addition cultural and systemic inertia of each sector hinder adequate changes up to pace in time (Hoornstra, 2018). Yet, all transitions happening now direly demand room in time to be planned through, and in space to be embedded. Moreover, there is a clear conundrum in technological choices: all technologies are developing so fast, though it takes so long to put things in place that choices have to be made before being able to unravel all downsides (Bossink, 2018).

It may sound like a worn out refrain to some, but collaboration and open knowledge transfer among quadruple helix sectors is here utterly needed. Our research brought us to stress it once again, because it still does not happen enough (ORAM, 2018). Professionals who have perspective especially from the academia should be matched by government and industry in order to feed implementable insights and prevent investments that would be bygone in a decade. This concerns especially the integral approcah of transitions. In a region like the MRA for instance, energy, logistic, and data need to be adressed as integral as possible together with work. For this the triple helix works best at regional scale, whilst the quadruple at local (Quarles van Ufford, 2017).

4.4 Turning the lack of grip into operational matter, from regional to building scale

4.4.1 Framing instead of prescribing

Often municipalities face a governance challenge, finding themselves in a difficult position to steer developments: lack of certainties, lack of land position, little leverage to induce the market towards desired plan ambitions. As a backlash, such situations do not ease dialogues with entrepreneurs, developers, and all other stakeholders, making it difficult for them too.

From this perspective, the case of Achtersluispolder is quite exceptional and shows a different possible approach: learning by doing. The municipality has engaged in dialogue with local entrepreneurs, including

the harbour on the other side of the IJ and the larger surroundings. Furthermore, in order to attract the market, the municipality has chosen for a less prescriptive line of action, setting wide frames determined by a series of qualitative ambitions and a set of minimum conditions to be fulfilled, as well as maximums not to be exceeded. Within the minimum and maximum there is room for entrepreneurs and developers to experiment and adjust strategy in agreement with the municipality. That means the municipality has loosened their grip, but keeps continuous control on the evolution of the plan and intended results, leaving the market lead within the given frame and learning what planning tools are the most adequate to apply. No FSIs are assigned yet. This will be done in due course when a critical mass of projects will reveal the test of the minimum and maximum. In this way the municiaplity keeps an active role engaging the market in a responsible way to comply with social, economical and spatial quality criteria envisioned for the area.

4.4.2 Spatial framework, fasing and temporary projects

"A good spatial framework is a basic condition for future resilience" (van Antwerpen, SADC, 2017)

According to several relevant interviewees and engaged stakeholders a gradual urban development based on a defined framework to be developed through fases in time - of which only the very first steps are set -, is a resilient approach, flexible and most appropriate to todays circumstances. It can be said that, with due adjustments, such "Learning Urban Developement" approach (Peek & Stam, 2019) is valid from regional to building scale. Hereby temporary projects and initiatives play a crucial role to ignate processes or test guidelines and further directions. If such projects are succesful and able to be stabilized or up-scalable, they can even become permanent. In order to allow this, special legal status and/or strategies have to be developed, as well as sustainable business models - all of which requires consistent dialogue of all involved stakeholders.

In the Sluisbuurt, the first buildings will arise in 2020. The starting phase in a tabula rasa development is extremely delicate. The plan framework has prepared a pioneering fase with two different strong inputs: one more permanent but dynamic, the other more temporary and flexible. The first input relates to the key role played by the school InHolland of Diemen that will trailblaze the area with about 6.000 students and teachers. They will establish a new seat and use the development of the area as main topic of their educational programme as a living lab; analysing, testing, monitoring and undoubtly contributing to its liveliness. The second input befits the plan spatial framework and its phasing: hosting temporary activities of creative entrepreneurs that are now being selected via open tendering. The municipality has long investigated with „typical" creative entrepreneurs, to understand their needs. The most relevant insights have been: affordable rent, plug and play condition to move along with the development, changing plot according to construction fases, though providing a longer investment and presence in the area; and eventually support for later on to achieve a permanent position. This open framework allows experimentation (and monitoring) at area level.

4.4.3 Experimenting and monitoring

Indeed, experimenting in urban development is of utmost importance, especially in the realm of working areas or mixed ones. It also is an important layer of the new Environmental and Planning Act (Omgevingswet) at national, province and municipal levels. In order to be consistent with the aims, experiments need to be stimulated, backed up and monitored. For this the example of the Maatwerkzone (Bespoken Work Zone) of the Port of Amsterdam is quite relevant. The Port has identified two areas within its borders that now fall under a special status: all companies within are allowed to experiment practices that enhance circular economy and innovation, especially for exchange of rest materials or other activities that are not allowed within not up-to-date legal schemes. The Port did not change anything in spatial terms (yet), but has set up a special „green lane" in agreement with the regional environmental service department and the municipality to smoothen the process for application of permission or other required authorizations to proceed. Meanwhile their knowledge on the topic is expanding, as well as that of the companies involved.

4.5 Formulating shared ambitions and responsibilities

4.5.1 Open involvement

In The Netherlands, the field of urban development is limited to government, developers, investors, housing corporations and few other big players. It is already complex enough to get all these parties together.

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However, when concerned to mixed use urban developments or working areas, breaking down this closed network is a challenge that needs to be dealt with at least two main issues: professional division of knowledge and experience, and taking on board the end user, the entrepreneurs.

On the one hand, parallel to legal and financial systems, also professional expertises are separated: developers, advisors, designers, real estate agents, are most often either specialised in housing or working. Especially at area level, a new sort of expertise has to be nurtured that can embrace programmes in a wider merge. On the other hand, entrepreneurs hold the practical knowledge, and most often cradle the needed innovation changes. They ought to be part of the planning decision makers from scratch. Saying that, it has to be taken in account that not all entrepreneurs have time and skills to join, therefore entrepreneurs unions can bridge the gap, and/or plans can start with a group of more willing entreprepreneurs that then will spark participation among a larger group. A careful begin of a planning process involving all stakeholders is elaborated and may take longer time than usual, yet it provides the base for agreements and is a benificial investment for faster implementation (ORAM, 2018). This entails, among others, a new breed of tenders and operating plans (Hoonstra, 2018).

The workshop in Ijmuiden is a tangible example of missing stakeholders. It was attended by municipal officers, directors of the local housing corporation as well as a representative of local entrepreneurs, but during the session it became clear more entrepreneurs should have taken part, as well as a financial advisor and a real estate expert that could straddle housing and healthcare/caregiving issues. Part of the questions were thus to be postponed, delaying the process.

5 SUMMARY AND CONCLUSIONS: TOWARDS RESILIENT METROPOLITAN REGIONS

5.1 Scales

Aiming at providing room to the future of work, we need to re-understand how to operate on three scales.

5.1.1 The Metropolitan Region

Daily life, production and consumption chains, services, are greatly bound to regional scale. Whilst a metropolitan region is an offical system of urban cores and their hinterland, each realm of dialy life does not pertain to formal borders. Any of them concerns a bespoken regional scale that is not contained within administrative borders. It can only be partially contained if clear ambitions among stakeholders are set, e.g. embracing circular economy. Economical and social inclusivenss can be achieved primarily by looking for complementarities of functions and connections at regional scale. Hereby travel distance and integrated mobility are essential to ensure access to everyone and cohesion of offer (Quarles van Ufford, 2018).

5.1.2 The backbone

To support and maintain connections across the region, infrastructure and networks are basic conditions in the field of energy transition, logistics/mobility, and data (these three at least for the MRA). Smartly organised infrastructure systems are thorough investments for the future and offer open frameworks at regional scale, while enabling economical and deographic changes. This is the level where the highest potential for making a Metropolitan region inclusive lies.

5.1.3 Local area

“The area is the classroom. That's where an even platform is created, by seeking solutions together. The scale of the area must be given more meaning for new regulations, in order to make area development as future-proof as possible and that stimulates area-oriented economic renewal. By understanding and initiating the process, by testing, you will gain insight into the opportunities, risks and coherence of new value development, as well as achieve reasonable shares of contributions and costs.” (Ravenhorst and Spronk, 2017).

The succesfull accomplishement of an urban development or transformation at area level depends on area-specific factors, in correlation to its surroundings. Ideally, thanks to involvement of all stakeholders, and “learning urbanism”, developments could achieve a smoother way to absorb changes, in a resilient way. All in all, each area needs a tailormade approach.

5.2 Spatial planning implications

Central to the research is the insight that the future is complex and exact predictions are impossible. We must, so to speak, plan for the unknown without defining a programme or planning specific activities, but indicate and stimulate potential use. Needless to say, in doing so, we must of course take into account the knowledge and needs of today, but in full awareness that society is constantly changing. This calls for the following:

5.2.1 Clear frameworks and simple rules

Rules that are too convoluted or change during the process can be regarded as an overkill. Simple and clear rules, fixed for the duration of the process, build trust and provide clarity, transparency and continuity. This makes the process more accessible to different types of stakeholders (Moroni, 2018). Essential here is the balance between what needs to be laid down as minimum in order to guarantee a solid basis, and what can be left open to stimulate development and innovation. That translates in ambitions for the longer term, and frameworks, with financial and legal openness to experiment, defining only what exactly is required to achieve the next phase of the process.

5.2.2 Open involvement

It is important to include entrepreneurs from the beginning of planning process, and to train new professional expertise that can bridge and overlap knowledge about housing and working.

5.2.3 "Activities" instead of "functions"

Living, working and leisure increasingly converge; in city districts, neighbourhoods, streets and buildings. Spaces increasingly accommodate overlapping activities, including production. Therefore, we want to introduce the idea of 'activities' to suggests that 'functions' are more fluid. The space can be understood as the means in which activities flow, sometimes overlap and sometimes not, or even change significantly. Meanwhile the space is resilient and does not change, not substantially at least, being ready to accommodate next activity.

5.2.4 Space for experimentation and evaluation, blanks

The transition of work calls for new spatial practices. This requires pilots and tailor-made experiments, with a variety of deliberately chosen frameworks of experimentation. Regular joint monitoring and evaluation helps to spread lessons and successes as new standards or guidelines.

Eventually, planning for the unknown requires planning gaps: blanks in the process and in plans, to be filled in in time moving along with an uncanny future (Urhahn, 2010).

6 FURTHER RESEARCH: VALUE WORK AS COMMONS

With our research we have attemped emphasising how work is merely as essential as housing, and how urban development trends are making it harder and harder to accomplish balance. This is empirical daily evidence. At the same time, work has ceased to be as standard and predictable as in the past. The role, meaning and appreciation of work in the economy and society is changing, and that has direct spatial implications. Nonetheless, work is an intrinsic value for an attractive living environment. Being active and productive is a basic human need and is essential for our identity, independence and dignity (Sennet, 2008). At the same time, it is at the base of our social bounds (Arendt, 1958).

This is why we want to further investigate the concept of work as a Commons. As by history and academic literature the Commons are resources that are accessible to all members of a group or society for individual and collective benefit. These can be natural resources, such as clean water and clean air, but also sources of information, knowledge and culture, anything that is meaningful to the livelihood to its realted community (Lessig, 2001; Boyle, 2008). It is a given fact that we no longer directly depend on resources the same way as in the past, and at the same time new economy may threaten our productive capacities as human beings. In a Marxist reading we could say we are getting "alienated" even from our capacity to work. Therefore, work seen as a collective asset could be newly framed under the category of Commons. Consequently spaces that enable work should be also considered a Commons.

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May this conclusions still be precarious and not enough supported, the research is now entering a next phase to further elaborate on the topic of work and urban planning for the future and collective values, at the Rotterdam University of Applied Sciences. The central question focuses on 'Work as a Commons. Planning instruments for urban ecosystems of work'.

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🏆 *reviewed paper*

Leveraging Newly Available Big Data for Urban Architectural Heritage: Designing a Recommendation System for Heritage Sites through the Lens of Social Media

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1 ABSTRACT

Urban heritage sites are essential part of the cities, because they reflect the historical background of societies and create attraction for tourism industry. However, as tourism industry focuses exclusively on economic growth, usually historical urban cores are under the pressure of mass tourism and urbanization, causing negative experiences for residents and visitors such as overcrowd, nuisance and waste. Therefore, there is a need to understand what attributes attract visitors to certain heritage sites and which heritage sites are overrepresented in space and time, so that recommendations can be given to the visitors and local government in order to reduce the negative impacts of mass tourism. On the other hand, the rise of Internet usage has fundamentally changed the perception for built environment. People are able to reflect own ideas or opinions leaving behind their digital footprints within urban areas. Such digital footprints can be collected as datasets that reflect people's behaviors and opinion in time and space. In this respect, the aim of this paper is to define a common framework for extracting information on the attractiveness and representation of heritage sites by using spatial big data. This paper reports a conceptual framework in order to investigate the motivations of visitors to visit the heritage sites and the influences of their visitations to the heritage sites by exploiting spatial big data and analytics. Moreover, a bibliometric network among the keywords related to existing state-of-the-art is revealed in the literature review section by using VOSviewer. The paper will conclude with discussions on how the results of the proposed framework can contribute to designing positive tourist experiences in overly touristic historical cities. Furthermore, Destination Management Organizations (DMO's) can benefit from the results of this proposed framework since they can develop urban facilities in more peripheral areas instead of heavily touristified zones.

Keywords: urban heritage sites, overtourism, crowdsourcing, big data, context-aware recommendation

2 INTRODUCTION

Urban fabrics consist of different elements such as landscape, built environment, infrastructure, and open space. Historical urban core is assessed within the built environment and it is under the pressure of mass tourism and urbanization. Historic city centres are the essence of European cultural heritage and these are protected considering the each country's rule (García-Hernández et al., 2017). These places are considered as magnet for visitors because of their relevance regarding history and they attract many visitors.

The attractiveness is an important component for visitors to many historical cities (Kourtit et al., 2019) and the attractiveness of a heritage is dependent on the characteristics of heritage (i.e. typology, uniqueness), characteristics of built environment where the heritage is located (i.e. distance to other attractions, facilities, transport network) and visitors' characteristics (i.e. interests, activity-schedules, opinions). In order to understand contribution of heritage attributes and people's motivations behind their visitation, heritage attributes can be analysed under the stated choice analysis. In this research, heritage attributes will be considered in two groups; visitor (tourist) oriented and heritage oriented (Vong & Ung, 2012).

Nowadays, the usage of smartphones and cameras not only have influence on heritage interaction, but also effect on people's experiences and interpretations of heritage sites (King et al., 2016). The growth of social media has been influential on people's choices of destination. The fast development of Information and Communication Technology (ICT) is contributed to the flow of a large amount of data for urban studies and it is becoming a prominent component of urban research (Long & Liu, 2016). Big data provides various data sets such as mobile phone activities, geotagged photographs, travel trajectories, and recommendation on web platforms. These type of data can be utilized to track people's behaviour at very fine scale, since human trace is an element to understand interaction between people and urban areas, in that sense spatial distribution with time stamp is an important source for analysis. The excessive spread of tourism in urban neighbourhoods in particular heritage sites led to an overtourism, since a large amount of visitors stuck in certain locations. For instance, around 17.5 million people visited Amsterdam in 2016 and it is projected to double by 2030

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(Boucher, 2019). In order to combat with overtourism in Amsterdam's hotspot such as Dam Square, Vondelpark and Zeedijk, less visited areas are offered by Amsterdam Marketing which is an organization that is funded by local government. A VR (Virtual Reality) experience was installed in Amsterdam Centraal Station in 2018 to push tourists away from the city center; therefore, visitors were encouraged to visit other nearby areas. The VR introduces to tourists other less known places around the Amsterdam such as Haarlem, Volendam, Zaanse Schans and Zandvoort was promoted as a beach resort which is located west coast of North Holland and it renamed the "Amsterdam Beach" to draw tourists' attention. Some popular places are almost exceed carrying capacity and these places are not capable of coping with such amount of visitors. Innovative solutions could be helpful to manage with visitor influx, and less-visited places including heritage sites can be recommended in order to scatter people evenly by highlighting the hidden treasures of the cities.

In order to understand the overtourism phenomenon from the perspective of heritage sites and their visitors, and to solve this problem in the cities, we propose a methodology in four steps (fig. 1). Big datasets that have location annotation can explain visitor behavior and opinions spatio-temporally. Current literature already emphasizes the importance of utilizing newly available big data sources for volunteered based and data-driven management of historical cities (Ginzarly et al., 2018; Koutras et al., 2019). However, there is no study to utilize and fuse newly available big datasets for better understanding the relation of heritage and visitors by taking into consideration heritage attributes, and heritage tourism problems related to overtourism. The conceptual framework is based on the four phase mode of research including qualitative and quantitative analysis. First, the attributes that have an influence on heritage attractiveness to understand people's motivations behind their visitations are determined (Falk & Dierking, 1992; Vong & Ung, 2012). The evaluation on the importance of each attribute is done by stated choice experiments. This method provides weights per attributes; it is based on observations of responses that made by participants in controlled hypothetical situations. Participants select the attractiveness of the levels of each attribute that contribute to the evaluation on rating scale (Kemperman, 2000). Second, big data sources such as Flickr, Twitter, TripAdvisor, and Google Places are investigated in order to align with the result of first step. Most useful dataset alternatives (based on the availability of possible attributes in the datasets) are brought together and utilized to explain the attractiveness of heritage sites. Next step describes the leveraging of urban big data for scattering people within historical urban core by giving recommendations on alternative less popular heritage sites considering the weights per attributes. Fourth and the last step is to propose a recommendation/replicable system that can be applied to cities that have the similar scenario regarding overtourism. Finally, this paper will propose a conceptual framework for big data-based recommendation system and it can be concluded that the proposed method will provide knowledge for future practice in the relevance of newly available big data and heritage studies.

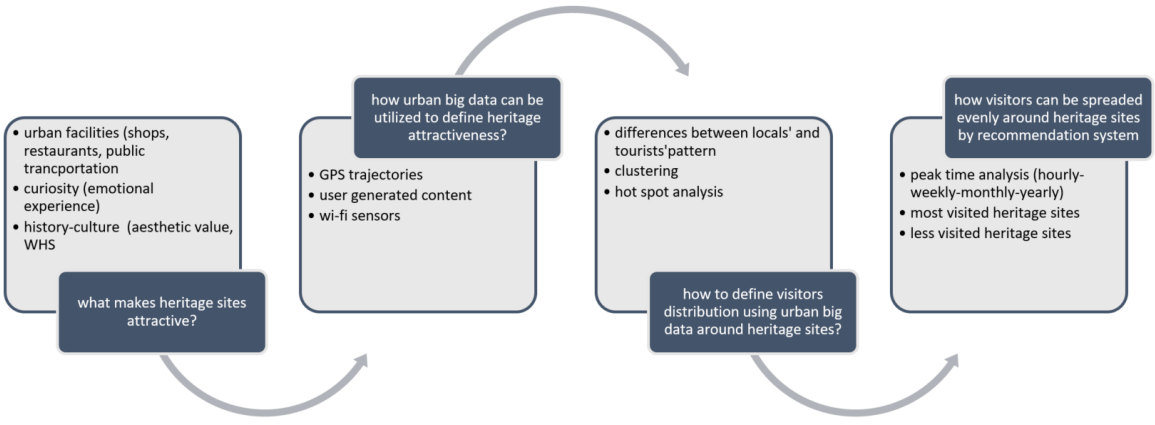

Fig. 1: Conceptual framework of proposed recommendation system

Next section shows the related works. In order to define the knowledge gap in the literature, text mining technique is applied using VOSviewer, therefore; the relation among the selected keywords are visualized. After, the methodology section explaines intented methods, research questions and expected results. Moreover, the relevance and the relation of each research questions are described in this section. Final section refers to the results, discussion and future works.

3 RELATED WORKS

The purpose of this research is four-fold; the current state-of-the-art is explained per the four steps of conceptual framework.

3.1 Heritage attractiveness and people's motivations

Heritage sites consist of different levels such as existing built environment, intangible heritage, cultural diversity, socio-economic factor and environmental factor (Centre, 2019). These levels complete each other, for instance; perception of existing built environment depends on people's background and they are linked with intangible heritage e.g., customs, traditions. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO) approach, historic urban landscape covers not only preservation of the built environment, but also it focuses on the whole human environment with tangible and intangible factors. Heritage sites are one of the key elements from past to present and they can be assessed to understand interaction between people's motivations and heritage attractiveness. Falk & Dierking (1992), explain the attractiveness of heritage sites with a complex spectrum of associative components such as personal (motivation and interest), social (experience and behaviour), and physical settings (the atmosphere of heritage sites). It can be suggested that both internal and external factors are worth-stressing components of heritage meaning.

Heritage attributes can fall into two categories; human oriented is related to visitor experience, and heritage oriented is connected to component of cultural heritages (Vong & Ung, 2012). A. Morozov & M. Morozov (2018) highlight the factors that contribute to attractiveness of the destination with 9 parameters; the presence of cultural and historical tourist resources, transport availability, socio-economic development in destination, general infrastructure, urban facilities, natural factors, information security, site security and attitude of local residents. Karunanithy (2013) explaines the heritage attributes by the tourism perspective. The heritage attributes are evaluated with five indicators; tourist package, style of historical building, cultural village and entertainment. Gaffar et al., (2011) highlight that characteristics on cultural heritage sites are evaluated with six aspects; attractions, activities, accessibilities, amenities, anchillary services and available services. The combination of attributes and levels are shown in table 1.

Tourist (visitor) oriented		Heritage oriented	
Urban facilities and services	Heritage attractiveness	History and culture	Heritage interpretation
Proximity -shopping -museum -public transportation	Curiosity -emotional experience -positive expectation	Historical value -aesthetic -social -spiritual	Ample relevant information -old-fashioned -audio-visual -digital
	Overcrowding -local -tourist	Site uniqueness -WHS -non-WHS	

Table 1: Heritage attributes and levels (Vong & Ung, 2012)

3.2 Newly available big data and distribution of people

The concept of big data face rapid growth in recent years. The amount of information has been growing continuously, because it is produced automatically by different form of sensors. Big data consists of a wide range of information and it presents data-driven evidence on the basis of numbers instead of anecdotes, stories or experiences (Song & Liu, 2017). This type of data contains three key concepts "3V's"; Volume represents a large amount of quantity, Velocity is described as the measurement of how fast data arrives from sources and Variety is the range of data types (Laney, 2001). After, this concept is updated by adding Veracity (Laney & Beyer, 2012), which represents the accuracy and applicability of data, and Value (Mao et al., 2014) is the potential of big data; it can be transform into desired information. Such data influx is coming with various information that is why newly available big data have been becoming essential tool for urban studies and planning practices.

Urban big data is divided into five categories; sensor systems, user generated content (UGC), administrative data, private sector data and hybrid data. Volunteered geographic information is placed under the UGC and it

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supplies real-time analytics to researchers (Ginzarly et al., 2018; van Zanten et al., 2016). People can be considered as sensor, because they contribute to generate the data. UGC is at individual level and collected at fine levels of spatio-temporal scale; therefore, it allows understanding and modelling human behaviour in urban scale. Social media services such as Twitter, TripAdvisor, Foursquare, which contains volunteered geographic information, have a wide range of digital footprints and these location based services provide data on the urban services, and such data can allow monitoring of events, emotions and preference of users (Thakuriah et al., 2017). Planners can utilize the newly available big data sources with the observations and surveys, hence big data can be used as a supportive way to access information related to human and urbanscape interaction (Frias-Martinez et al., 2012).

The newly available big data based urban heritage studies have different dimensions such as destination management (van der Zee et al., 2018), tourist activity in historical cities (Kádár, 2014), mapping historical values (Ginzarly et al., 2018), and investigating historical places (Koutras et al., 2019). As far as heritage attributes are concerned, UGC big data sets can be utilized to investigate relation between heritage sites and people. For instance, “facilities-services” are placed under the visitor-oriented heritage attributes, and these are influential factors for the attractiveness of heritage locations (Vong & Ung, 2012). Therefore, if tourist movements are traced around the shopping and eating locations, the relation between facilities and tourists’ behaviour can be described by statistical methods (as shown at Dane et al., 2019), and this relational behaviour can also be visualized by mapping and simulation techniques. Another example is “overcrowding” which is associated with heritage attractiveness and in order to investigate whether overcrowding has influence on heritage locations or not. In that sense UGC big data is a valuable source for understanding overcrowding in space and time, because the rising of social media results in increasing trend of leaving digital traces (Paldino et al, 2015).

Overtourism and ever-growing tourism influx have negative impacts on cities throughout the world. It can be described as too many visitors in a particular destination. The identification of highly-visited areas and reasons behind the over visitation can be helpful to reduce the pressure of overcrowds in historical places. Historic city centers consist of tangible and intangible heritages, monuments and cultural landscapes (van der Zee et al., 2018). The service providers such as, hotel, restaurant, and tour guides are shaping functional places for tourists (Ashworth & Page, 2011). The combination of historical places and services can create an attractive historic district.

People distribution in the cities can be investigated as local and tourist, since they are followed different patterns. While tourists are clustered in the city center, local movements are extended such as parks and recreational areas (García-Palomares et al., 2015). It results in unbalanced dispersion, because heavily concentrated areas are placed in the city centre and urban core is the main attraction for tourists and tourism products (Ioannides et al., 2018; Kádár, 2014; van der Zee et al., 2018; Zhang et al., 2017).

In order to define tourist and local, researchers have used different threshold; Girardin et al. (2009), Garcia-Palomares et al. (2015), and Koutras et al. (2019) use 30-days, Kádár (2014) and Huang (2016) use 5-days limitation to separate tourist and local. If user upload more than one photograph within assigned threshold, it can be named as tourist. Otherwise, it can be accepted as local residents. The issues related to overcrowding result in degrading of the environments for local people; therefore, they are seeking more mature urban heritage destinations (Ganzaroli et al., 2017; van der Borg et al., 1996; van der Zee et al., 2018). It is highlighted by case study in Venice, overtourism has destructive effect on urban heritage areas (Ganzaroli et al., 2017).

It can be concluded that historical urban core draws tourists’ attention and they should be distributed evenly within the city in order to avoid detrimental factors of overcrowding.

3.3 Recommendation system

Tourists often need to help effective travel planning when they visit to city. Recommender system can be beneficial tool for users to identify their need from a vast amount of data. The observation of interaction between users and objects are the base of the recommendation system. It is able to combine different characteristics; user preferences and past behaviours, preferences and behaviour of the user community, items’ features and how they can match user preferences, user feedbacks, context information and how recommendations can change together with the context (Amanto et al., 2016). The experience from previous

users in similar context can be valuable information to current users who would like to visit certain destinations.

Recommendation techniques are classified into three groups; collaborative filtering (recommendations based on previous user with similar preferences), content-based recommendation (provide a user based on her/his formerly preferred) and hybrid approaches (Huang, 2016). Generating recommendation based on predicting users' interest can enhance the tourists' experience, because the system can suggest locations in which are derived from UGC. In that sense location recommendation using GPS trajectories or aggregating geotagged social media data has a valuable potential to create identify locations when people visiting the heritages.

3.4 Distribution of big data based heritage studies considering tourism and recommendations

Table 2 classifies the distribution of literature example regarding subject, data collection, and method and research question. It consists of examples that are used to propose recommendation system. It starts with what makes heritage sites attractive, and follows how urban big data is utilized to define hotspots & POI(s), and how recommendation system can be developed using UGC.

Author (s)	Subject	Data collection	Method	Research question
(Kempiak et al., 2017)	Heritage tourism & attraction and visitor experience	Self-administrated questionnaire	Univariate-bivariate analysis, exploratory factor analysis	What are they key factors influencing the visitor experience at heritage attractions?
(Vong & Ung, 2012)	Heritage attributes and heritage tourism	Survey	Principal component factor analysis, The Kaiser-Meyer-Oklin test, The Bartlett test	What are the critical factors that are essential to enhance tourist experience when visiting Macau's heritage sites?
(Trinh & Ryan, 2017)	Heritage visitors and analysis of cultural tourism site	Questionnaire	Textual analysis by Leximancer and CatPac	Is there an articulation of differences arising from different national groups when visiting a site representing a culture different from their own?
(Ganzaroli et al., 2017)	Heritage tourism	TripAdvisor and the number of hotel arrivals	Correlation between reviews and concentration ratio	Does TripAdvisor contribute to strengthening the popularity of already known restaurants in spite of their ranking?
(García-Palomares et al., 2015)	Tourism	Panoramio	Density map and correlation relations	How can the popular attractions be identified using photo sharing services?
(Girardin et al., 2009)	Tourism	Flickr and network data (AT&T)	Density map and spatio-temporal distribution	How do locals and visitors share the space?
(Koutras et al., 2019)	Tourism	Flickr	Density-based algorithm	How can GIS analysis be employed to identify tourist behavior in the Athens?
(Huang, 2016)	Recommendation	Flickr Weather Underground API	Clustering method (DBSCAN) and collaborative filtering	Does context-aware methods provide location recommendations matching a tourist's travel interests and visiting context based on geotagged photos?

Table 2: Distibution of existing studies

In order to analyze attractiveness of heritage sites, questionnaires are applied to visitors, and analysis are carried out by the Kaiser-Meyer-Oklin Measure of Sampling Adequacy (KMO) value. While Kempiak et al. (2017) reveal that heritage settings (atmosphere), special events related to heritages, availability of well-informed staff and the conservation are the important factors for heritage experience, Vong & Ung (2012) emphasize that respondents have high opinions of heritages' historical value and preserving the local heritage in a good condition. In addition, history and culture, facilities and services at heritage sites, heritage interpretation and heritage attractiveness are distinctive factors for heritage tourists in Macau. Trinh & Ryan (2017) analysed the motivations of heritage visitors from different nationalities and their interpretations of heritage sites in New Zealand. It is found that culture is an essential determinant how tourists perceive a place and their experiences of visit.

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Big data based studies are processed with different data sets and methods. Ganzaroli et al., (2017) analyse the efficiency of TripAdvisor on the quality of a restaurant as part of the cultural heritage of Venice and it is concluded that ranking of restaurants is strongly related to visitors' expected quality in Venice. Garcia-Palomares et al., (2015) focus on identification of tourists' hot spot based on social networks, and they reveal that uploaded photos are concentrated around monuments, tourist attractions, and museums. Tourists' photographs are clustered in the city center; however, locals' movements are extended such as parks and recreational areas. Girardin et al., (2009) carried out quantifying urban attractiveness using digital footprints and they are revealed that waterfront attractiveness is shown positive growth over the summer. Koutras et al., (2019) focus on tourist behavior using social network data in Athens and it is possible to define temporal tourist concentration in every POI, weekly, monthly and yearly time intervals by using spatio-temporal characteristic of Flickr data set.

Huang (2016) proposes context-aware location recommendation using geotagged photos and research suggests that experiences from past users in similar context can be helpful to choose where to visit. The experiment results in aggregating other tourists' travel histories matching in current users travel preferences and the context of the visit.

From this point o forward, it can be said that the visitation of heritage sites can be motivated by different attributes and they can be investigated for better understanding for what makes heritages attractive. It is possible to reveal people movement with high resolution spatio-temporal data by means of GPS and WiFi enabled devices and social media networks. Such data has location, time and user characteristic and they enable to researchers to investigate human behaviour in urban scale. It can be stated that overcrowding has a negative impact on heritages (van der Zee et al., 2018) and historical places are exposed to tourist pressure. UGC and WiFi sensors can be utilized to find solution and they can be employed to propose recommendation system to disperse people within historical urban core.

In order to define the network within the existing literature, VOS clustering technique is applied to articles which are downloaded from Scopus database. Keywords are selected considering the conceptual framework. VOSviewer is a software tool to construct and visualize bibliometric network and it offers text mining to construct the occurrence of important terms extract from a body of literature (VOS, 2019). Total number of 2149 articles are uploaded to VOSviewer. The association strength method is selected to normalize strength of the links between keywords, and visualization is done by occurrences. Figure 2 shows the connection between keywords and the relevance between keywords are emphasized by the distant of each frame.

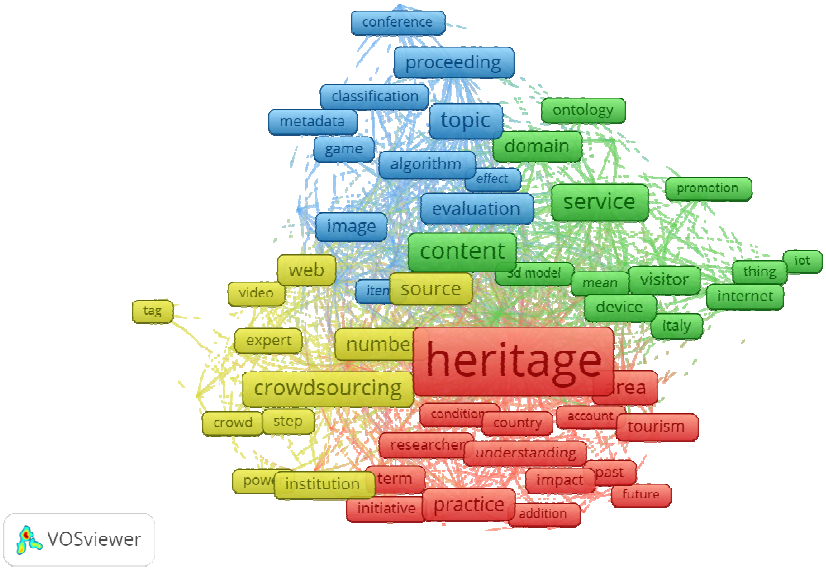

Figure 2: The network visualization of the most occured keywords

As it can be seen in the figure 2, the closest keywords for heritage related studies generally associated with crowdsourcing, content and device. On the other hand, there is a lack of interrelation between understanding, tag, classification, crowd, service, evaluation, tourism and visitor. The blue cluster and yellow cluster has the same number of keywords and they show the relation between "heritage AND context-aware" and "heritage

AND crowdsourcing" respectively. The second cluster (green) depicts the connection between "heritage AND big data", and the red cluster represents topic related to "heritage AND tourism".

Current literature already emphasizes the importance of utilizing newly available big data sources for volunteered based and data-driven management of historical cities. However, there is no study to utilize newly available big datasets for better understanding relation of heritage and visitors by taking into consideration heritage attributes, and heritage tourism problems related to overtourism.

4 METHODOLOGY

The intended research adopts different methodologies throughout the process to correspond to the objectives of each step. Table 3 shows the the planned methods; the combination of qualitative and quantitative analysis can be used to develop research.

Step	Research Question	Relevance	Methodology	Expected results
Step 1	What attributes contribute to attractiveness of heritage sites and what are the people's motivations behind the visitation of heritage sites?	Initial point	Literature review Stated choice experiment	The relevant attributes will be derived from state-of-the-art. A stated choice experiment will be designed considering these attributes. It is vital to understand people's interpretation and understanding to the heritage sites.
Step 2	What is the urban big data and how can big data be utilized within heritage sites?	Utilize the output of the stated choice analysis and to provide detailed understanding about urban big data and heritage sites	Qualitative (tag mining) and quantitative (regression analysis, DBSCAN algorithm, machine learning algorithm, neural networks)	The identification of hotspots and attractive heritage sites, and their relations between urban facilities will be investigated. People's flow between landmarks will be investigated by GPS and geotags. People's opinions and experiences will be derived from tags and images. There is not enough implementation of big data analysis with each attribute of heritage sites.
Step 3	How can urban big data (UBD) be leveraged for identifying the attractiveness of heritage sites in a dynamic way, and how can urban big data be used for distributing people evenly within heritage sites?	Respond the findings of the 2nd step, to provide detailed information about people' distribution within heritage sites and it explains what makes heritage sites attractive using big data	Case study in Amsterdam using big data sets (online textual/photo) Semi-structured interview around heritage sites	Developing different scenarios derived from spatio-temporal analysis and people's understanding are the main input of the recommendation system
Step 4	What are the visitor recommendation systems and how can new systems be developed using big data?	Final output (can be adapted as an application or website)	Context-aware location recommendation with collaborative filtering	Proposed system can contribute to reduce visitor pressure in heavily touristified areas and can be combined with real-time datasets

Table 3: Methods and expected results

The research question of step 1 will be responded by literature review and stated choice experiment. The literature review can be contributed to develop heritage attributes, since relevant publications can provide evidence based results. The experiment enables researchers to control certain factors (attributes), and it can be conducted with binary choices (two alternatives) or multinomial choices (more than two alternatives) (Johnson et al., 2007). The main aim of experiment is to have an understanding on people's preferences considering different heritage attributes. The descriptive statistics of users can be useful to analyse socio-demographic characteristics and representation of population. The model that emerged can have six attributes (Table 1); accessibility, curiosity, overcrowding, historical value, site uniqueness and ample relevant information. Intended duration for experiment can be a month with 750-800 respondents through the

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web-based questionnaire. Results can be evaluated by multinomial logit (MNL), mixed logit and latent class logit models. As a result, coefficients of attributes' levels can be evaluated to interpret which choices are the best for respondents, so the importance of weight for each attribute can be identified to use in the recommendation system. Current studies are based on surveys or on-site questionnaires; however, they have some limitations. They can be applied a limited number of visitor, because the collection of traditional data takes more time than the collection of big data. Moreover, questions are asked on site; only visitors of certain heritage sites are able to respond questionnaire. Online survey can be applicable to large number of people, and it can be collected and analysed more efficiently compare to traditional survey.

Second phase of research focuses on the utilizing big data considering weights per attributes of heritage sites. Step 1 can result in extensive data set, and it can be important to analyse the results from questionnaire one by one, because each attributes can contribute to understand degree of influences each other. The step 2 focuses on newly available big data experiment to combine with the results of the step 1. Peoples' evaluations of heritage attributes can improve to develop better insight for understanding, since only big data cannot sufficient to interpret peoples' viewpoint to the heritage sites. Data collection can be done by coding such as HTTP-GET and GO. The Application Programmers Interface (API) of each data sources e.g., Flickr, Facebook, Instagram, Twitter contains metadata and it can be downloadable using parameters. The dataset from social media mainly contains time, location (lat.&lon.), tags, reviews, and photographs. The time stamps and locations of each photographs/reviews are valuable sources for urban research. Combination of heritage data and the spatio-temporal distribution of people can provide essential insight of their movement and preferences. In order to analyse relation among the urban facilities, the attributes of heritage sites, and people's behaviour, statistical methods such as geographical regression analysis can be done (Ioannides et al., 2018). Sentiment analysis can be carried out to investigate curiosity, site uniqueness and ample relevant information, because the tags of photographs/reviews contain textual description about visitors' experience. Moreover, tags can be utilized to visualize heritage values using Tag Clouds which represent frequency of tags (Ginzarly et al., 2018). The degrees of overcrowd can be assessed clustering methods such as DBSCAN, K-means and hierarchical clustering. Results can reveals the hotspots/POI(s), and they can be accepted as attractive points for people. The motivations of visitors to visit the heritage sites, and the influences of their visitations to the heritage sites by exploiting spatial big data and stated choice experiment can provide better understanding to the reasons of heritage sites attractiveness/popularity; therefore, results can contribute to develop recommendations in order to reduce visitors' pressure in heritage sites.

As suggested in the literature, overcrowd is an impotrant issue in historical cities and many destinations are facing the problem of overtourism (Seraphin et al., 2019). The step 3 attempts to explain how people can be distributed evenly in historical cities. The step 2 is the main input of this phase, as peoples' opinion about the heritage sites and big data analysis can provide novel approach to spread people around the heritage sites. After investigate the most attractive heritages and their attributes, unvisited/less visited heritage sites can be subtracted by means of GIS software such as ArcGIS, QGIS. The step 1 also can be evaluated to identify the reasons of less visitation; for example audio-visual guidance is available for some heritages and the weight of heritage interpretation can be analyzed whether it is effective to use such an audio-visual tool to increase the visitation or not. It is possible to apply spatial statistics within the GIS environments; therefore, it could improve to analyze relation between urban facilities and unvisited/less visited heritage sites visually. Spatio-temporal distribution of people in Amsterdam considering heritage sites can be analyzed, and it can be used as an input of step 4. The case study brings to better understanding for step 3 by involving tourist and local participation and semi-structured interviews could be designated for both target groups. Reducing concentration of tourists in hot spots by offering less crowded heritage sites can be a solution to minimize overcrowds in historical core. Big data-based analysis can provide space-time relation and it can be utilized to spread visitor flows' throughout the city even county level. Furthermore, it can be possible to identify areas where might be exposed to under tourism browsing previous space-time tags and less-known and forgotten heritage sites can be promoted as new hotspots.

The step 4 focuses on developing recommendation system for the visitors of heritage sites. It can be useful tool for visitors to find what they need from retrieving a wide range of data. Although many websites and applications are available to access relevant information before the trip, personalized recommendations which can combine several aspects such as purpose of trip (leisure), urban facility (museum), weather (summer), time (evening) enhance the heritage experience. It can help to visitor in retrieving information that

affiliate with own preferences by recommending locations from a wide range of choice. Suggested heritage sites can be offered by selecting less visited heritage sites in which are exposed to under tourism. The results of stated choice experiment (step 1), big data analysis (step 2), and semi-structured questionnaire (step 3) can be input to find under touristified areas, because local residents have tendency to visit less touristic places and they can contribute to develop new recommendations.

Proposed system can be based on different datasets and knowledge, and it can allow to manage all the different kinds of information. The 4 steps can complete each other and results from previous step can be the input of the next step. The aim of this paper is to elaborate the approach for investigating heritage attractiveness, and to utilize big data sets to understand interactions between people and heritage through the lens of social media. These methods can provide location recommendation to visitors where to visit using similar context other people often visit. However, the aim is to reduce visitor pressure in heritage sites; therefore, suggested locations should be chosen considering less visited heritage sites. Timeframe of geotagged information can provide real-time data and, it can be developed as an application or web-sites which serve as a tailored (customized) guide for the visitors of heritage sites. It can provide personalized recommendation matching visitor's preferences including type of attraction (museum, park, art gallery), experience (positive), proximity to public transport (train, tram), historical value of heritage (aesthetic, social, spiritual). The crowdsourcing can support the maintenance of the system's knowledge base enriching visitor activities and recommendations can be supported by real-time data.

5 RESULTS AND FUTURE WORKS

Proposed recommendation system which consists of state choice experiment, urban big data analysis with user generated content and context-aware recommendation can result in the creative an effective way to distribute people in heritage sites. The first part of the research can contribute to understand the relevance of heritage attributes as heritage oriented and visitor oriented. After the stated choice experiment, results can be evaluated to analyse the impact of attributes over the heritage tourism. The most/least attractive points can show the people perception toward the heritage sites by considering weight of attributes. The big data based analysis can contribute to better understanding in fine spatio-temporal scale. The methodology that will be applied in this research can reveals the hotspots and it can be used as an input to distribute people evenly in the historical core. People's attitude to the heritage sites will be analysed with tags and it can enhance the knowledge about emotional expectations/experiences. Lastly, the case study in Amsterdam can be supportive to make an observation in a real conditions. The research not only contribute to cover a knowledge gap in literature, but also provide a holistic viewpoint relation between heritage and people.

The final output will contains deeper analysis about the reason of heritage visitation and attractiveness. Spatio-temporal pattern of people can provide the information about the usage of space in time. These type of information can be analysed by municipalities and companies to take measure in overcrowd areas such as it is possible that increase the frequency of public transportation in rush hours, and to provide special route for shuttles to promote less visited heritage sites. Destination Management Organizations can benefit from the result of the research, they can develop urban facilities in less touristic areas instead of heavily touristified zones. As a visitor perspective, final output can be helpful while making a decision where/when to visit, because real-time data flow can be embedded into proposed recommendation system.

This recommendation system can be tested using two different methods with a focus group around 30-50 people, who have experiences about overtourism. If the proposed system will be tested as a conceptual framework, participants can be informed about projected crowds in advance so that they can make an observation in the overtouristified heritage sites (i.e Amsterdam). On the other hand, if it will be tested as an application or website, notifications about expected crowds can be posted to the focus group and they can evaluate on site whether the proposed recommendation system work or not. Therefore, the system can be improved by considering focus group's experience.

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🏆 *reviewed paper*

Micro Housing: No Contribution to Affordable Housing – a Berlin Case Study

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1 ABSTRACT

The limited body of research on micro housing, which refers to small-scale housing units for single-person households, often associates this with housing affordability. In this study, we analyse the affordability of micro housing based on housing advertisements using Berlin as case study area. Therefore, we focus on different target groups of micro housing named by industry-driven research.

On the one hand, we argue that the relevance of some of these groups for housing affordability from an urban development planning perspective is questionable. On the other hand, the results indicate that micro units are hardly affordable for target groups such as students, who are often affected by housing affordability problems. Our study illustrates that for Berlin there is a substantial mismatch between the potential contribution postulated in literature and the actual contribution of micro units to affordable housing.

Keywords: reduction of living space, micro-apartments, housing affordability, micro housing, rental housing market

2 INTRODUCTION

Providing affordable housing is one of the main challenges of urban development planning. At the same time, it is high on the agenda of public and media discourse. In Germany, housing affordability problems receive substantial media attention. Policy makers attempt to reduce these problems by means of regulations. An example of statutory intervention in the housing market at the federal level are the regulations on the permissible rent level under Section 556d of the German Civil Code (Mietpreisbremse), while at the state level the Berlin Senate passed a rent cap (Mietendeckel) in 2019.

Pressure on housing markets does not only lead to actions of policy makers. Investors and developers also adapt their actions to market conditions. We interpret micro housing as such a response, additionally driven by e.g. the household development. While in 1974 only 35% of all urban households in Germany were single-person households, their share had risen to 50% by 2018 (Destatis 2020).[1] From this increasing share, the relevance of micro housing, which refers to small housing units with different rental periods for single-person households, can be derived. The press also reports, for example, on the boom in micro apartment facilities in major German cities (see, for example, Mattauch 2017; Ochs 2016). Here, micro apartments are praised as "rising stars of the housing market" (Ochs 2016). By contrast, there are only few scientific publications on the topic of micro housing. These often associate micro housing with affordable housing (see Dickerson 2016; Iglesias 2014; Infranca 2014). However, empirical analyses of the affordability of micro housing are lacking in the literature.

In this paper, we aim to situate micro housing in the context of affordability. To this end, we first explain the necessary theoretical foundations of both micro housing and affordability. Thereby, we focus on different approaches to assess affordability. Subsequently, we analyse the affordability of micro housing in Berlin on an empirical basis. First, however, we clarify our understanding of micro housing and describe its characteristics focusing on the German housing market.

3 MICRO HOUSING IN GERMANY

A precise definition of micro housing is yet to be established. The German planning law (Bauplanungsrecht), which differentiates between residential housing and commercial accomodation, offers a point of orientation in order to situate micro housing. For residential housing in the sense of the planning law, a certain duration of residence is determinant. Some publications cite a minimum rental period of three months as a reference (Gregorius 2017), even though the planning law does not precisely define this as limit (Ewer 2017). Commercial accommodation is characterised by shorter rental periods and additional services (Federal

[1] In German cities, with more than 100,000 inhabitants.

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Administrative Court, ruling of 29 April 1992). Thus, a basic destinction between residential and commercial concepts is necessary.

In the meantime, there is a category of dwellings with increasing diversity attributed to micro housing. Its emergence is linked to the demand for short-term rentals and trends such as the rise of multilocal lifestyles (Hilti 2013). While apartment hotels are an example for commercial accommodation, micro-apartments are mainly assigned to residential concepts. Boarding houses are located somewhere in between. Here, the services offered and the intended rental periods determine the classification. An overview of the different concepts is shown in figure 1.

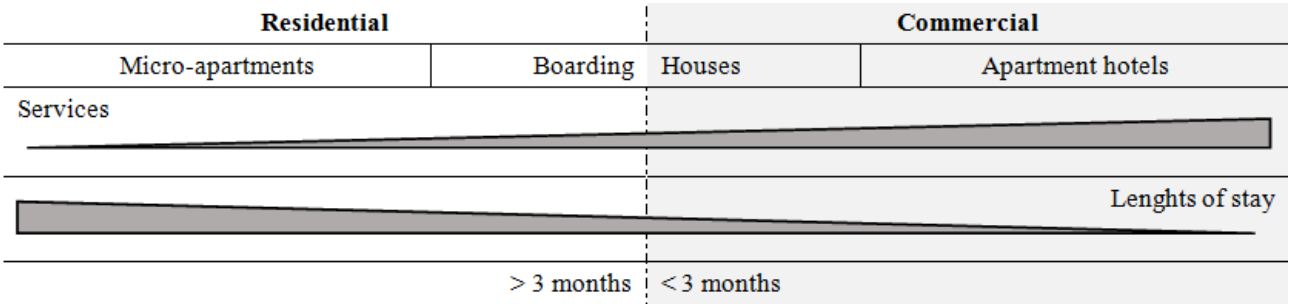

Fig. 1: Differentiation between residential and commercial concepts of micro housing.

These residential and commercial concepts of micro housing have in common that they offer living space - often furnished - for single-person households, providing a kitchen or kitchenette and a separate bathroom. This distinguishes them from single room occupancies (SROs) in which kitchen and bathroom are shared with other residents. As the term suggests, a reduction in individual living space is also a constitutive factor for micro housing. However, the definition of maximum floor spaces requires consideration of local market conditions. Consequently, maximum floor spaces of micro housing are to a certain extent linked to the average studio sizes of the market considered (ULI 2014). Literature defines the characteristic floor space of micro housing as 20% to 30% smaller than that of conventional studios (ULI 2014).

As a result of the reduction in individual living space, micro housing often appears in high-density neighbourhoods. It is also associated with high tenant turnover rates. Suppliers prior target groups of micro housing are students, weekly commuters, and employed persons whose profession requires a high degree of spatial flexibility (Ponnewitz und Kienzler 2016). The group of employed persons can be differentiated into persons who are looking for a housing unit as their main or secondary residence. A summary of the typical target groups as well as their motives for moving into a micro home can be found in table 1.

Target groups	**Motive**	**Example**
Persons in educational stage	Studies	Students
	Apprenticeship	Apprentices
	Internship	Temporary internship in another city
Employed persons	Project work (secondary residence)	Temporary projects in another city
	Weekly commuting (secondary residence)	Employed people whose main residence is so far away from their place of work that they need a housing solution during the week
	New recruitment	Transitional solution during the probationary period, orientation period on the housing market
	Temporary employment (mainly professionals)	Doctoral students, assistants, private lecturers
	Job-related mobility requirements	Cabin crew, pilots and field staff
Others	Change of residence	Bridging the orientation period on the housing market
	Intentional reduction of individual living space	Senior citizens, singles

Table 1: Target groups and residence motives of micro housing (according to Gregorius 2017; Ponnewitz und Kienzler 2016).

Even though exact surveys of the stock of micro units are not available due to differentiated supplier structures, research points to the dynamic development in this market segment (see, for example, CBRE 2018; Savills 2018). In Germany, the spatial focus is on major cities with strong growth and high student numbers (Glatter et al. 2014), where housing demand exceeds supply (Neubrand und Brack 2018). In order to explain the market dynamics of micro housing, various trends driving the demand are listed in industry-led research. In addition to the increase in multilocal lifestyles, individualisation processes that are reflected in a steadily rising number of single-person households are mentioned.

It is unclear, however, to what extent the market situation in many major cities encourages the development of the micro housing stock. Small-scale housing units temporarily occupied do not correspond to the actual housing preferences of the target groups, which consist mainly of younger cohorts (Frank 2019). For example, for most residents the decision to move into a micro-apartment is a result of the restrictions that a constrained housing market situation imposes on their choice of housing and they see this as a compromise (Clinton 2018). Thereby, they typically trade off the idea of living alone and the amount of rent that is perceived as affordable against reduced living space (Clinton 2018). The location of the dwelling is very relevant here; micro housing is usually located in city centres or neighbourhoods close to city centres. Restrictions on housing choices can thus also serve as an explanation for the increasing supply of micro housing.

4 HOUSING AFFORDABILITY

Approaches to assess affordability exist for both home ownership and renting. In this study we focus on rented housing, as this is the dominant housing form in major cities in Germany.

Affordability combines housing cost burden and housing quality (Haffner 2018; Stone 2006b). To measure and assess affordability, indicators and standards must be defined for both aspects. A dwelling is considered affordable if it meets the standards of both housing quality and housing cost burden.

Due to difficulties in setting minimum standards for housing quality, approaches to assess affordability primarily involve the housing cost burden. Minimum standards for housing quality can be legally established in Germany at the level of the federal states, for example, with regard to living space. In Berlin, for instance, an apartment must have at least 9 sqm for each occupant from the age of seven onward and at least 6 sqm for each child up to the age of six (law to eliminate housing shortages in Berlin (Gesetz zur Beseitigung von Wohnungsmissständen in Berlin (WoAufG Bln)). The multidimensionality of housing, which means that housing has a social dimension in addition to a physical dimension, is an obstacle to the definition of minimum standards. Minimum standards for social needs such as identification or self-realisation can hardly be defined. Nonetheless, neglecting aspects of housing quality is a central weakness in existing approaches for analysing affordability.

The indicator of the housing cost burden generally corresponds to the ratio of housing costs and household income. This ratio approach is widely used due to simple calculation and low data requirements. There are differences in the housing costs used and the standard defined. The European Union defines housing costs as gross warm rent including electricity costs, which should not exceed 40% of net household income (eurostat 2014). The ratio approach ignores the fact that the share of non-housing costs in income depends on the level of income and the household characteristics. Studies have shown that the ratio approach underestimates the impact on lower income households and larger households, as they have to pay a larger share of their income for non-housing costs (Stone 2006a; Stone et al. 2011).

As an alternative to the ratio approach, the residual income approach was developed, which does not identify a ratio but the difference between disposable income and housing costs as an indicator for affordable housing. This approach focuses on the idea that the income of a household minus housing costs should be sufficient to cover non-housing costs adequately (Grigsby und Rosenburg 1975). If this is the case, the dwelling is considered affordable for the household. Non-housing costs are, for instance, costs for food, mobility or clothing. Non-housing costs are higher for larger households. Compared with the ratio approach, the understanding of affordable housing is therefore changing. A dwelling cannot be affordable per se. Whether a dwelling is affordable or not depends on the household characteristics and its monetary possibilities (Stone 2006b). In contrast to the ratio approach, the estimation of affordability is therefore

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differentiated according to household type. In addition, standard values for non-housing costs must be applied. This is the reason why the residual income approach requires more data than the ratio approach.

5 CASE STUDY

In this paper, the city-state of Berlin serves as case study area. As a reaction to the price dynamics of asking rents for new lettings, which are particularly high even in comparison to other major cities in Germany, the Berlin Senate passed the draft of a rent cap (Gesetz zur Mietenbegrenzung im Wohnungswesen in Berlin Berliner MietenWoG) in mid-2019. In this law, the maximum rents to be paid are defined depending on the year of construction and features of the apartments. For Germany, this represents a turning point in the political reaction to the lack of affordable housing in major cities. Excluded from the regulations, which are effective subject to a resolution in the Berlin House of Representatives, are apartments constructed 2014 or later.

5.1 Data and methods

In this context, we analyse apartment advertisements of micro units. By micro units we mean studios with a floor space of 15 sqm to 28.5 sqm and with both a private bathroom and a kitchen or kitchenette. Since we question micro housing as a measure against the lack of affordable housing, we only examine apartments built in 2014 or later, which will not be subject to the legal regulations regarding maximum rent levels in the future. The maximum floor space for micro units is based on the determination that micro units are 20% smaller than common studios in the respective submarket (ULI 2014). In Berlin, the median size of studios is 35.6 sqm.[2] Accordingly, the maximum floor space of micro units in Berlin is 28.5 sqm. The minimum floor space of 15 sqm follows the assumption that a studio with a floor space smaller than 15 sqm hardly has a bathroom and kitchen or kitchenette. At the same time, these studios meet the minimum floor space standards prescribed by law (see section 3). In order to be able to present the findings on micro units more clearly, we also define a comparison group that is similar in all parameters except for floor space. These are also studios built in 2014 or later, which have a floor space of more than 28.5 sqm and less than 70 sqm. The upper limit of 70 sqm is due to the fact that the majority of single-person households in Berlin (75%) live in apartments with a floor space between 30 sqm and 70 sqm.[3]

Our data is based on advertisements of rental apartments put up on the platform ImmobilienScout24.de between 11 November 2019 and 15 January 2020. In total, the database comprises 11,268 advertisements with complete details. It contains 127 advertisements that fulfil the conditions of our definition of micro units (corresponds to approx. 5% of all advertisements for apartments with a construction year of 2014 or later). The comparison group comprises 291 advertisements. The focus on a single study area and the comparatively small volume of data limits the representativeness of this study. Since the rental contracts of micro units are often adapted to the semester periods of universities (Engelhardt und Kaljic 2017), many tenant changes occur at the end or beginning of the semester. Due to the chosen survey period, these tenant changes are not captured.

Asking rents are the central analysis parameter. Since both the residual income approach and the European Union ratio approach include the total cost of housing, our analysis focuses on the total rent as the sum of net rent and utilities. In this respect, there is a limitation regarding the comparison between the group of micro units and the comparison group. While the total rent for micro units usually includes heating and electricity costs, electricity costs are not included in the total rent for the comparison group. Heating costs are partially included in advertisements of the comparison group. In addition, it is common practice to let micro units partially furnished.

5.2 Results

In a first step, we compare the total rent and the price per sqm of micro units with those of the comparison group (see figure 2). The price per sqm also refers to the total rent. A central finding is that the median of the total rent of micro housing is higher than that one of the comparison group (micro housing: EUR 674; comparison group: EUR 655). This is particularly noteworthy since, according to our definition, the units of the micro housing group, without exception, have less living space than those of the comparison group

[2] Own calculations based on census data (Statistische Ämter des Bundes und der Länder 2020).
[3] Own calculations based on census data (Statistische Ämter des Bundes und der Länder 2020).

(median micro housing: 24.0 sqm; median comparison group: 36.2 sqm). In contrast, the spread is much smaller for micro units than for the comparison group. While the minimum and maximum total rent for micro units is EUR 440 and EUR 1,150 respectively, the minimum and maximum total rent in the comparison group is EUR 270 and EUR 1,560 respectively.

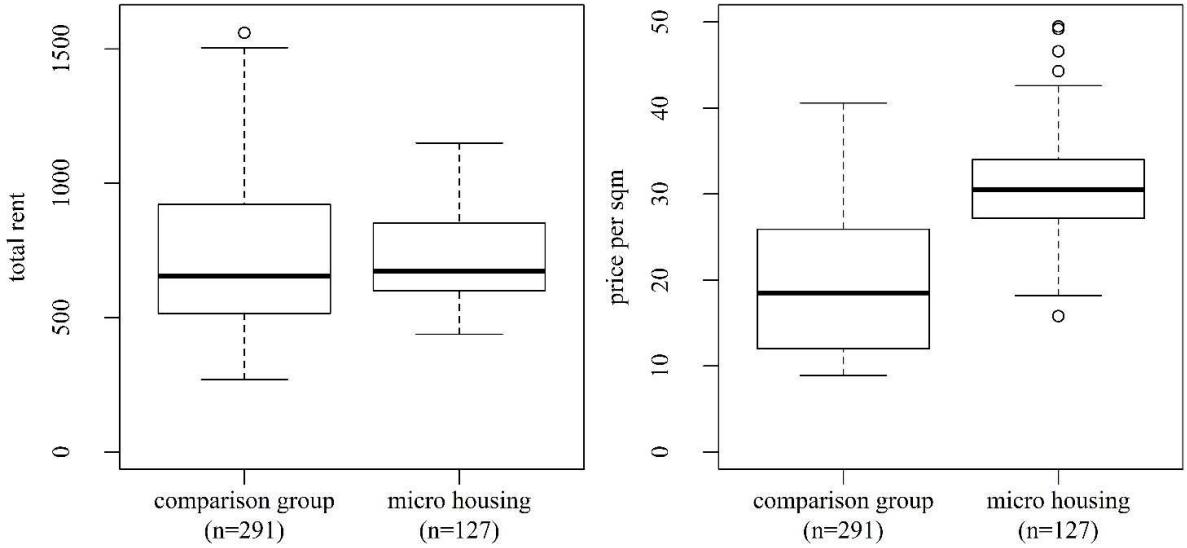

Fig. 2: Total rents and prices per sqm differentiated between micro units and units of the coparison group (own calculation).

In terms of the price per sqm, there is a clear difference between the micro housing group and the comparison group. The median of micro housing is EUR 30.5 per sqm and the median of the comparison group is EUR 18.5 per sqm. The prices per sqm in the micro housing group are between EUR 15.8 and EUR 49.5, whereas the maximum price per sqm in the comparison group is EUR 40.6. The minimum price per sqm in this group is EUR 8.9.

In order to enable conclusions to be drawn about the affordability of micro units, we apply both the ratio and the residual income approach to the database. Figure 3 shows the share of affordable housing in the database depending on household income. Again, we differentiate between the micro housing group and the comparison group as well as between both approaches to assess affordability.

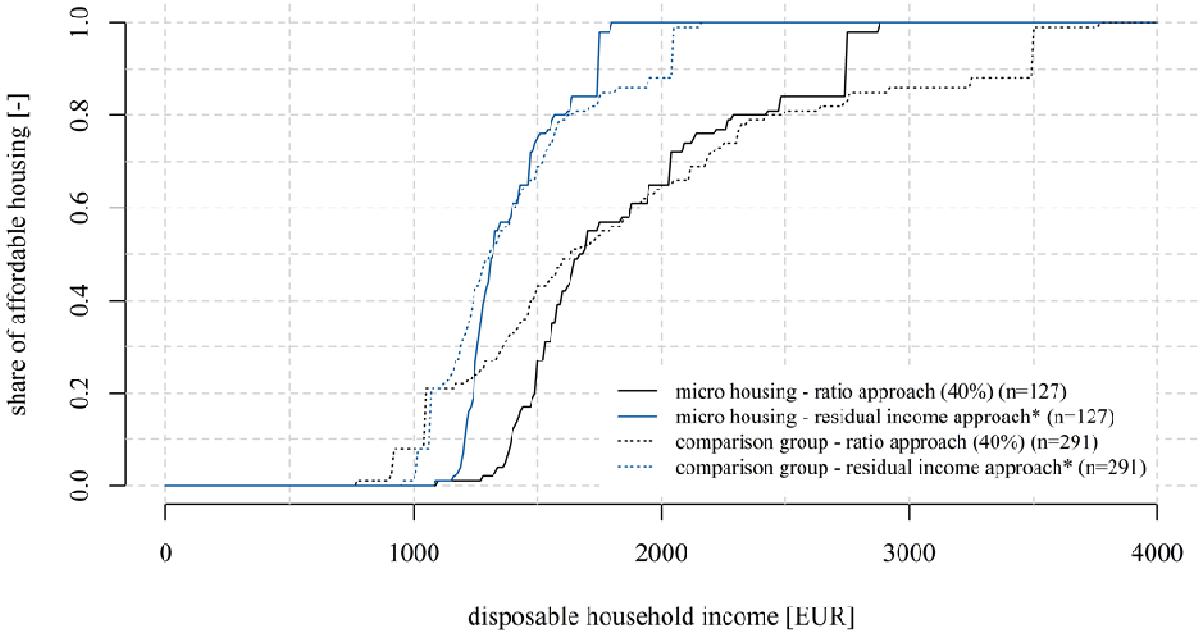

Fig. 3: Share of affordable housing depending on disposable houshold income (own calculations).

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Applying the residual income approach, 10% of the advertised micro units are affordable with a disposable household income of EUR 1,210 and half of these are affordable with a household income of EUR 1,320. In contrast, when applying the ratio approach, a household income of at least EUR 1,400 is required for 10% of the advertised micro units to be affordable. If a household has an income of EUR 1,680, half of the advertised micro units are affordable for that household. With a disposable income of EUR 1,800, all micro units in the sample are considered affordable under the residual income approach, whereas the ratio approach would require a disposable income of EUR 2,880. If we compare micro housing with the comparison group, it is noticeable that with a low income, proportionally more studios of the comparison group are affordable. This effect is particularly evident when applying the ratio approach. In order for 20% of the studios compiled to be considered affordable for a household when applying the ratio approach, a disposable income of EUR 1,490 is required for the micro housing group, whereas for the comparable group only EUR 1,050 is required. This effect exists up to a share of 50% of affordable housing in the respective groups. Starting from this point the graphs of the micro housing group and the comparison group are approximately identical up to a share of 85%.

In order to be able to evaluate micro housing with regard to its affordability, we analyse it for the different target groups named in table 1. This is necessary because the target groups differ from one another in terms of their housing budgets. Table 2 shows the income distribution of single-households in Berlin differentiated by employed persons and persons in educational stage.

net household income [EUR]	share of affordable micro units		employed persons		persons in educational stage	
	ratio approach	residual income approach	relative frequency	cumulative frequency	relative frequency	cumulative frequency
0	0.00	0.00	0.00	0.00	0.00	0.00
500	0.00	0.00	0.14	0.14	0.47	0.47
900	0.00	0.00	0.22	0.36	0.42	0.88
1,300	0.02	0.44	0.10	0.46	0.06	0.94
1,500	0.27	0.75	0.21	0.67	0.06	1.00
2,000	0.65	1.00	0.16	0.83	0.00	1.00
2,600	0.84	1.00	0.08	0.91	0.00	1.00
3,200	1.00	1.00	0.10	1.00	0.00	1.00

Table 2: Household income distribution differentiated by target groups of micro housing in Berlin (single-households only) and the corresponding share of affordable micro units (own calculations; data of Berlin-Brandenburg Office of Statistics (Amt für Statistik Berlin-Brandenburg 2020)).

Persons in the educational stage, especially students, are a comparatively homogeneous socio-economic group. In the case study area, nearly 90% of this target group have an income below EUR 1,300. The average monthly income of students in Berlin is EUR 1,015 (Middendorff et al. 2017). This means that none of the advertisements recorded in the survey period can be rated as affordable for students with an average income, which applies to both the ratio and the residual income approach.

From a household income of approx. EUR 1,200 onwards, the share of affordable micro units depends strongly on whether the ratio or residual income approach is applied. When the ratio approach is used, no micro units are affordable at all for persons in educational stage with an income between EUR 900 and EUR 1,300. In this income range, to which 42% of the persons in the educational stage belong, 44% of the advertisements compiled are affordable when applying the residual income approach. For those from this group with above-average incomes (more than EUR 1,015), some of the advertisements are therefore affordable.

The group of apprentices has an average income of EUR 908 per month (BIBB 2019). Analogous to students, the prices of the advertisements recorded in Berlin are therefore above the affordability standards of the ratio and residual income approach for apprentices, which is why no contribution to affordable housing is identifiable here. Internships of three months or more are subject to the minimum wage law (Mindeslohngesetz) (Section 22 (1) sentence 2 nos. 2 and 3 MiLoG) in Germany and are therefore

remunerated at least at minimum wage. This results in a net income of approx. EUR 1,200 per month.[4] Even for such earnings, hardly any affordable advertisements have been recorded in the case study area. In summary, the micro units recorded do not represent an affordable form of housing for persons in the educational stage if they do not have an above-average income. This applies both under the ratio and the residual income approach.

Employed persons and private individuals are a much more heterogeneous group, which is why we cannot use meaningful average incomes for the affordability analysis. Nevertheless, the income distribution of employed persons living alone in Berlin allows us to classify these group. For employed persons with a net income of EUR 1,500, three quarters of all advertisements are affordable according to the residual income approach. However, almost half of them (46%) earn less than EUR 1,500. To what extent micro housing is now relevant and affordable for the different subgroups of employed persons will be discussed in the following section.

6 DISCUSSION

6.1 Target groups of micro housing and housing affordability

The results suggest newly constructed micro housing, even though it focuses on people in the educational stage as a target group, does not contribute to affordable housing for this very group. The incomes used are subject to the restriction that the disposable income of persons in the educational stage often depends to a large extent on family allowances. Financial support from relatives may increase if the use of funds is deemed appropriate (Brauckmann 2017), which is not reflected in the present assessment. The surveyed prices exceed the affordability standards so significantly that no fundamentally different results are to be expected even with this effect taken into account. However, the results should not lead to the assumption that the inhabitants of micro units themselves consider the units to be unaffordable. People accept different housing cost burdens at different stages of life (Hulchanski 1995). Therefore, it is not surprising that Clinton (2018) identifies affordable rent as the main motive for moving into micro-apartments in a survey of residents. Consequently, housing affordability assessed using the common approaches may differ from the subjectively perceived affordability.

The target group of employed persons is diverse in socio-economic terms. However, the income distribution shows that about half of the working population living alone in Berlin have a net household income, for which the choice of the affordability indicator is decisive for assessing how they are affected by affordability problems (see section 5). In other words, even in the case of net incomes that fluctuate around the average, the results vary widely depending on the approach used. In addition to the findings outlined in Section 4, our results indicate that the ratio approach overestimates the extent to which single-person households with average incomes are affected by affordibility problems compared to the residual income approach.

However, providers of micro housing focus especially on short-term rentals. This is the case for people who are involved in project-related activities needing a secondary residence for these activities. The same applies to weekly commuters who live in a second home at their place of work. The question arises to what extent this temporary demand for housing is relevant to the discourse on affordability, which has so far addressed less solvent, permanent demanders. In the case of project-related activities, the rent may be paid by employers or clients. In this scenario, high rents would be a problem for companies rather than for tenants leading to economic rather than social implications. Another argument against considering this group in the context of affordability is that the search for a secondary residence can also be interpretated as decision to maintain the main residence. If demanders were to dissolve their main residence, their housing budget for the place of work would increase. We are not overlooking the social consequences of such a decision. We would rather like to raise the question: From an urban development planning perspective, shall there be a legitimate claim to an affordable secondary residence? How relevant is the number of people with such a claim in quantitative terms?

In contrast, the target group of newly employed persons is looking for a main residence. Here a heterogeneous income structure can be assumed, so that lower income groups are included. This group is

[4] Assumptions: EUR 1,621 monthly salary (gross); tax class I; West Berlin; no children; no church tax; statutory pension and health insurance.

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distinguished from other demanders by the fact that they are not actually looking for temporary but permanent accommodation. If a flat is needed for a period of several weeks or months in order to orientate oneself on the housing market, this points to constrained market conditions. This suggests a lack of affordable conventional housing, which temporary forms of micro housing are intended to compensate for. From an urban development planning perspective, new entrants should be placed in the context of affordability as a group whose representatives are relevant to affordable housing but need permanent housing solutions. Longer periods of orientation in the market, resulting in a quantitatively relevant demand, should not be the objective.

Among people working in temporary employment, especially professionals are seen as a target group for micro housing (Savills 2018). Thus, the examples of temporary employment in table 1 can be assigned to the science sector, which is characterised by fixed-term employment and frequent changes of location (see, for example, Klecha und Reimer 2008). Part-time contracts are also common, which is why affordable housing is important for this group with its temporary demand. This applies in principle to other forms of fixed-term employment, assuming that changing employment patterns are accompanied by corresponding changes of location. If this is not the case, however, temporary employed persons are not the short-term demanders defined as target group of micro housing.

Other private individuals who bridge a orientation phase on the housing market after a change of residence only become target groups for micro housing if conventional apartments are not sufficiently available. These, we also place in the context of affordable long-term housing.

Finally, the target groups include senior citizens and other private individuals who intentionally want to reduce their individual living space. In principle, these are relevant groups in the context of affordability. In particular older households that live in rented housing are often affected by high housing cost burdens (Gordo et al. 2019). The high housing cost burdens of senior citizens are also linked to remanence effects, which drive the increase in the individual take of living space in Germany. In general, micro housing has the potential to provide older households with affordable housing. To what extent the forms currently dominating the market do so is questionable. For example, accessibility in micro-apartments is difficult to realise (Engelhardt and Kaljic 2017), which is why they generally fail to meet a basic requirement of senior citizens.

6.2 Emerging research problems from an urban development planning perspective

Leaving the level of the target groups behind, we will discuss the results with regard to their implications for urban development planning in greater depth. On the surface, micro units seem to fulfil the objectives of investors and developers, occupants, and urban development planning. They are supposed to reduce the take of individual living space, meet the return expectations of investors, and be affordable. Our analysis results suggest that micro housing is a way to achieve high rents per sqm and thus increase returns. In comparison to the group of conventional newly constructed studios, they show significantly higher rents per sqm. The difference in the median values of EUR 12 is partly due to the fact that they often include furnishings. Also, construction costs for smaller apartments are generally higher due to more complex building technology and a greater proportionate use of space in corridors and stairwells. Nevertheless, the development of supply and investment volume indicate the attractiveness of this market segment for investors (see Savills 2018). Micro units are also accompanied by low levels of individual living space. On the other hand, the results of the analysis do not indicate a contribution to affordable housing.

From a municipal perspective, one factor that has so far been neglected is becoming increasingly important for affordability: the length of rental periods. It is to be discussed from which rental periods local authorities consider affordable housing to be necessary. Trends such as the flexibilisation of employment and increasing multilocal lifestyles, which are seen as driving forces behind short-term rentals, must be assessed in terms of their quantitative importance for housing demand. This group must be considered in relation to the unmet long-term demand. Local authorities should also bear in mind that unmet permanent demand can induce additional temporary demand. This is especially true against the background that short-term micro housing is mainly located in major cities with high demands causing housing affordability problems. From an urban development planning perspective, the possible need for affordable short-term rentals depends on the actual demand, its income structure, and intended rental periods. There is a need for research here. The question of

whether the existing forms of micro housing, both residential and commercial, can provide suitable affordable solutions to this problem is also raised.

With regard to housing quality, the reduced living space of micro housing indicates that meeting needs such as self-realisation is limited. The extent to which this can be compensated by the location and amenities of an urban environment is questionable. At the same time, the level of rents corresponds to that of the comparison group, whose units are larger. From the point of view of socially equitable urban development, maximisation of rents per sqm does not appear to be beneficial. If, for example, micro-apartments are suitable for the development of residual urban areas on emitting transport infrastructure which are not fit for conventional housing (Engelhardt and Kaljic 2017), noise pollution must also be taken into account when assessing housing quality. Further research on this issue is also required from an urban development planning perspective.

7 CONCLUSION

Although affordability and micro housing are brought together in the existing literature, we see the need for a differentiated reflection. First, two levels need to be considered:

- Which of the target groups of micro housing are relevant in the context of affordability?
- Does micro housing provide affordable housing for these groups?

Without being able to answer these questions conclusively, we suggest assigning persons in the educational stage and senior citizens to the group affected by housing affordability problems. In the case of those in employment, there is a need to socially negotiate the affordability requirements, especially for temporary demands. We argue that it is necessary to distinguish between demand for main or secondary residences and temporary or permanent housing demand. Planners and policy makers should take into account that unmet permanent demand induces temporary demand when housing is rented for orientation in the market. We also formulate the hypothesis that micro housing hardly contributes to affordable housing for people in the educational stage. Micro units seem to address more affluent students. To validate this hypothesis, further areas of study should be analysed.

The comparison of the ratio approach applied the European Union and residual income approach shows that the variation in results are smaller when used for micro housing than for larger households. Nevertheless, they vary widely in some income areas where the ratio approach tends to overestimate affordability problems.

We see an urgent need for research in the demand patterns for short-term renting. Further research should be conducted on the quantitative effects of, say, multilocality or flexible employment on housing demand. Since micro housing is currently primarily based on temporary demand, quantitative approximations to the dimension of the demand group represent an important basis for assessing from an municipal perspective.

As a result of the focus on temporary demand groups, potential benefits of micro housing are not exploited. For the future of urban housing, we consider concepts of long-term micro housing as an interesting component, although it remains to be seen whether such concepts can establish themselves on the market.

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🏆 *reviewed paper*

MILP Model for Energy Supply Design to overcome the Cannibalization of Solar Thermal Plants and large-scale Heat Pumps in Urban District Heating Systems

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1 ABSTRACT

Urban infrastructure is accountable for a large share of carbon emissions, especially energy supply to meet the demand for thermal heat and domestic water. Regarding the climate agreements these systems have to be decarbonized. In urban neighbourhoods, district heating systems (DHS) are efficient solutions to supply heat and favoured by locally or regionally operating municipal utilities. To integrate renewable heat from solar thermal plants or waste heat from lakes or rivers by using heat pumps, DHS in highly densed agglomerations face major problems. On the one hand the availability of land respectively free space is limited. On the other hand operating times of solar thermal plants and large-scale heat pumps are similar considering a long-term planning horizon. In this contribution a mixed integer linear programming (MILP) model is developed to determine the implementation of both options solar thermal plants as well as large-scale heat pumps in DHS with adjustable generation plants in an optimal way. The model computes minimal investment costs and related emission savings for different alternatives integrating heat of renewable sources. The results can support the decision-making regarding the feasibility. Furthermore, good combinations of different renewable energy sources and their integration into a DHS can be identified even though the sources are distributed over the DHS. Main decision variables are the choice of possible plant sizes under consideration of the (existing) DHS-network layout and available space in highly densed urban districts. The network topology as well as energetic and ecological constraints (e.g. maximum flow capacity in pipes or operating times of heat pumps due to boundary conditions of heat sources) lead to a selection of plant combinations which represent the optimal solution to lower the emissions at acceptable investment costs. The developed model is applied to a case study for an DHS in a newly built neighbourhood with several available heat sources for heat pumps and free areas for solar thermal collectors. The results proof the function of the model and illustrate that an energetic improvement of the DHS is possible by integrating solar thermal plants and large-scale heat pumps at economically acceptable conditions.

Keywords: District Heating Systems, Heat Pump, Mixed Integer Linear Programming, Solar Thermal, Urban Energy Supply

2 INTRODUCTION

The necessity of reducing anthropogenic greenhouse gas (GHG) emissions to decelerate climate change is incontestable. Various infrastructure in urban neighbourhoods such as residential zones are responsible for a large part of the GHG emissions, especially because heating and domestic hot water is often provided individually by fossil-fueled energy supply systems. Thus, urban built district energy systems must be decarbonized. (IPCC, 2018; REN21, 2019)

Current policy measures of the European Union and several countries aim at upgrading buildings which underlie a fossil-fired energy supply (e.g. KfW, 2020). In contrast to individual heat supply, district heating systems (DHS) offer the possibility of absorbing (waste) heat from miscellaneous (renewable) energy sources, transporting it over (long) distances and providing it elsewhere in various buildings for (space) heating and domestic hot water (preparation). This fundamental idea of DHS is shown in Fig. 1. It is essential for the success of the energy transition that a mix of local energy sources and various technologies fulfil the DHS supply task in urban agglomerations and neighbourhoods and contribute in the long term to a sustainable and preferably emission-free energy supply including an improved energy efficiency.

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Traditionally, excess heat resources have their origin in other energy sectors, i.e. combined heat and power (CHP) plants for electricity generation or industrial processes. Today, there is an additional interest in the use of renewable heat in DHS. A combination of providing recycled and renewable heat is the focus for future DHS. As a result primary energy supply for heat demands will be substituted and lower environmental impact will be achieved. Some potential renewable energy technologies in DHS are solar thermal collectors and heat pumps. Both have better economic and environmental costs and benefits at a (large) district scale compared to an individual building scale. For this reason, their application in DHS makes particular sense. In the future, they will be of great importance, as fossil-fired DHS supply possibly needs to be replaced over time as far as possible. (Frederiksen and Werner, 2013; Wiltshire, 2016; Werner, 2017)

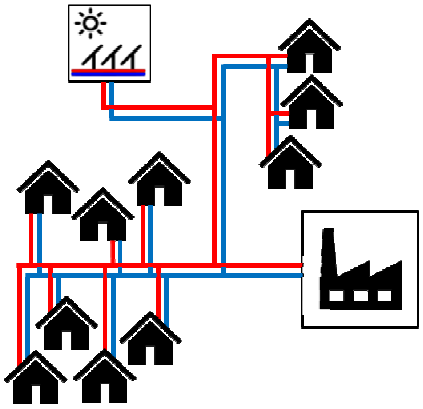

Fig. 1: Schematic overview showing the basic parts of a DHS according to its fundamental idea.

In general, DHS are unique, e.g. regarding their use of resources or network size. Some of the biggest cities in Germany (e.g. Hamburg) respectively agglomerations (e.g. the Ruhr area) rely on DHS to provide space heating and domestic hot water. DHS in-feed is mainly based on CHP, because the plant operation can be optimized by producing at times with attractive power market in-feed tariffs (cf. Fang and Lahdelma, 2016). However, the operation of CHP plants is controllable, so it is possible to achieve a beneficial in-feed for both, DHS and the power grid. In 2018, heat from CHP plants accounted for 80 % of DHS supply in Germany. In the future the combination of (de-) centralized CHP plants and DHS in urban areas is reasonable, since there is a link between the residual power load and the heat load. Especially in times without wind and sunshine CHP plants can meet delivery obligations for DHS as well as flexibility requirements for the power grid with a high efficiency. However, to achieve sustainable (district) energy systems deep energy savings are required and also the integration of renewable energy sources must be pushed forward both in the electricity market and the heating market. (Connolly et al., 2014; Werner, 2017; AGFW, 2019; Thommessen et al., 2019)

2.1 Integration of renewable heat into district heating systems

Locally or regionally operating DHS business utilities often face a number of problems when upgrading the DHS performance or considering renewable energy supply possibilities for their existing infrastructure. Basically, technical and operational parameters of several generation technologies are the former constraints in the decision-making during all stages from (economic) planning, through construction until operation, especially for generation plants that generate heat from renewable energy sources. In addition, a major problem in many high dense urban cases is the availability of space or the competition in the use of (free) land. Ongoing (sub-) urbanisation results in cities with high energy demands but scarce land for an efficient (district) energy supply and distribution, especially in DHS. Such initial conditions make the integration of renewable heat more difficult since a specific amount of space is required. (Miglani, 2018)

Moreover DHS operation temperatures are crucial to the overall system efficiency. Current DHS research focuses inter alia on optimizing supply and return temperatures. Hereby, the development of better piping technology is ongoing. Improvements are needed in order to become a reliable, cost-efficient basis of novel DHS schemes with lower temperatures and a larger share of renewable energy sources. Furthermore, the mature technology of surveillance systems, sophisticated controls and heat meters needs to evolve to make DHS smart in the sense of digitalization. Several studies show that DHS operation temperatures will

decrease, so that heat loss reduction and an efficient heat generation become crucial. (Wiltshire, 2016; Werner, 2017)

In Germany, the integration of e.g. large-scale heat pumps or solar thermal plants is becoming increasingly important which is apparent from the fact that the last call for bids to fund innovative CHP systems was oversubscribed for the first time in December 2019. Innovative CHP systems are defined as selected and modern systems with a high energy efficiency and low-GHG emissions. As a requirement the cogeneration plants need to be operated in flexible combination with other technologies, i.e. to achieve a high portion of heat supply from renewable energy. Therefore, an innovative CHP system consists at least of three components, i.e. the CHP plant itself, a component for the provision of renewable heat (e.g. solar thermal) and a electric heat generator (e.g. direct electric boilers). As a constraint the production of cogenerated electricity and heat is intendet to be useful for both the power grid and DHS and thus, must accord to demand or loads, respectively. Additionally, the individual components of innovative CHP systems must be jointly regulated and controlled. (BAFA, 2020; BNETZA, 2020; cf. KWKG, 2020)

2.2 Cannibalization effect and financial issues

To achieve higher shares of renewable energy in DHS the integration of solar thermal energy and heat pumps makes particular sense. However, operation times of those technologies cannibalize each other since solar radiation and the required temperature from other renewable heat sources are mainly reached in the summer and transitional periods of a year. Thermal storages can bridge the time between supply and consumption, but require additional free space and imply higher costs for investment and operation. Fig. 2 comprehenses the common cannibalization effect of solar thermal plants and heat pumps in urban DHS in a graphical way.

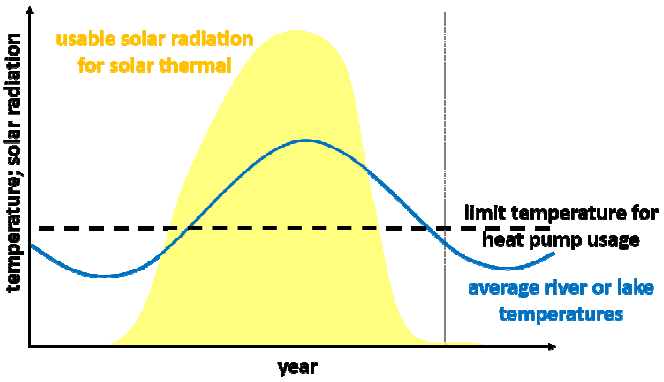

Fig. 2: Cannibalization of operation times for solar thermal plants and heat pumps by means of solar radiation and the temperatures of predestined heat sources.

Next to technical operation parameters financial issues always play a great role in the choice of energy supply source in DHS. Regarding the technologies in focus in this contribution, various advantages and disadvantages can easily be identified, which are related to the long-term economic operation of the energy supply plants.

Depending on the targeted energy yield, a solar thermal plant requires a certain amount of free space, which is (as described before) usually very limited in urban agglomerations. These systems can be mounted on roofs, which in turn places new static requirements on buildings. For planning reasons, it is generally easier to install solar thermal collectors on new buildings than to retrofit it on existing buildings. As shown in Fig. 2, the operating times are relatively easy to predict during the summertime of a year. This means that other operating parameters (e.g. thermal storage, DHS pipe dimensioning) can be easily determined with the aid of suitable calculation tools. Depending on the potential location of a solar thermal plant and the required operating conditions, the investment costs can be determined. Operating costs of solar thermal plants for e.g. pumps or maintenance are usually the minor expense and are usually subordinated when considering the entire lifetime of a solar thermal plant. (cf. Mangold, 2020)

The feed-in of environmentally sustainable heat by using heat pumps makes sense in DHS, especially since this technology can be achieved in a cross-sectoral manner to serve the power network as well. For large DHS, there are special requirements for the heat source of the heat pump, which is correspondingly of a large-scale. In order to achieve high feed-in capacities, high volume flows from a heat source are necessary,

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which should also have a certain temperature level. Usually lakes or rivers are suitable for this purpose, but their temperature fluctuates over a year. It follows the outside temperature (very) phase-shifted and with (strongly) attenuated peaks, which depends on the size of a lake or river. However, in certain seasons of the year, operation often has to be discontinued in order not to cool down the public waters too much, e.g. for reasons of species protection. Heat pumps which take advantage of the ground temperature that rises with depth, operate at relatively constant source temperatures. But the costs of drilling are for most European countries not yet in a reasonable proportion to the energy yield. Generally, a large-scale heat pump that is well designed in accordance with the existing conditions of the heat source requires little space in comparison to a solar thermal plant, although (also for reasons of operational control) a separate operating building must usually still be erected at the selected heat pump location. However, financial issues regarding heat pumps in Germany do not depent on technical operation. Current research shows that the integration of large-scale heat pumps into DHS are not cost competitive with (existing) fossil-fired units because of the regulatory and economic framework. (cf. Popovski et al., 2019)

2.3 Aim of this contribution

All in all DHS technology is improving and business actors react to political efforts to ensure a sustainable energy supply for society. In high-dense urban cities DHS imply low heating costs due to the ability to (re-) use a range of (locally available) heat sources, especially heat from CHP plants and waste heat from industrial processes, as well as renewable heat from solar thermal plants or (large-scale) heat pumps. However, limited space and technological as well as environmental requirements lead to challenges regarding a sensitive DHS network and supply design for a secure energy supply. Considering the number of DHS supply possibilities in current issues, e.g. arising from legislative framework (cf. BAFA, 2020), optimization modeling can be a tool for an improved design of DHS in urban districts or neighbourhoods.

The main goal of this contribution is the development of a computational method in order to determine the optimal design of renewable energy supply for urban districts with DHS. There are several tools available, e.g. to determine excess heat potentials (cf. PETA4, 2020), but decision-making regarding improving DHS supply actually focusses on solar thermal plants and large-scale heat pumps for legislative reasons, e.g. in Germany as mentioned above. Since the operation of those technologies cannibalizes each other, finding an optimal energy supply design considering those renewables as integration into existing DHS can be complex. Mixed integer linear programming (MILP) is chosen to develop a model with the implementation of both options solar thermal plants as well as large-scale heat pumps in DHS. This contribution attempts to address the challenges associated with the modeling of optimal DHS supply design and operation of solar thermal plants and large-scale heat pumps in the long-term.

3 METHODOLOGY AND MATHEMATICAL MODEL FOR IMPROVED ENERGY SUPPLY

The optimization approach developed within this contribution minimizes the total investment costs and considers GHG emissions (in carbon dioxide equivalents) of an energy system. It includes a formulation which allows the analysis of the impact of large-scale heat pump operation on the temperature of several heat sources (ground and river water) with respect to the fluctuating performance due to external factors (as measured by the coefficient of performance, COP). The mathematical model for an improved renewable energy supply design in urban neighbourhoods was developed to overcome the problems arising from the cannibalization of solar thermal and heat pumps mentioned before. With the MILP-model combinations of different renewable energy sources and their integration into a DHS can be identiefied as start values for further steps, i.e. detailed planning and economic calculation for a supply concepts lifetime. The general purpose of the model is shown as a graphic in Fig. 3.

For the general MILP-model some indices, parameters and (decision) variables are being introduced for time steps, heat pumps, solar thermal and transport pipes (in order of appearance):

$$t = 1, \dots, T$$
$$hp = 1, \dots, HP$$
$$st = 1, \dots, ST$$
$$tp = 1, \dots, TP$$

The mathematical model computes minimal total investment costs (TC) with the objective function and related emission savings (TE) for different alternatives integrating heat of renewable sources with a second function:

$$min\ TC = \sum_{hp=1}^{HP} C_{hp} + \sum_{st=1}^{ST} C_{st} + \sum_{tp=1}^{TP} C_{tp}$$

$$TE = \sum_{t=1}^{T} \frac{e_{ref} \cdot D_t}{\eta_{ref}} - \sum_{hp=1}^{HP} E_{hp} - \sum_{st=1}^{ST} E_{st} - \sum_{tp=1}^{TP} E_{tp}$$

$$S_{hp,t} + S_{st,t} + S_{tp,t} = D_t \quad \forall t$$

For the calculation of emissions (E) and the related savings (TE) an energy supply reference (ref) is to be assumed (i.e. often individual supply by heat boilers on a building-scale). The main calculation of the economic variables depends on the selected technology mix, which ensures the energy supply of the neighbourhood for the selected period (e.g. usually one year). This is represented by the third equation above, whereas the demand (D) represents the heat load as well as the energetic DHS losses. In this context, different energy equations must be considered for several supply (S) possibilities:

$$S_{st,t} = \tau_{stm} \cdot SR_t \cdot A_{st} \cdot (1 - \rho_{stm}) - \left(k_{0,stm} \cdot A_{st} \cdot (T_{st,t} - T_{a,t}) + k_{1,stm} \cdot A_{st} \cdot (T_{st,t} - T_{a,t})^2\right) \quad \forall st, t$$

$$S_{hp,t} = COP_{hp,t} \cdot P_{hp} \quad \forall hp, t$$

$$COP_{hp,t} = f(K_{hp}; T_{source,t}; T_{supply,t}) \quad \forall hp, t$$

$$S_{tp,t} = \dot{m}_{tp,t} \cdot c_p \cdot (T_{DHS,supply,t} - T_{DHS,return,t}) \quad \forall tp, t$$

$$\dot{m}_{tp,t} = \frac{\pi}{4} \cdot {d_{tp}}^2 \cdot \rho \cdot v_{tp,t} \quad \forall tp, t$$

As shown in detail for solar thermal plants, there are many parameters that influence the calculations depend on system properties (stm). This also applies to heat pumps and to the necessary transport pipes. Therefore, this documentation is limited to the essential influencing factors. All formulas regardig energetic conversion and supply are based on literature, where further and more detailed (e.g. time stepwise) calculations can be found, too (cf. Witte-Humperdinck, 2019; Wesselak, 2017; Cube and Steimle, 1978; Doering et al., 2016). Other current feasibility studies can be used for comparison in terms of energy calculation and evaluation (e.g. Bücken et al., 2017).

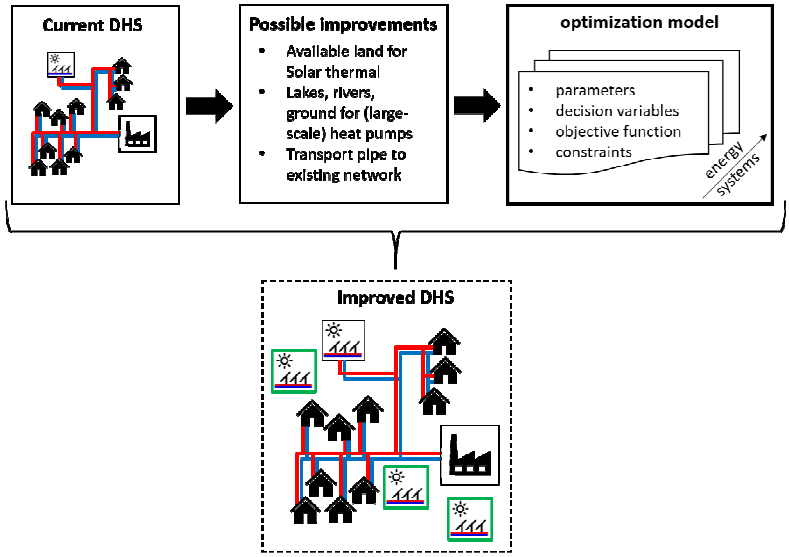

Fig. 3: Schematic overview of the optimization model for DHS supply design considering solar thermal plants and heat pumps.

In the case of solar thermal systems, the main factors for energy supply are the collector surface area (A), location based parameters such as solar radiation (SR), orientation or angle of inclination, as well as (solar thermal and DHS) system temperatures and ambient temperatures (T). In the case of heat pump operation, the COP is the most important variable. It depends on the capacity (K) of the heat pump and its specific

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system properties (e.g. refrigerant), and the temperatures of the heat sink (i.e. DHS supply) and heat source, which are possibly weather-dependent. In the case of transport pipes, the DHS temperatures and the maximum transport capacities (m), which can be determined on the basis of the pipe geometry, are decisive for reliable operation. Constraints referring the (existing) network layout are considered in pipe diameters (d) and its maximum flow capacity (v) (cf. ÖKL, 2016).

However, for cost calculation the main decision variables are the choice of possible plant sizes (K for heat pumps and A for solar thermal) and transport pipe parameters (d for the diameter and l for the length):

$$C_{hp} = C(K_{hp})$$
$$C_{st} = C(A_{st})$$
$$C_{tp} = C(d_{tp}; l_{tp})$$

For programming and solving this MILP-model, special software is needed. A common solver is CPLEX. While solving this optimization problem, DHS topology and the defined energetic and ecological constraints above lead to a selection of plant combinations which represent the optimal solution to lower the emissions regarding the investment costs. In parallel to the underlying heat network design, the potentially possible supply concepts play a decisive role (e.g. connection to existing networks, construction of new generation plants).

However, in general the MILP-model developed considers distributed locations and sources in existing or new-built DHS in urban neighbourhoods. As the available space in high dense urban districts limit the amount of possible solutions drastically regarding solar thermal plants, the main focus is often on local optimal solutions for (large-scale) heat pumps or transport pipes, which connect DHS. Hereby, maximum pipe flow and operating times of heat pumps due to boundary conditions of heat sources are considered. In cases where a solar thermal plant is combined with a large-scale heat pump, the challenge is to overcome the cannibalization effect. Sometimes a combination of transport piping, solar thermal plant and heat pump is the best solution, because new transport pipes can transport renewable (excess) heat from both, solar thermal and heat pump operation in other networks which would otherwise be fossil-fired during times in which the cannibalization effect would be felt.

4 MODEL APPLICATION TO A CASE STUDY

In this section the mathematical model developed is applied to a case study in the German Ruhr area. After the second world war DHS were introduced in this area since there is a high dense population which implies high heat demands. Nevertheless, some parts in the Ruhr area rely on individual heating systems on building-scale. Improved DHS energy supply needs to be considered today and the MILP-model can support the decision-making. In order to illustrate this, at first the investigated neighbourhood is introduced.

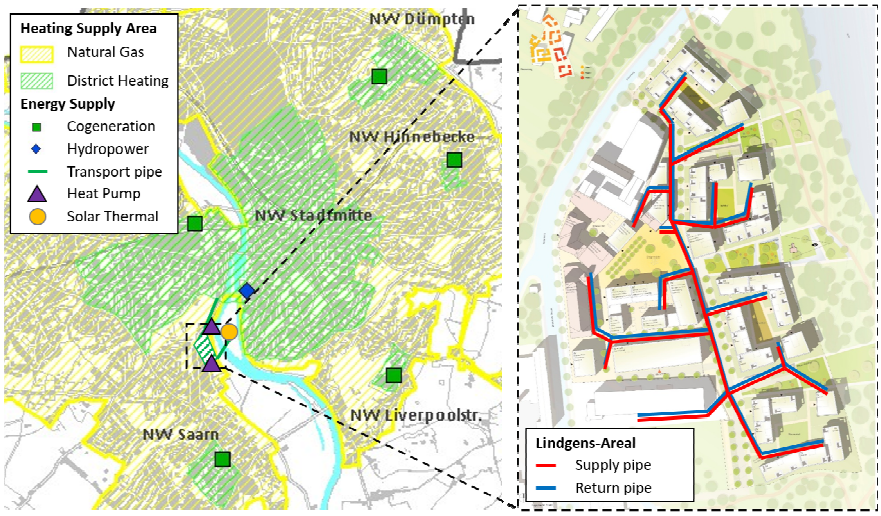

Fig. 4: District heating and gas supply areas in Mülheim (Ruhr), Germany, and localisation of the investigated neighbourhood (Lindgens-Areal) in the urban area. Existing energy generation plants and possible places for new heat pumps and solar thermal collectors assumed are included as well as a possible DHS route in the neighbourhood. (Modified from Marx, 2019; Rödel and Urbanski, 2020; cf. RHA, 2020)

The planned neighbourhood is located in the city of Mülheim (Ruhr) on the western side of the Ruhr river between the districts Broich and Saarn. It covers a total area of approximately 42 ha and is an urban development project of the former Lindgens leather factory. In the published urban development draft a scarcity of space and a resulting competition in terms of land use can be illustrated by the delimitation of the project development area. Fig. 4 shows the planned neighbourhood and the surrounding heat supply with all relevant energy generation facilities of a locally operating municipal utility. For the planned neighbourhood a new DHS with heat supply from a solar thermal plant and large-scale heat pumps is considered, too.

Due to its location several energy supply possibilites can be identified. There is an island in the Ruhr, located east of the neighbourhood. This area comes into question for the use of solar thermal energy, especially because of its size about 60 ha. Solar thermal collectors on the roofs of (new-built) objects in the neighbourhood are also sensitive. Furthermore, two types of large-scale heat pumps are considered, which differ in their heat source. The first uses river water and the second uses energy from the ground in the south of the neighbourhood, which can technically be implemented by e.g. borehole heat exchangers. Finally, a network connection to the existing DHS in the north must also be considered. The route of a transport pipe can be oriented along the course of the main road. Any connection pipes for correspondingly large energy supply systems are also taken into account.

4.1 Extract of data and relevant calculations of the model

Basic weather-related influences that apply to every possible energy supply design concept has to be determined carefully. For the MILP-model typical data is used for this purpose, which is called “Test Reference Years” (DWD, 2020). The outside temperatures and solar radiation are of particular interest. In the following Fig. 5 average values per month are representated at the location of the new neighbourhood.

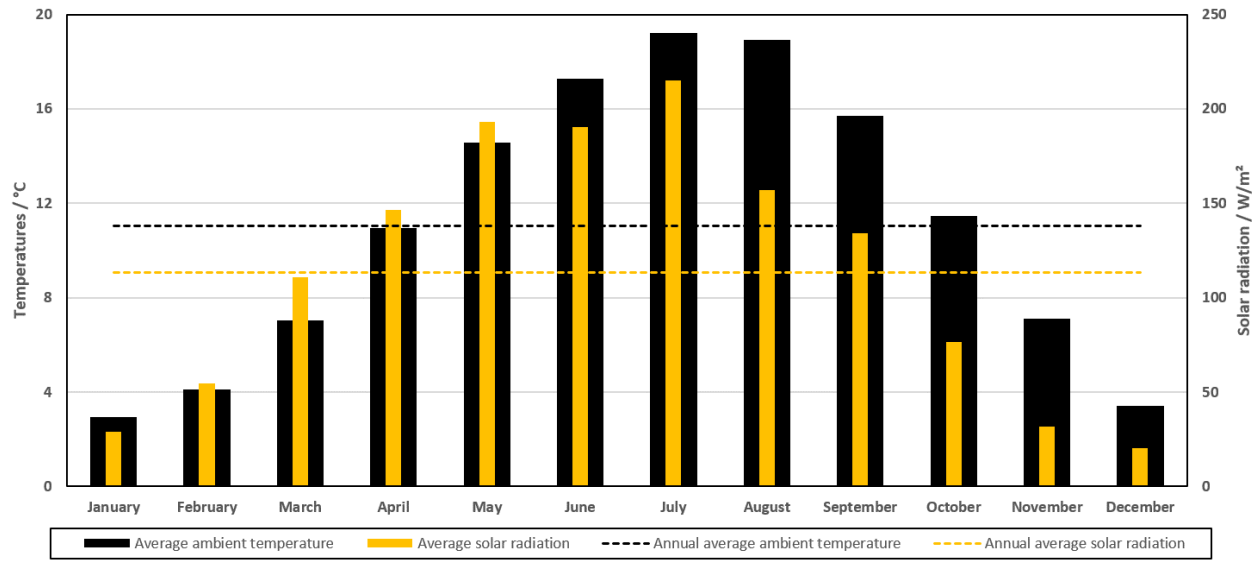

Fig. 5: Average ambient temperatures and solar radiation for the case study.

It is noticeable that the curves are similar. Of course, this was to be expected, as these curves can be understood as the cause of the cannibalization effect described at the beginning. Note in this figure that the values for solar radiation are somewhat distorted by the hourly resolution of the data set. During the day, obviously, higher values can be expected, especially in the summer period. The peak in the data set used is 918 W/m². An average annual temperature of around 11 °C can be determined.

However, all further calculations are based on the hourly values of the data set. This approach plays a particularly important role in all calculations for solar thermal plants. Various collector types from different manufacturers are also included in these calculations. These can be taken from another data set, e.g. (SKN, 2020). Within the framework of MILP-model development, a separate database was created with the typical solar thermal collectors from known large-scale projects in Germany. In order to calculate the two heat pumps considered in the model, different data must be collected for the Ruhr river water temperature and ground temperature, respectively. In the first mentioned case (LANUV, 2020) is a very helpful source of information. There is a collection of historical river water data (e.g. temperatures) and related details about

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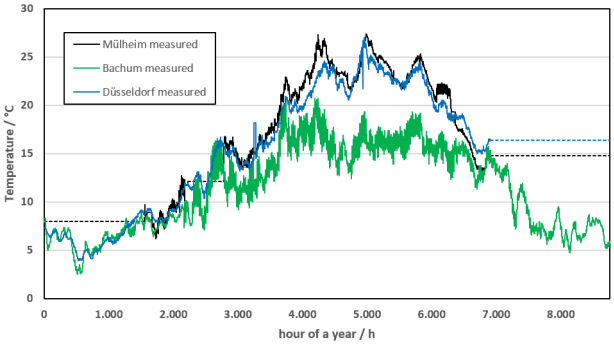
the geographical information of the metering stations in the German state of North Rhine-Westphalia. A station suitable for the area under investigation is located in the immediate vicinity of the hydropower plant (see Fig. 4). For the present MILP-model calculation water data of the past year are used. In general, it can be noted that the course of the water temperature follows the course of the ambient temperature with a slight time lag.

As Fig. 6 shows, there were gaps in the recording of the water temperature in some places. In the figure measured data is represented by completed lines and missing time periods are represented by dashed lines. The gaps may be related to malfunctions of the measuring devices. For this reason the temperatures were first compared with the temperatures of the next available measuring point upstream the Ruhr river. The location of this measurement is Bachum. It is noticeable that especially in summer significantly lower water temperatures of the Ruhr are present at this measuring location. It can be assumed that this is related to the industry located along the Ruhr river. Water from rivers is often used as a refrigerant in production processes or for (fossil-fired) electricity generation. Especially during summer it heats up. As many industries have traditionally settled in the Ruhr area, an increased use of river water as a refrigerant is to be expected and therefore, the variance of the measurements can be explained. In order to set reasonable values in the MILP-model calculation, the water temperature of the (spatially) next metering station was also compared. It is located in Düsseldorf on the Rhine river. Here, a similar course of the water temperature can be observed. From all available water data, the model calculates a representative annual course, which corresponds best to the data of the Mülheim metering station, if possible. Deviations are corrected in a meaningful way based on the measured values of the other two metering stations. Fig. 7 shows the calculated river water temperature for furhter system analysis within the MILP-model.



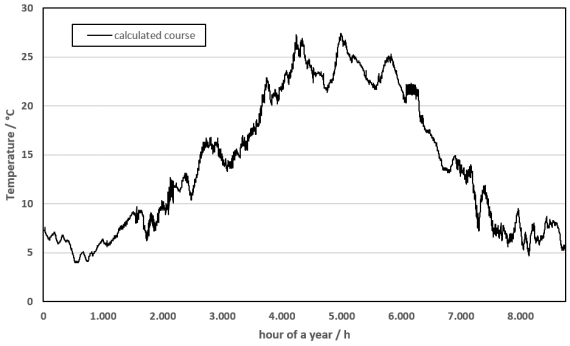


Fig. 6 (left): Water temperatures of relevant rivers for the case study calculation. Fig. 7 (right): Representative annual course of the river water temperature available for the operation of a heat pump.

Furthermore, different ground temperatures must be determined. For this calculation, the approach according to (Thommessen et al., 2018) is used, which is based on the ambient temperature data from (DWD, 2020). At a certain depth, the ground temperature responds very inertly or time-delayed to the ambient temperature and with very damped peaks. A baseload heat pump can make use of this for DHS supply, but the achievable temperature and energy yield must be in a reasonable relationship to the drilling depth and the costs related for boreholes. In the model a usual depth of 8 m was assumed. Additionally, the ground temperature at a common depth of 1.2 m for DHS pipes was determined to calculate the DHS heat losses in the neighbourhood according to (Thommessen et al., 2018). Fig. 8 above summarizes these results.

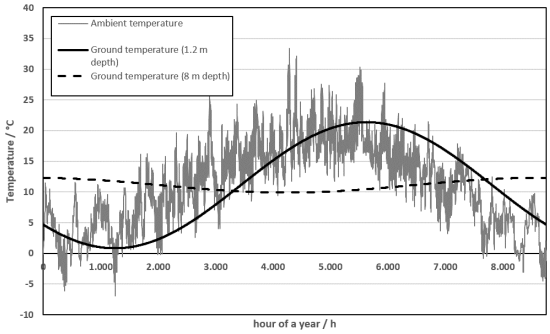


Fig. 8: Ground temperatures calculated from the ambient temperature.

In addition to solar thermal collectors, databases of heat pumps (and their essential system properties, e.g. refrigerant) and common pipelines were implemented. An exemplary approach for DHS route selection is presented in (Résimont, 2019). It was adapted for the purpose of this contribution to determine the routing of transport pipes which connect the investigated neighbourhood with existing DHS nearby. Basically, just one transport pipe to the existing DHS called "Stadtmitte" makes particular sense (cf. Marx, 2019).

Finally, the calculated DHS heat losses are included in the total energy demand of the neighbourhood. As described in the MILP-model a chosen energy supply design must cover the total demand at all times. In order to determine an annual energy balance in the neighbourhood a heat load curve is generated, as described in (Witte et al., 2019), which results in a required total heat demand of 2.1 GWh/a (heat demand of the buildings and heat losses of the DHS). Hereby, a sliding flow temperature control depending on the ambient temperature is assumed with DHS supply temperatures of 110 °C in winter and 70 °C in summer. The value of the DHS return temperature is assumed to constantly be 55 °C. The determined value for the total heat demand is consistent with the results calculated from other approaches (cf. PETA4, 2020; Möller et al., 2018), where e.g. an average DHS efficiency of 0.8 has been assessed at 100 % DHS share for the location of the investigated neighbourhood. Fig. 9 represents the heat load curve or the required heat supply, respectively.

Within the MILP-model, the economic calculations of possible energy supply solutions are based on established average values from literature. The investment costs of each possible solution is calculated depending on the main influencing factors of a supply option described in section 3. Specific average costs for solar thermal energy are estimated at 350 €/m². For heat pumps 2,000 €/kW are assumed. Regarding transport pipes, general costs of 1,000 €/m are considered. Additionally, individual costs (e.g. for civil construction) are assumed and added depending on the route of a transport pipe.

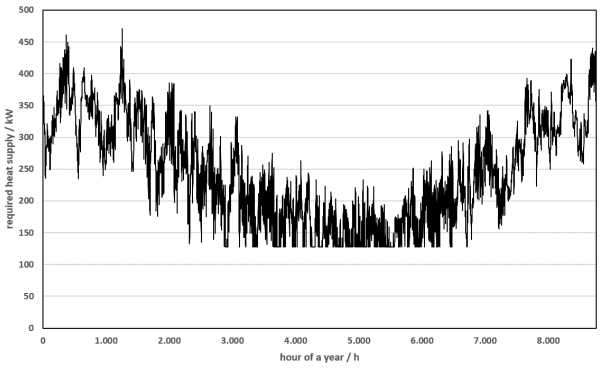


Fig. 9: Required DHS supply for the neighbourhood, calculated on an hourly basis.

4.2 Results

In this section the results of the energy system analysis performed with the developed MILP-model are presented. The approach differs from other current literature (cf. Witte-Humperdinck, 2019). However, similar approaches can be observed for energy system analysis as well (cf. Miglani, 2018). For an improved energy supply of the new neighbourhood an optimal concept consists of a river water heat pump and an additional transport pipe. The chosen heat pump operates with ammonia as refrigerant and a associated connection pipe from the river to the district is considered. The transport pipe is of size DN 300 and connects the DHS of the new neighbourhood with the existing network "Stadtmitte". The route follows the course of the main road over a length of about 1 km. The chosen concept implies total investment costs of 1.54 million € (in addition to the costs incurred in any case for the construction of the new DHS). The savings of GHG emissions calculated by implementing this district energy supply solution amount to 388,478 t carbon dioxide equivalent. The presumption that biomethane-fired CHP plants are operated in the existing DHS plays an important role in this assessment.

The heat pump selected can be operated through the year and therefore, it has many hours of operation. In winter full-load operation is not possible because the river water is cold and a minimum cooling down to 2 °C is set as a boundary constraint in the MILP-model. Nevertheless, a temperature control by pre-heating from the DHS with higher temperatures can be considered as an additional improvement, since a connection pipe for the heat pump from the river to the neighbourhood would have to be built in any case. However, the

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river water reaches high temperatures in summer, so that the energy conversion process of the heat pump works particularly efficiently. This can be seen from the course of the COP for the river water heat pump operation over one year. This is shown in Fig. 10 for the heat pump selected. The average annual COP amounts to 2.74. However, for the continuous operation shown, maintenance and service intervals would also have to be considered. Obviously, a heat pump cannot be operated during these periods.

No heat pump is selected that uses the ground temperature as a heat source due to the usable ground temperatures and the temperature of the DHS to be provided. During the course of the year, the required temperature rise to supply ground source energy into the DHS is often higher than the temperture rise of a river water heat pump. So the efficiency of the heat pump is finally worse. The cost of drilling also plays a major role. Furthermore, associated drilling costs are added to the costs for connection pipes. Although the ground source heat pump is located closer to the neighbourhood, additional costs for drilling are not justified. This result was to be expected. The fact that the developed MILP-model excludes such a supply possibility illustrates its suitability as a decision aid with regard to the feasibility of improved (and renewable) energy supply concepts.

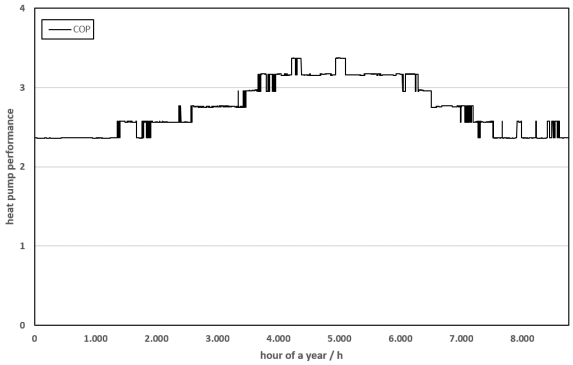

Fig. 10: Performance of chosen river water heat pump.

No solar thermal plant is part of the solution given by the model. One reason is that the year-round operation of the chosen river water heat pump can ensure a base-load supply on its own. Due to the free capacities in the existing network and the selected transport pipe, the energy needed to cover the demand beyond the supply of the heat pump is obtained. Moreover, the costs for connecting a solar thermal plant on the island in the river are extremely high. It would be imperative to build a culvert. In this context, further actions must be taken to ensure that the underground construction and related works are successful. Of course, such costs plays a role in the decision, too. Nevertheless, the MILP-model could have chosen solar thermal collectors on the roofs of the buildings in the neighbourhood, but the costs involved could have been avoided since the predictable operating time of such solar thermal plants makes no sense due to the DHS supply potential of the river water heat pump and, especially, to avoid the cannibalization effect.

However, if a thermal storage tank is integrated into the energy supply concept, the final result could look different again. Depending on the long-term strategy of the utility company (e.g. DHS expansion towards the south or connection of new customers along the transport pipe towards the north) it may make sense, if not even necessary. Of course, in such cases the total thermal energy demand increases. With the additional possibility of interim storage, more renewable energy from a solar thermal plant or a ground source heat pump could be fed into the DHS and via the transport pipe also into the existing DHS. However, energy supply from a new CHP plant should also be examined in further investigations. As shown in Fig. 4 above, various DHS in the overall urban area are supplied by a CHP plant.

The optimal supply concept chosen by the MILP-model meets the total annual heat demand of 2.1 GWh and, additionally, environment-friendly energy is fed into the existing DHS during the summer months. The energy balance for the neighbourhood shown in the Fig. 11 illustrates these relationships. The river water heat pump feeds a total of 1,317.7 MWh of thermal energy. About 12.5 MWh are transported into the DHS “Stadtmitte” in summer, while 839.8 MWh are drawn from it during the rest of the year.

In general, just over 60 % of the total annual demand is covered by the river water heat pump. On the one hand, this is due to the base-load operation of the heat pump and, on the other hand, to relatively low demand peaks in the winter and in the transitional periods. This is because a high standard of the buildings (e.g.

insulation) is expected as most buildings will be newly constructed in the investigated neighbourhood. The selected supply transport pipe covers the remaining heat load peaks.

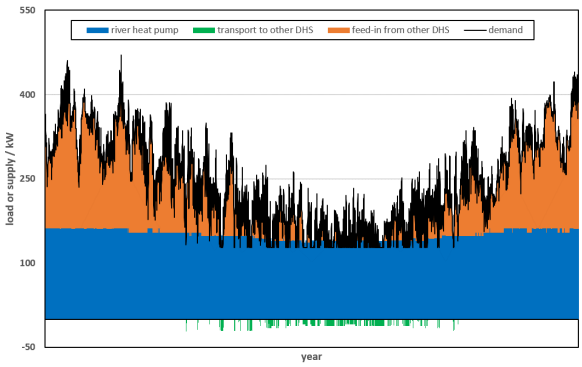

Fig. 11: Energy balance of chosen concept.

The energetic results determined support the decision-making process when examining the feasibility of improved DHS energy supply concepts. However, the results are based on many assumptions and variable parameters, so the calculations do not replace a detailed energy system design or final dimensioning (e.g. plant sizes or pipe diameters). In particular, the economic calculation of energy supply concepts should not be limited to the investment costs alone. In subsequent work also operating costs should be taken into account and should be discounted over the lifetime of the plants chosen for an optimal solution. In Germany, e.g., there is an awkward regulatory framework, so that the operation of heat pumps is not cost-competitive compared to other (fossil-fired) energy supply systems (cf. Popovski et al., 2019). However, the MILP-model created is an approach that can be further developed in any direction and take other influencing variables into account.

5 CONCLUSION AND OUTLOOK

There are many requirements for energy supply systems in urban districts. Especially in the heating sector the challenge of ensuring an improved energy supply for society and, e.g., the integration of more renewable energy (sources) is becoming apparent. Urban planning has to meet the expectations of various disciplines and business actors in order to implement energy efficient supply solutions both in new neighbourhoods as well as in existing urban districts. DHS can provide energy for space heating and domestic hot water in a particularly efficient and environment-friendly way. In order to encompass several sectors (i.e. electricity and heating) DHS is increasingly seen as an integral part of the overall energy system, e.g. to enable the usage of increasing and fluctuating renewable electricity.

In the context of this contibution, a MILP-model was developed, with whose it is possible to improve DHS energy supply concepts by examining various (renewable) energy supply options. The main focus was on solar thermal plants and large-scale heat pumps because their operating times are similar. In order to avoid this cannibalization effect, the model computes with annual data in high temporal resolution. Specifically, a mathematical optimization based on hourly data was carried out to investigate whether the construction of new plants is worthwhile. The final investment costs were used as a decision parameter. They vary depending on the energy supply source associated actions, e.g. civil constuction.

The functionality of the model was demonstrated using a current case study from the Ruhr area. Key findings are that, from an energy point of view, (existing) neighbourhoods, as well as (regenerative) energy supply possibilities, are individual and depend on many external impacts that can hardly be influenced or even not at all (e.g. solar radiation for solar thermal plants due to a geographical location). The boundary constraints implemented to calculate the case study mainly influence the result. However, by applying the MILP-model an energetically reasonable concept could be determined, which is associated with acceptable additional investment costs and a high saving of GHG emissions.

Furthermore, worthwhile approaches for further investigations or further development of the model were identified. The consideration of other technical systems, e.g. thermal storages, may be useful. Moreover, the consideration of operating costs as well as plant lifetimes is recommendable against the background of current political and legal conditions. Finally, the adaptation of the MILP-model to other use cases is also of

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interest in order to identify further improvement possibilities and to implement appropriate solutions for improved energy supply design in urban DHS.

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🏆 *reviewed paper*

Monitoring Street Infrastructures with Artificial Intelligence

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1 ABSTRACT

Sensor-based IoT data is enhancing information gathering methods for urban planning in many ways and, due to the growing data pool provided by these sensors, more and more cities and municipalities are consequently putting the use of artificial intelligence-based (AI) methods on their agenda. One area of urban planning that will benefit significantly from the new possibilities enabled by AI is that of infrastructure monitoring. As the topic of the investment backlog of German road infrastructures increasingly pushes into public discourse, many potential areas for application of such a system are opening up. Given the fact that a large part of the German road infrastructure was planned and built several decades ago, and considering that the traffic volume has increased tremendously since then, the urgency in the development of improved maintenance methods is evident: Today's solutions for infrastructure monitoring are either too labor-intensive, too resource-intensive or too inflexible for the scenario at hand. However, a promising avenue for further research opened up through the advent of mobile communication devices, such as smartphones, in combination with artificial intelligence approaches. This paper describes the methodology applied in the ongoing research project DatEnKoSt, in which these comparatively cheap and sensor-laden devices are used to realize low-cost acquisition methods: Mounting the smartphone in a vehicle, a multi-sensor datastream can be recorded, including, for instance, accelerometer data, GPS coordinates, image or even audio data. From the datastream, features correlated with the road condition can then be extracted, e.g., image processing methods may extract individual cracks from the image data, signal processing can aid analysis of the accelerometer data to determine strength of vibrations, etc.. Using supervised learning methods, these features may be mapped to standardized profiles of the current state of the infrastructure. Even more, predictive methods can, in addition to a mere monitoring of the current state of the infrastructure, enable new ways to provide more precise forecasts and eventually, leveraging optimization algorithms, automatically derive the right maintenance measures for each given situation. The municipal preservation of traffic routes becomes more efficient and sustainable. The methodology enables the potential for further use in the light of real-time as well as predictive road infrastructure monitoring such as winter road services.

Keywords: Sensor-Based, Predictive Maintenance, Street Conditions, Infrastructure Monitoring, Artificial Intelligence

2 THEORETICAL FRAMEWORK

In recent years, the discussion regarding the investment backlog in German road infrastructure has increasingly entered the public discourse, mainly because large parts of Germany’s road infrastructure were planned and built several decades ago. Since then, general traffic volume increased steadily, with heavy goods traffic in particular causing disproportionate damage to the roads due to heavy vehicle weight (Bundesanstalt für Straßenwesen, 2017). This raises the question, how to detect and monitor these damages as well as predict potential issues in the context of small public budgets. For instance, if fine cracks in the asphalt aren’t recognized as road deficiencies in the same way potholes are, they can cause just as much damage to vehicles. In general, two methods of collecting street-related data can be distinguished: A sensor-based approach –which our project is focussing on – and an approach based on user-generated-content (UGC), where people manually detect and report issues, as can be seen in various projects in recent years (FixMyStreet, 2015; Rock Solid, 2019). In order to understand the need for new approaches to monitoring and maintenance, it is worth taking a look at the recording practice currently in use. At the state level the condition of the classified road network is determined at regular intervals according to the precise guidelines for condition recording and assessment (Bundesanstalt für Straßenwesen, 2020) although very few local authorities can resort to such methods due to the high costs involved. Instead, the condition is usually determined in relation to the problem, but only retrospectively by specialist personnel, who record the problem areas on a sample basis and in a partially analogous manner (often still with pen and paper). Such

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measurements are subjective by nature, which leads to a suboptimal data basis for decisions on and prioritisation of investment measures.

The automatic, sensor-based approach can be further distinguished. One option is a 'dedicated' approach, in which purpose-built vehicles are equipped with sensors (StreetScan, 2017; Ramboll, 2019; Vaisala, 2020) which are primarily configurated and maintained by service providers. In the second approach, which has an auxiliary character, ordinary vehicles are equipped with supplementary sensor technologies. Hence, no purpose-built vehicles are needed and the data-gathering is done by enhancing exisiting vehicles with easily attachable, consumer-market mobile sensor technologies (such as smartphone e.g.). DatEnKoSt, presented in this article, and other projects utilizing this second approach exemplify the flexibility and ease of implementation of such an approach (MIT Senseable City Lab, 2018; NewUrbanMechanics, 2019; RoadBotics, 2019; Vialytics, 2020). The reason lies in the fact, that we wanted to design a light-weight approach which can be adapted as easily as possible by the communities and tailored to the respective challenges at hand. In addition, due to limited resources, only prolonged investigation cycles are feasible for most communities, which makes an actually interesting real-time observation impossible. Those responsible therefore lack a tool, which, in contrast to classic, standardised procedures, proactively guarantees a more cost-effective and yet qualitatively adequate status assessment of road infrastructures. These new technological and methodological possibilities include mobile communication devices (IoT approach) for sensor data acquisition, which can continuously collect real-time data and use AI for evaluation.

3 METHODOLOGY

A suitable solution for monitoring and maintenance of streets for municipalities has to be affordable, simple and flexible to use. In this section, we first discuss why and how a combination of smartphones and AI algorithms can meet these requirements (Sec. 3.1) before giving a general overview of the approach (Sec. 3.2) and describing its major steps (Sec. 3.3-3.4).

3.1 Motivation

Public authorities need precise and as up-to-date as possible data in order to maintain their roads but they are struggling to find appropriate, cost-sensitive ways to gather these data. Existing, standardized forms of data acquisiton are offered by specialized companies but are too expensive for most municipalities: The average price per kilometer can reach up to €150. For an average German town that would mean hundreds of thousands of euros in order to obtain the data for their street network. In contrast, the methodology we put forward in this paper would allow for data gathering of comparable magnitude for a fraction of this sum. There are two main reasons why a standardized monitoring according to precise guidelines such as the German ZEB are so expensive. The first reason is that highly specialized measuring hardware is being used. Typically, measurement vehicles are equipped with multiple precise sensors: Multiple laserscanners, to measure the evenness of a road both in the driving and ortohogonal direction, several cameras to take images of potential cracks and potholes, a customized construct consisting of a slanted wheel and more sensors to determine the grip of the road. As an example, the measurement system S.T.I.E.R. by the German company Lehmann + Partner specialized in ZEB data acquisitions has an estimated value of roughly one million euros (Renninger, 2018). The second reason is the high manual effort for processing the acquired data. In particular, surface damages such as cracks have to be annotated for many thousands of photographs.

Interestingly, both reasons, the necessity of expensive sensors and the high manual effort for data labeling, can be adressed using AI, as examples from other domains than urban planning show. Regarding the necessity of expensive sensors to obtain measurements at a sufficient level of quality, the example of smartphone cameras demonstrates that intelligent processing methods can, to a large extent, compensate for the deficiencies of the comparatively cheap hardware used. Despite physical limitations due to the small size of their image sensor, such as noise, or of their lenses, such as color fringes, smartphone cameras can nowadays compete with medium-priced dedicated digital cameras. E.g., de-noising methods help to reduce visible noise, other image processing methods remove color fringes or distortion, and even image contrast and exposure can be optimized automatically using AI-based methods (Draa and Bouaziz, 2014). AI can also help when it comes to reducing manual data labeling effort. Supervised learning methods can learn how to label various types of data automatically based on a set of training data containing exemplars. One popular example is object detection, that is, recognizing relevant objects in images and assigning them to a defined

class, such as “car”, “dog” or “building”. This task, which has applications in image search or surveillance scenarios, can be solved with accuracy levels of up to 90% using Deep Learning approaches (Zhao et al., 2019).

3.2 Overview

The insights outlined in the preceding paragraph motivate the idea to transfer the same approach to the domain of infrastructure monitoring, leveraging intelligent processing methods to allow for cheaper monitoring equipment and reduced manual effort.

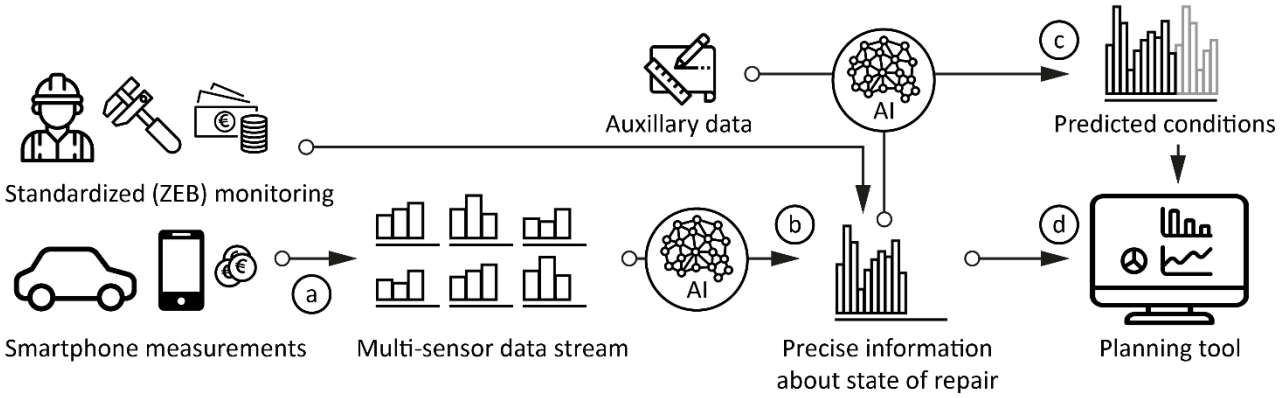

Fig. 1: Overview of the proposed methodology and the data flow.

The core of the proposed methodology (Fig. 1) is the use of smartphones as relatively cheap but still versatile measurement hardware. Modern smartphones are equipped with a wide range of different sensors: multiple image sensors, accelerometers, gyroscope sensors, microphones and GPS receivers, to just mention the most common ones. This means that, mounting such a device in a vehicle and driving along a road, a diverse stream of multi-sensor data can be recorded (Fig. 1, a). In doing so, the respective condition of a road is implicitly reflected in the recorded data: The accelerometer will record stronger vibrations for uneven or cracked roads than for freshly paved ones. When orienting the smartphone so that its camera is pointing towards the road, individual potholes and surface problems will become visible in the recorded photographs. To derive the actual road condition from the multi-sensor data stream, this mapping of road quality and recorded data has to be “inverted” for which supervised learning may be used to generalize from existing, standardized quality data for a set of roads (Fig. 1, b). This step will be detailed in the following section. Estimating the current state of the road network in this way already greatly lowers the monitoring costs. However, AI can additionally be used to assist in the decision for resulting maintenance tasks, based on the monitoring data. Combining sequence prediction and optimization approaches, the expected future condition can be estimated (Fig. 1, c) and automated suggestions for the next maintenance tasks to be undertaken can be generated (Sec. 3.4). Finally, the integration of the aforementioned AI components into a planning tool for municipal administrations (Fig. 1, d) is planned. The tool will allow the administrative staff to access recent monitoring results and predictive functions in an easy to use way.

3.3 Prediction of Road Condition from Sensor Data

The aim of this step is to map data recorded while driving along a particular street or road to a standardized quality profile as accurately as possible. On an abstract level, this corresponds to a supervised learning problem: Given smartphone sensor data and precise monitoring data – within the scope of this paper, we will focus on data obtained according to the ZEB standards – the goal is to train a machine learning method to predict the latter from the former. A model trained in this way takes the smartphone data recorded for a road segment as input and returns an estimate of important quantitites such as the evenness, the cracking and others.

Achieving this requires three steps: First, a labeled dataset has to be constructed, consisting of both smartphone-recorded data (Fig. 2) and ground truth quality profiles for a set of street/road segments and ideally recorded at the same point in time or with small temporal delay. The second step involves the extraction of a set of descriptive features from the raw sensor data recorded for each segment. Different features can be extracted from different types of sensor data. The third step is then to train a supervised model to finally map the extracted features to the desired quality output based on the labeled dataset.

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Fig. 2: Smartphones are mounted on the windshields of vehicles and used as mobile sensor units. Image credit: Cyface GmbH.

3.3.1 Building a Dataset

Fig. 3: Exemplary road segments from a ZEB acquisition. Good segments are colored green, problematic ones range from yellow to red (black means no measurement was possible). The left image shows cracking while the right one depicts evenness. (Own Source)

The foundation for any machine learning application is a dataset. In our scenario, the dataset will consist of sensor data measured by using a smartphone on one hand and corresponding ground truth ZEB data for the same set of roads on the other hand. ZEB measurements are defined with respect to segments (cf. Fig. 3). These segments have a length of either 100 meters when measured for a road (outside of town) or 20 meters, respectively, when measured for a street (inside of a town). The location of each segment is uniquely defined by the two adjacent nodes ("Netzknoten") of the road network that it is located in between of and an offset in meters that specifies the driving distance from one of the nodes. The smartphone sensor data is recorded over the course of multiple sessions, alongside a GPS track. Using a map matching algorithm (Karich and Schröder, 2014), data can be first assigned to the correct street or road it has been recorded on and then be split up according to the defined segments it covers. For the corresponding standardized data, we draw from two sources: Data for roads has to be acquired on the federal state level by law, usually in intervals of four years. In Germany, this data is publicly available upon request and can be used as is. As outlined in Section 2, the situation is different for most German communities which cannot afford the same measurements. Nevertheless, it is crucial to also include intracity streets in the dataset as their characteristics can vary from those of rural roads and a machine learning model only trained on country roads may not generalize well for communal roads, which our system is mainly intended for. Within the scope of our project we therefore commission a ZEB acquisition for a set of streets to obtain the necessary data.

3.3.2 Feature Extraction from Multi-Sensor Data

In the feature extraction step, a number of meaningful quantities is derived from the original raw sensor inputs. The idea behind this is to reduce the necessary complexity and amount of training data for the

subsequent supervised model (Sec. 3.3.2) by providing it with data that has a more direct relation to the different quantities to be predicted than the unprocessed sensor data. While a prediction of actual ZEB results from multi-sensor data has not been done before, different researchers have proposed heuristical methods to derive rough estimates of "street quality" usually based on the data of only a single type of sensor at a time (Chugh, Bansal and Sofat, 2014). The processing steps proposed in these works can serve as building blocks to form a robust set of initial features. We will detail some frequently chosen types of features in the following, giving examples for accelerometer and image data.

Concerning accelerometer data, common simple features are the minimal or maximal sensor values recorded for a segment (Allouch et al., 2017), various statistical moments (mean, variance, …) of those values (Rajamohan, Gannu and Rajan, 2015) or features automatically extracted from the frequency spectrum, for example using correlation-based feature selection, of the sensor data which can be obtained using the fast fourier transform (Allouch et al., 2017).

Regarding image data, one type of approach that can be used for feature extraction in the context of our proposed system are crack detection methods. Given an input image, these methods highlight the parts of the image corresponding to potentially different types of cracks. Examples are the works of Mokhtari (2015), Quintana, Torres and Menéndez (2015) and Kim and Cho (2018). The output of these approaches can be easily translated back into numerical features for the final supervised learning step, e.g. using the percentage of (road surface) pixels in the image corresponding to cracks. This is not very different from the actual ZEB standards, where a similar estimate of the percentage of the surface suffering from cracks is determined, albeit in a manual way.

3.3.3 Supervised Learning

Supervised learning is a certain type of machine learning setting in which the task is to learn a mapping from input to output data where the mapping is not given explicitly but only implicitly in the form of a set of sample pairs of inputs and corresponding outputs, respectively (Russell and Norvig, 2016). In our case, the input data consists of the features extracted for the road segments in the dataset (Sec. 3.3.1) which in turn have been computed based on the original sensor measurements, the outputs are the corresponding standardized quantifications of the road's condition measured according to the ZEB guidelines. The wide range of possible supervised learning algorithms that may be used in this step include, among others, artificial-neural networks, decision trees or support vector machines.

3.4 AI-based Maintenance Support

Besides reducing the costs for a more objective and detailed data acquisition that captures the current state of repair of a community's streets as described in the preceding section, artificial intelligence methods can in a second step also facilitate maintenance planning. Sequence prediction methods can be trained using snapshots of the state at different points in time to generate forecasts of future degradation. Currently, maintenance planning on the federal state level is mainly based on heuristics that try to model these developments. A data-based approach using supervised learning can potentially offer more precise predictions than a heuristical model. In particular, additional knowledge such as the traffic volume over time, the type of pavement used or the speed limit can be taken into account in the machine learning process in a flexible way and enhance the forecast, even if their effects would be hard to capture using a hand-crafted model. On the technical side, several algorithms for sequence prediction have regained attention recently and will be evaluated within our project. Especially recurrent neural networks (Hochreiter and Schmidhuber, 1997) have proven to be valuable for difficult sequence prediction tasks like translation (Sutskever, Vinyals and Le, 2014) or image captioning (Vinyals et al., 2015). When combined with an optimization approach like a genetic algorithm (Goldberg and Holland, 1988), these predictive methods can, furthermore, be valuable for generating automated suggestions for maintenance planning to assist municipal planners.

4 FIRST RESULTS

In this section we present some of the findings from our still ongoing project.

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4.1 Image Analysis

Fig. 4: Automated ROI detection. We combine information from line detection using the Hough transform (left) and a semantic scene segmentation approach based on Deep Learning that is able to detect the parts of the image pertaining to the street or road (middle) to automatically determine a quadrilateral region of interest for each image. (Own source)

The image data recorded using the smartphone is one of the most valuable sources for the extraction of meaningful features that can then be relevant for the actual prediction of the condition. The first problem that has to be tackled working with the images is a suitable pre-processing. While the images used for standardized ZEB measurements are taken using multiple calibrated cameras mounted outside of the car so the camera viewing direction is orthogonal to the surface of a road and images show nothing but said surface, the situation is very different using a smartphone mounted in the windshield of a car for data acquisiton. Only a small portion of the image, the one showing the street or road surface of the current driving lane, is actually relevant for the feature extraction. To automatically detect this region of interest (ROI), we combine a line detection algorithm based on the Hough transform (Matas, Galambos and Kittler, 2000) (Fig. 4, left column) with a Deep Learning-based scene segmentation approach (Fig. 4, second column) (Zhou et al., 2018). While the line detection step enables us to identify the boundaries of the lane (lane markings or curbs, Fig. 4, middle column), and therefore the left and right delimitations of the ROI, the segmentation allows to choose the top and bottom ones such that we neither include portions of the dashboard nor of things located above the street's "horizon". This works quite well in most of the typical scenarios, both inside (Fig. 4, first row) and outside of a city (Fig. 4, second row). Current limitations become apparent in situations when there are no prominent lines that can be clearly attributed to lane markings or curbs (Fig. 4, last row), e.g. at crossroads or in turns. The computed ROIs for three sample scenarios are shown in the rightmost column of Fig. 4.

After the initial ROI detection, meaningful features for the supervised learning step have to be extracted. One approach to this is to use deep neural networks trained to detect the cracked regions within the cropped ROIs to determine the share of the road surface that is cracked. In our initial experiments we compared two existing methods: U-Net, a deep neural network which is able to produce dense segmentations of an object category of interest such as cracks (Ronneberger, Fischer and Brox, 2015) and a second approach which performs a patch-wise classification of cracked vs. non-cracked regions (Cha, Choi and Büyüköztürk, 2017). Exemplary results for a sample image are shown in Fig. 5. Both approaches can identify many of the present cracks and allow to estimate the relative area of the cracked surface.

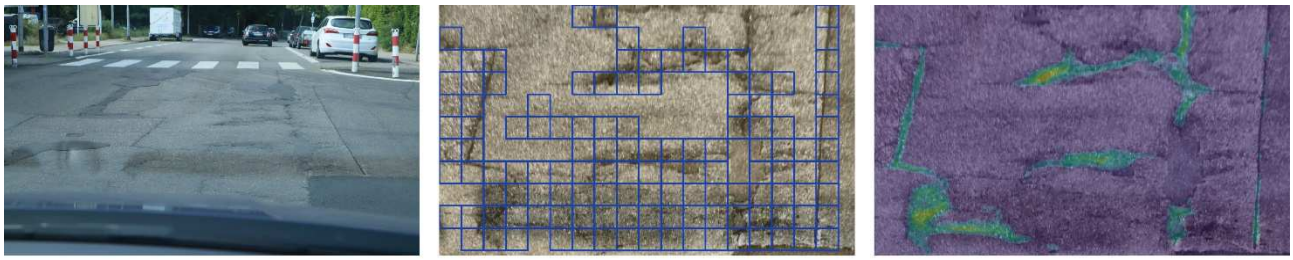

Fig. 5: Detection of cracks in the street surface. The left column shows the original input image from which the ROI is cropped using the described approach and then fed into two crack detection methods (second and third column). From these outputs, numerical features for the state of repair prediction can be derived. (Own source)

4.2 Accelerometer Data Analysis

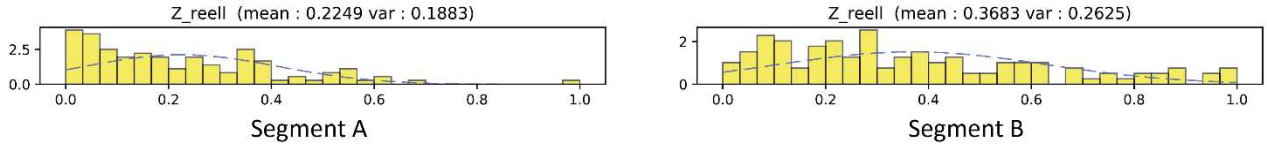

Fig. 5: Acceleration values measured for two 10m street segments together with fitted normal distributions. (Own source)

A second important type of sensor data is that recorded by the smartphone's accelerometer. Several researchers in the past have proposed to analyze accelerometer data to classify the quality of a street. Notable examples include the Roadsense (Allouch et al., 2017) and Maargha (Rajamohan, Gannu and Rajan, 2015) systems which both assign a coarse quality label to street segments. Another way to approach the monitoring problem is to try to detect individual anomalies such as potholes from the data (Silva et al., 2018). Our problem setting differs in that we follow a supervised learning approach that tries to estimate the values of different quality metrics as if they had been measured using a standardized approach. We thus resort to the features proposed in the aforementioned papers but rather use them as input to the final classification step rather than as immediate output of the monitoring system. One of those features is shown in Fig. 5, the variance of a normal distribution fitted to the acceleration values (measured in the direction orthogonal to the street's surface).

5 FURTHER FIELDS OF RESEARCH

The described approach offers a wide variety of potential use cases for communities and public authorities in general. Besides monitoring road conditions in various time intervalls as well as qualitive analysis regarding the asphalt conditions (detection of cracks, uplifts etc.) the project settings could also be applied to analyzing road markings and signages. This involves short term signages such as special road markings for constructions sites as well as permanent road limits and markings. Especially in the light of self-driving cars, the quality of these mentioned road markings will be crucial.

A more institutionalised use of mobile sensors in the future is desirable, as general quality and availability of data, especially real-time data, would be greatly improved. Modern cars itself contain a huge amount of sensors (an average AUDI contains 4000 various sensors for instance), and they can collect internal and external data. The potential to make use of this data for planning purposes is tremendous and very promising for research (Massaro et al., 2017). Although in addition to the discussed approach, the given example of DatEnKost will use artifial intelligence for predictive purposes as well. From this perspective, it is not about the current status of roads, instead the aim will be to predict cracks in the road (or other traffic influencing issues) in the future based on current data. Besides this, the spatio-temporal perspective of the measurements is crucial in general. While data provided by current methods is highly dependent on measurement cycles, this approach would also allow a consistent, real-time map-based view of road conditions. The implementation of such a system could either be done by equipping community-owned vehicles or by employing volunteers. A combined solution of urban fleet vehicles, which regularly run test intervals during their regular operation, in combination with a crowdsourcing approach, i.e. data acquisition by private individuals, represents the most promising configuration. A broader database for instance allows for insights, not only into structural, but also temporary changes in road condition e.g. due to weather. This incorporates weather damage, winter services, wet leaves, etc.. The potential of this approach is shown in a study by MIT,

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which found in a comparable setting that even a small number of vehicles can be sufficient to cover a large part of the urban network (O'Keeffe et al., 2019). The approach used to detect road damage can also be easily transferred to thematically similar problem areas, for example to report temporary danger spots. This applies, for example, to temporary road surface impairments, such as damp foliage in autumn, or the inspection of tram markings. In this context, it would also be possible to equip the municipal winter road clearance services accordingly in order to detect potential danger spots and ensure that the use of road salt is demand-driven. Depending on the application requirements, this technical solution can be integrated into private vehicles or into vehicles of public authorities and thus represent a multitude of potential thematic fields of application in the context of 'predictive maintenance'. The multi-functionality of the "sensor smartphone" allows the further integration of other sensor funcitonalities in order to gather additional relevant data such as environmental data, driving times, parking situation, etc.

Though, this flexible and adaptive approach also comes with potential risks. From a technological point of view, the respective field is still novel and innovative and thus needs further pratical elaboration in order to create reliable and profound data. Besides the need for field studies regarding the data gathering methods, processing extremely large amounts of data has to be institutionalized. In addition, respective to the given use case, the quality of the data is to be guaranteed, which will be especially relevant in crucial aspects such as bad weather and lighting conditions. There are also legal questions to be answered, for example in regards to image recordings and related to that, the social acceptance is also to be considererd, as, especially in Germany, the population is highly sceptical in regards to data protection and image rights. And if data gathering will be done with a UGC-approach, the mentioned obstacles have to be taken in consideration in order to convince citizens to particiapte.

6 CONCLUSION

Due to the fact, that the thereotical promises will have to be verified in further project work, the general practicability and reliability of the project approach have yet to be proven. These demands will be caused by difficult to foresee environmental influences as well as technical constraints. Will the smartphone-based approach be adapted only on designated cars for instance, the range of potential influencing factors could be reduced and controlled. In this approach, specialized road analysis won't be replaced, because their demand especially in the light of high quality of data and reliability in accordance with LIDAR-measurements will persist in the future for detailed quantitative analysis. Though, for an adhoc qualitative analysis, the described methdod will enable multiple options for communities. A further benefit is the potential integration of UGC. Though, this use comes with the given general uncertainity regarding the "quality" of sensor installation in the car which has to taken into consideration. The findings of the project will demonstrate that the innovative combination of light-weight sensor technology and corresponding AI components for cities and municipalities is a universally applicable toolkit, the possible use of which makes a positive contribution to the fields of work of the municipal authorities. As shown in the paper, the approach provides the chance for public authorities to install a lightweight system based on a sensor-application which is easily installable. By developing adjacent services based on this toolkit, communities can offer other cost-effective services and and save personnel and organizational costs in the long run. With the interoperable design, the integration of other sensor connected via smartphone, the flexibility also for other potential use cases is given. Thus, the objective of a demand-oriented road maintenance system for communities with frequent update possibilities becomes achievable.

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🏆 *reviewed paper*

Multimodale Verkehrslösungen als Chance für nachhaltige städtisch-ländliche Beziehungen

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1 ABSTRACT

Nicht nur in städtischen Gebieten, sondern auch in erweiterten Stadtregionen und peri-urbanen Gemeinden ist ein deutlicher Trend zu multimodalem Mobilitätsverhalten zu beobachten. Der Trend, nur einen Verkehrsträger zu nutzen, ist hingegen rückläufig. Vielmehr wollen die Verkehrsteilnehmerinnen und Verkehrsteilnehmer das für ihren jeweiligen Zweck und ihr aktuelles Ziel am besten geeignete Verkehrsmittel oder die geeignetste Kombination von Verkehrsmitteln nutzen. Multimodale Mobilitätskonzepte machen diese Verknüpfung möglich. Dieser Trend zu einer nachhaltiger Mobilitätsentwicklung wird anhand der beiden Good-Practice Beispiele „GUSTmobil“ und „REGIOtim“ im Steirischen Zentralraum aufgezeigt. Die Realisierung dieser alternativen Mobilitätskonzepte fördert sowohl die Lebensqualität der Bewohnerinnen und Bewohner als auch die Austauschbeziehungen und Synergien zwischen den städtischen, stadtnahen und ländlichen Gebieten der Region.

Keywords: multimodal transport systems, last and first mile, rural-urban synergies, demand-responsive mobility, transportation

2 EINLEITUNG

Eine zunehmende Dringlichkeit im Bereich Klimaschutz und Energiewende erfordert umweltpolitische und gesamtgesellschaftliche Veränderungsprozesse. Der Verkehrssektor ist einer der Hauptverursacher für Treibhausgasemissionen, wobei der motorisierte Individualverkehr einen erheblichen Anteil daran trägt. Das derzeitige Verkehrssystem führt jedoch nicht nur zu schwerwiegenden Folgen für Mensch und Umwelt, sondern bringt auch hohe volkswirtschaftliche Kosten mit sich. Gesundheitliche Folgen, hervorgerufen durch Schadstoffemissionen und Lärmbelästigung, eine starke Beeinträchtigung der Luftqualität sowie eine hohe Flächeninanspruchnahme für den Bau der Infrastruktur verursachen Kosten, die von der Allgemeinheit zu tragen sind (Umweltbundesamt 2018). Das Verkehrssystem birgt allerdings auch soziale Ungerechtigkeiten, indem die Mobilitätsangebote und Erreichbarkeit für jene Bevölkerungsgruppen, die über kein eigenes Auto verfügen, enorm eingeschränkt sind. Davon betroffen sind Kinder und Jugendliche, ältere Personen und Menschen mit Behinderung sowie Mitglieder einkommensschwacher Haushalte. Die Förderung von öffentlichen Verkehrsangeboten, die für alle Bevölkerungsgruppen zugänglichen sind, ist daher für ein sozial gerechtes Verkehrssystem vordringlich (VCÖ 2018b). Es sind aber auch flexible Konzepte nötig, um die Bedienqualität des öffentlichen Verkehrs zu verbessern und eine Verlagerung vom motorisierten Individualverkehr auf den öffentlichen und nicht-motorisierten Verkehr voranzutreiben. Multi- und intermodale Verkehrskonzepte und Sharing Systeme spielen daher eine immer bedeutendere Rolle in den regionalen Verkehrssystemen, wie die folgenden Ausführungen zeigen.

2.1 Neue Mobilitätskonzepte

Ein multimodales Verkehrsverhalten herrscht vor, wenn mehr als ein Verkehrsmittel für unterschiedliche Wege herangezogen werden. Das Fahrrad wird beispielsweise für kurze Wege in der Stadt genutzt, der öffentliche Verkehr für die tägliche Pendelstrecke und das Auto für Ausflüge am Wochenende. Eine spezielle Form der Multimodalität ist die Intermodalität, die dann vorliegt, wenn innerhalb einer Wegstrecke verschiedene Verkehrsmittel miteinander kombiniert werden. So wird beispielsweise für die tägliche Strecke zwischen Wohnung und Büro, zuerst das eigene Fahrrad bis zum Bahnhof genutzt. Mit dem Bus wird der Weg in die Stadt bewältigt und der letzte Abschnitt wird mit dem Fahrrad von einer öffentlichen Bike-Sharing Anlage zurückgelegt. Die Möglichkeit, viele verschiedene Verkehrsmittel für eine oder mehrere Wegstrecken zu nutzen, erlaubt es, optimale Mobilitätslösungen für jeden einzelnen zu erzielen. (Deutsches Institut für Urbanistik 2018) Im fortlaufenden Text werden unter Multimodalität sowohl Multi- als auch Intermodalität subsumiert.

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Für die Attraktivität von Multimodalität sind unter anderem Sharing Systeme ein wesentlicher Faktor. Sharing Konzepte im Bereich der Mobilität können als eine Form der Sharing Economy betrachtet werden. Im Allgemeinen ist damit „das systematische Ausleihen von Gegenständen und gegenseitige Bereitstellen von Räumen und Flächen, insbesondere durch Privatpersonen und Interessengruppen“ zu verstehen (Bendel 2016). Das Teilen von Fahrzeugen ermöglicht einen höheren Auslastungsgrad von Autos, Mopeds, Fahrrädern oder Scootern und verringert somit ihre Stehzeit. Dies ist vor allem in urbanen Zentren relevant, wo der Raum für Parkplätze begrenzt ist. Ein Vorteil beim Autoteilen, liegt für Individualbenutzerinnen und Individualbenutzer auch darin, dass Sprit- und Reparaturkosten gespart werden (VCÖ 2018a). Die effiziente Ressourcenverwendung und die Flexibilität, die das gemeinsame Nutzen von Fahrzeugen mit sich bringt, beeinflusst zunächst vorwiegend das Mobilitätsverhalten der urbanen Bevölkerung. In vielen Großstädten sind Car- und Bikesharing-Systeme nicht mehr aus dem Mobilitätsangebot wegzudenken. Zersiedelte, ländliche Regionen sind hingegen durch weite Distanzen geprägt und weitläufige Strecken sowie Defizite im öffentlichen Verkehr verstärken die Abhängigkeit vom privaten PKW. Die steigende Belastung des Verkehrssektors auf das Klima und den Menschen erfordert jedoch, neben politischen Maßnahmen, auch neue und innovative Konzepte. Nur so kann eine stärkere Verlagerung des motorisierten Individualverkehrs auf den öffentlichen und nicht-motorisierten Verkehr realisiert und die Mobilitätswende vorangetrieben werden. Flexible Mobilitätskonzepte gelingen vor allem im urbanen Raum, wo die Nachfrage und die Zahl der potenziellen Nutzerinnen und Nutzer groß ist. Die voranschreitende Digitalisierung bietet jedoch immer mehr Möglichkeiten für ländliche Gebiete. Diese setzen vermehrt auf den Ausbau des Mikro-Öffentlichen-Verkehrs (Mikro-ÖV), sprich auf kleinräumige Mobilitätsangebote, die vorwiegend auf kommunaler Ebene die Mobilitätsbedürfnisse der lokalen Bevölkerung bedienen. Mögliche Umsetzungsmodelle des Mikro-ÖVs sind Linienbus, Rufbus, Anruf-Sammeltaxi, Gemeindebus oder Ortstaxi (VCÖ 2014). Mobile Applikationen (Apps) können das Organisieren von Taxidiensten und das Teilen von Fahrzeugen übernehmen (Jacoby / Wappelhorst 2016). Zudem wird das Teilen von Informationen über Fahrpläne, unterschiedliche Mobilitätsoptionen und Möglichkeiten zur Kombination von mehreren Verkehrsmitteln erleichtert (Deutsches Institut für Urbanistik 2018).

2.2 Mobilität im Stadt-Land-Kontext

Intensive Austauschbeziehungen und Wechselwirkungen zwischen städtischen und ländlichen Gebieten deuten darauf hin, dass diese Raumtypen nicht, wie lange üblich, getrennt voneinander zu betrachten sind (Woods / Heley 2017). Die Grenzen von Stadt und Land sind in vielerlei Hinsicht fließend. Die Pluralisierung von Lebensstilen, der Fortschritt von Informations- und Kommunikationstechnologien und die Entwicklung der Verkehrsinfrastruktur hat den räumlichen Bewegungsradius sowohl der ländlichen als auch der städtischen Bevölkerung verändert. Starke Verkehrsströme existieren zwischen Stadt und Land, um Arbeits- und Ausbildungsplätze sowie kulturelle Einrichtungen in den Städten und Ballungsräumen oder Naherholungsgebiete in den ländlichen Regionen aufzusuchen. Zum einen erhöht dies den individuellen physischen Aktionsradius und ermöglicht eine verstärkte Bewegung von Menschen und Gütern zwischen ländlichen und städtischen Gebieten (OECD 2013). Zum anderen bietet die Digitalisierung die Möglichkeit für neue Arbeitsmodelle, die wiederum Pendlerstrukturen verändern können. Auch neue Lebensformen, wie beispielsweise die residentielle Multilokalität nehmen dadurch zu.

Ländliche Räume sind heterogene Gebiete mit sehr unterschiedlichen siedlungsstrukturellen, naturräumlichen und infrastrukturellen Charakteristika und unterscheiden sich daher in ihren Ausgangsbedingungen für die Realisierung klimaverträglicher Mobilität (Laberer / Winkler 2016). Die Strukturen der Siedlungsgebiete in vielen ländlichen Gebieten forcieren geradezu die hohe Abhängigkeit vom privaten PKW. Zersiedelte Siedlungsstrukturen und Einkaufszentren auf der grünen Wiese erfordern eine dicht ausgebaute Verkehrsinfrastruktur, um die Erreichbarkeit dieser Orte garantieren zu können. Aus diesem Grund ist der Anteil von Zweit-PKWs in den Haushalten Österreichs zwischen 2000 und 2018 um über 50% gestiegen (VCÖ 2019b) und dies vor allem in ländlichen Regionen. 2014 besaß jeder dritte österreichische Haushalt einen Zweit- oder Dritt-PKW. In peripheren Bezirken ist es fast jeder zweite Haushalt mit mehr als einem PKW (VCÖ 2019a). Der öffentliche Verkehr ist in zersiedelten Gebieten mit geringer Bevölkerungsdichte oft nicht rentabel und daher nur unzureichend verfügbar. Ist dieser nicht vorhanden, können die Mobilitätsbedürfnisse älterer Personen, genauso wie jene von Kindern und Mitgliedern einkommensschwacher Haushalte, nicht erfüllt werden (VCÖ 2018b). Nachfrageorientierte Angebote und alternative Mobilitätsformen können jedoch eine Ergänzung zum öffentlichen Verkehr

darstellen und bieten die Möglichkeit, die Bedarfe in ländlichen Regionen sicherzustellen (Jacoby / Wappelhorst 2016).

Im Rahmen des aktuellen EU-Projekts ROBUST – Rural-Urban Outlooks: Unlocking Synergies – werden unter dem thematischen Fokus „Öffentliche Infrastruktur und soziale Dienstleistungen“ auch Erfahrungen mit der Umsetzung von alternativen und zukunftsorientierten Mobilitätskonzepten unter den europäischen Partnerinnen und Partner ausgetauscht. In Österreich beteiligt sich der Steirische Zentralraum, welcher die Landeshauptstadt Graz sowie 51 weitere Gemeinden in den Bezirken Graz-Umgebung und Voitsberg umfasst, am ROBUST-Projekt und stellt ein sogenanntes Living Lab dar (Kobzeva / Knickel 2018a). In den letzten Jahren konnten hier bereits mehrere innovative Maßnahmen im Bereich Mobilität umgesetzt werden. Die zentrale Forschungsfrage dieses Beitrages lautet, inwiefern alternative Mobilitätskonzepte zu Synergien zwischen Stadt, Stadtumland und Land hinsichtlich einer nachhaltigen und sozial-inklusiven Regionalentwicklung beitragen können.

2.3 Das Living Lab Steirischer Zentralraum

Der Steirische Zentralraum stellt eine der sieben Großregionen in der Steiermark dar und verbindet die zweitgrößte Stadt Österreichs mit den stadtnahen und ländlichen Gemeinden der Bezirke Voitsberg und Graz-Umgebung. Insgesamt umfasst er 52 Gemeinden und zwei LEADER Regionen, die LAG „Hügel- und Schöckelland“ und die LAG “Lipizzanerheimat”. Die Region ist mit 494.227 Einwohnerinnen und Einwohnern die bevölkerungsstärkste Region in der Steiermark und wächst stetig (Amt der Steirischen Landesregierung 2019). Die demographische Entwicklung im Steirischen Zentralraum ist jedoch differenziert zu betrachten. Die Landeshauptstadt sowie die angrenzenden Gemeinden weisen einen zunehmenden Bevölkerungszuwachs auf, während der Bezirk Voitsberg einen Rückgang der Bevölkerung verzeichnet. Die Prognose für 2019 bis 2030 zeigt in Graz und Graz-Umgebung jeweils einen Anstieg der Bevölkerung um 11,8 % und 5,4%, während die Einwohnerzahl in Voitsberg um -2,1% sinken wird (WIBIS 2019a). Die Region ist durch einen sehr hohen Anteil an jungen Einwohnerinnen und EInwohnern geprägt, viele davon sind im urbanen Raum wohnhaft. Die Stadt bietet eine hohe Lebensqualität, die sich in einem diversifizierten Arbeitsmarkt, einem vielfältigen Angebot an Bildungs- und Kultureinrichtungen, öffentlichen Verkehrsmitteln und innovativen Mobilitätskonzepten, aber auch durch ein flächendeckendes Breitbandangebot widerspiegelt. Die suburbanen und ländlichen Räume bieten eine hohe Vielfalt an Freizeit- und Erholungsflächen. Diese Gemeinden werden daher auch stark als Naherholungsgebiete genutzt und sind beliebte Wohnstandorte. Der Bezirk Graz-Umgebung ist zudem nach Graz der zweitgrößte Arbeitgeberbezirk der Steiermark (WIBIS 2019b).

Die räumlichen Verflechtungen werden im Steirischen Zentralraum unter anderem durch die starken Pendlerströme sichtbar. Das damit einhergehende hohe Verkehrsaufkommen ist durch die vorherrschende Präferenz des motorisierten Individualverkehrs gekennzeichnet. Aufgrund der schlechten Luftqualität, des hohen Flächenverbrauchs und der negativen Auswirkungen des Verkehrs auf das Ökosystem wächst der Druck auf die Landeshauptstadt und ihr Umland (Bauchinger 2018). Die Kernstadt Graz und die umliegenden Gemeinden sind im Gegenzug auch über die Infrastruktur des öffentlichen Verkehrs stark miteinander verbunden. Graz ist der einzige große Verkehrsknotenpunkt in der Region mit einer Anbindung zum Schienenfernverkehrsnetz. Die Verbindung zwischen den Gemeinden des Bezirks Graz-Umgebung und der Stadt Graz wird durch die S-Bahn gewährleistet. In Gebieten ohne ausreichendes Bahnangebot bedienen mehrere (Regional-) Buslinien das öffentliche Verkehrsnetz. Der Regionalbusverkehr ist jedoch teilweise unzureichend, da er sich in vielen Gemeinden oftmals auf das Schulverkehrsnetz konzentriert und daher nur wenige separate Linien und Fahrten außerhalb der Hauptverkehrszeiten anbietet. Um die Bedienqualität in entlegenen Gebieten mit unzureichender Anbindung an den öffentlichen Personenverkehr zu verbessern, wurde ein Sammeltaxi (GUSTmobil) eingerichtet (Bauchinger 2018). Zudem wurde vor kurzem der erste regionale multimodale Knoten (REGIOtim), der das Kombinieren von unterschiedlichen Verkehrsmitteln erleichtern soll, in einer Gemeinde vor Graz implementiert. Dieser soll durch eine Reihe weiterer, gleichsam organisierter, Knotenpunkte ergänzt werden wird.

Das Regionalmanagement Steirischer Zentralraum ist ein zentraler Akteur in der Region und agiert als Schnittstelle zwischen den regionalen Akteurinnen und Akteuren. Seit 2015 begleitet und koordiniert das Regionalmanagement verstärkt die Entwicklung der Mobilität in der Region. Die regionale Entwicklungsstrategie 2020+ (RMSZR 2019), welche unter Einbindung regionaler Akteurinnen und Akteure

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und in Kooperation mit den LEADER-Aktionsgruppen 2019 erarbeitet wurde, dient als Grundlage für eine effiziente, integrierte Regionalentwicklung des Steirischen Zentralraums. Insgesamt beinhaltet die Entwicklungsstrategie vier Leitthemen als Basis für zwölf prioritäre Ziele und eine Vielzahl an Maßnahmenschwerpunkten. Diese bilden die Basis für die Entwicklung interkommunaler Projekte in den jährlichen Arbeitsprogrammen, welche durch ein Regionalbudget im Rahmen des Steiermärkischen Landes- und Regionalentwicklungsgesetz (StLREG 2018) unterstützt werden. Neben den Zielen (i) „Hochwertigen Lebensraum + integrierte Qualitätsstandorte gestalten“, (ii) „Gesellschaftliche Teilhabe + lebenslanges Lernen fördern“ und (iii) „Achtsamen Umgang mit Umwelt, Landschaft + Ressourcen sicherstellen“ ist der Themenblock (iv) „Bedarfsgerechte Mobilität + intelligente Verkehrslösungen ermöglichen“ ein zentraler Schwerpunkt der Region. Schlüsselthemen in der Mobilität sind vor allem die Erhöhung des Anteils des öffentlichen und kombinierten Verkehrs und eine Verbesserung der Anbindung zwischen Stadt und Land. Konkrete Maßnahmenschwerpunkte in der regionalen Entwicklungsstrategie 2020+ sind die (i) Verdichtung und der Ausbau des ÖV-Angebots, (ii) die Entwicklung bedarfsorientierter Zubringermaßnahmen, (iii) die Errichtung dezentraler Park and Ride Anlagen, (iv) die Schaffung von Radkonzepten und -schnellverbindungen und (v) das Ermöglichen eines multimodalen, serviceorientierten Mobilitätsverhaltens. Das Regionalmanagement Steirischer Zentralraum benennt in seiner Strategie ganz klar die Grenzen der Straßenkapazitäten, die schon lange erreicht sind, und bekennt sich zu einem massiven Ausbau des Öffentlichen Verkehrs, verschränkt mit supplementären Mobilitätsmodi. Zudem wird eine Verlagerung der Verkehrsmittelwahl zugunsten der Verkehrsmittel des Umweltverbundes (ÖPNV, Fuß- und Radverkehr) gefordert (RMSZR 2019). Diese Zielsetzung kann nur erreicht werden, wenn die Rahmenbedingungen für ein flexibles und nutzerinnen- und nutzerfreundliches Angebot des Öffentlichen Verkehrs gegeben sind. Neben der Verdichtung des Öffentlichen Verkehrs als Rückgrat eines Mobilitätssystems, spielen hierbei vielseitige und ergänzende Angebote, wie der Mikro-ÖV und Carsharing-Modelle eine zentrale Rolle. Das Regionalmanagement hat in der Phase des regionalen Entwicklungsleitbildes 2014 – 2020 den Ausbau der Mobilitätsangebote in der Region forciert und zwei Pilotprojekte (GUSTmobil und REGIOtim) umgesetzt.

2.4 Methodik

Der Steirische Zentralraum ist eines von elf Living Labs des EU-Projekts ROBUST (Rural-Urban Outlooks: Unlocking Synergies), dessen übergeordnetes Ziel es ist, die Beziehungen zwischen städtischen, stadtnahen und ländlichen Räumen zu analysieren. Weiters sollen Politikmaßnahmen und Governance-Strukturen, die Synergieeffekten zwischen diesen Räumen vorantreiben, identifiziert und städtisch-ländliche Kooperationen vorangetrieben werden. Wissenschaftlerinnen, Wissenschaftlern, Praktikerinnen und Praktikern aus elf europäischen Ländern arbeiten in sogenannten „Living Labs“ an fünf thematischen Schwerpunkten, die sowohl für den Austausch zwischen städtischem und ländlichem Bereich als auch für die Schaffung von Synergien zentral sind:

- Arbeitsmarkt und neue Geschäftsmodelle,
- Infrastruktur und soziale Dienstleistungen,
- Kulturelle Verknüpfungen,
- Lebensmittel und Landwirtschaft,
- Ökosystemdienstleistungen und Resilienz.

Diese Themengebiete werden anhand von „Communities of Practice“ bearbeitet, in welchen der internationale Austausch und gemeinsames Lernen im Vordergrund stehen. Im Steirischen Zentralraum werden neben infrastrukturellen Themen und Mobilitätslösungen auch neue Arbeitsmarktmodelle, kulturelle Verknüpfungen und soziale Dienstleistungen untersucht. Das Projekt stützt sich bei den Untersuchungen und Analysen der städtisch-ländlichen Beziehungen zum einen auf den aktionsorientierten Ansatz des Living Labs, bei dem verschiedene Akteurinnen und Akteure in einem realitätsnahen Kontext neue Ideen erproben und mit alternativen Ansätzen experiementieren (Hess et al. 2017). Zum anderen wird der Ansatz der Community of Practice verwendet, wodurch über ein Netzwerk an Personen, die an dem gleichen Thema Interesse zeigen, ein vertiefter Erfahrungs- und Wissensaustausch angestrebt wird (Barston / Tusting, 2005; Wenger et al., 2002). Darüber hinaus basieren die Forschungstätigkeiten im Projekt sowohl auf qualitativen als auch auf quantitativen Methoden. Expertinnen- und Experten-Interviews, Fokusgruppen und leitfadengestützte Interviews sowie Auswertungen von regionsspezifischen Indikatoren und

Nachtsatellitendaten sind nur einige der Methoden, mit Hilfe deren eine weitreichende Untersuchung der Stadt-Land Beziehungen in den einzelnen Living Labs, wie auch im europäischen Kontext, durchgeführt werden kann.

Im Rahmen einer Forschungsagenda, die als Leitfaden für die Umsetzung von Aktivitäten in den Living Labs über den gesamten Bearbeitungszeitrahmen der Fallstudien fungiert, wurden neben Zielen auch Erfolgskriterien definiert, eine Methodenauswahl getroffen, Verantwortlichkeiten verteilt und ein Zeitplan erstellt. Das übergeordnete Thema des Living Labs Steirischer Zentralraum wurde folgendermaßen festgelegt: „Gestaltung einer lebendigen Land-Stadt-Kooperation zur Förderung einer besseren Lebensqualität durch verstärkte regionale Zusammenarbeit, insbesondere in den Bereichen öffentliche Infrastruktur und soziale Dienstleistungen, innovative Geschäftsmodelle und kulturelle Verbindungen.“ Wichtige Ansatzpunkte sind dabei, die Potenziale von "Sharing-Systemen" und interkommunalen Ansätzen im Bereich der öffentlichen Infrastrukturen und sozialen Dienste zu erfassen. Für die Zusammenarbeit in den Communities of Practice (CoP) wurde ebenso eine Forschungsagenda erarbeitet. Im Allgemeinen gilt hierbei, dass die Themenschwerpunkte der Living Labs auf einer übergeordneten Ebene zu betrachten sind. Die Zielsetzung der CoP ist aufgrund der unterschiedlichen Schwerpunkte der Projektpartnerinnen und Projektpartner deutlich breiter als in den Living Labs. Ziele werden gemeinsam beschlossen und durch explizites und implizites Zusammenarbeiten aller Mitglieder erreicht. Hervorzuheben ist unter anderem auch die Gemeinschaft, die entsteht und das „Shared repertoire“ an gemeinsamen Werkzeugen, Konzepten und Praktiken, die innerhalb einer Community of Practice aufgebaut werden (Wenger 1998; Maye et al. 2019). Im Vordergrund dieser übergeordneten Zusammenarbeit stehen gemeinsame Lerneffekte. Living Labs sollen durch den Austausch von Wissen und Erfahrungen voneinander profitieren.

Aus einer Zusammenstellung und Analyse von Projekten, Studien und Governance-Strukturen konnten die Projektpartner bereits vorhandene Strategien und Konzepte in den Living Labs reflektieren. (Knickel / Kobzeva 2018b) Der Vergleich der Beispiele und der Erfahrungsaustausch in den Communities of Practice hat zum einen gezeigt, mit welchen Herausforderungen die anderen Living Labs zu kämpfen haben. Zum anderen konnten innovative Modelle und neue Ideenansätze generiert werden.

Aufgrund der Ausdünnung des öffentlichen Verkehrs und der Notwendigkeit von nachfrageorientierten Mobilitätslösungen in den strukturschwachen Gebieten vieler anderer Living Labs, wurde das Interesse innerhalb der Community of Practice „Öffentliche Infrastruktur und soziale Dienstleistungen“ unter anderem auf zwei Projekte des Steirischer Zentralraums gelenkt: Das Sammeltaxi GUSTmobil und der multimodale Verkehrsknotenpunkt REGIOtim.

3 ERGEBNISSE

Die Ergebnisse des Berichts stellen die Darstellung und Bewertung der zwei Pilotprojekte GUSTmobil und REGIOtim im Steirischen Zentralraum dar. Während der dreijährige Probebetrieb des GUSTmobils im Juni 2020 abgeschlossen sein wird und über eine Verbesserung und Fortführung des Projekts nachgedacht wird, befindet sich das Projekt REGIOtim erst seit November 2019 in der Umsetzungsphase. Nach Vorbild des urbanen Projekts „tim Graz“, wird das multimodale Mobilitätskonzept nun auch im suburbanen Raum realisiert. Es wird daher auf die intensiven Entwicklungsprozesse der beiden Projekte eingegangen und die komplexen Implementierungsphasen ausgeführt, die aufgrund der vielschichtigen Governance-Strukturen in der Region, viel Koordination und Sensibilisierungsarbeit seitens des Regionalmanagements erfordern. Zudem werden Nutzungsdaten aus dem Projekt GUSTmobil und erste Erkenntisse aus den alternativen Mobilitätskonzepten dargestellt.

Mikroöffentliches Verkehrsangebot: GUSTmobil

Bei GUSTmobil handelt es sich um ein mikroöffentliches Verkehrsangebot, welches eingerichtet wurde, um einerseits disperse Siedlungsgebiete an den höherrangigen öffentlichen Verkehr anzuschließen, und andererseits die innerörtliche Erreichbarkeit im Kontext der Alltagsmobilität zu gewährleisten. Fahrten können per Telefon oder über eine App, die in Echtzeit Informationen über den öffentlichen Verkehr liefert, gebucht werden. Das GUSTmobil ist ein ergänzendes Angebot und nicht als Konkurrenz zu den bestehenden Linien des öffentlichen Verkehrs zu verstehen. Daher garantiert eine spezielle Software neben einer effizienten Streckenführung und Poolingfahrten auch den Ausschluss von Parallelfahrten zu Bus und Bahn (Bauchinger 2018). Ein Netz aus 1.800 Sammelhaltestellen in allen beteiligten Gemeinden des Steirischen

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Zentralraumes ermöglicht den Nutzerinnen und Nutzern ein flächendeckendes Angebot mit geringen Entfernungen zum nächsten Einstiegspunkt. Jede Fahrt wird von Haltepunkt zu Haltepunkt von regionalen Taxiunternehmern als Vertragspartner abgewickelt. Der Preis für das Sammeltaxi wird je nach Entfernung und Anzahl der Mitfahrenden berechnet und beginnt bei 3 € für eine Distanz bis zu 3,5 Kilometern (Verkehrsplus 2018).

Multimodaler Mobilitätsknoten: REGIOtim

Die Anpassung eines städtisches Erfolgskonzeptes im Bereich der multimodalen Mobilität auf das peripher-ländliche Umfeld stellt das zweite Pilotprojekt des Regionalmanagements dar. Grundlage des Projektes ist das von der Stadt Graz, im Speziellen der Holding Graz Linien, entwickelte Konzept des multimodalen Mobilitätsknotens „tim – täglich.intelligent.mobil." (Holding Graz 2019). REGIOtim ist die Weiterentwicklung des städtischen Modells im suburbanen Raum. Der öffentliche Verkehr wird dabei mit e-Carsharing, öffentlichen Ladestationen, Fahrradparkplätzen, mikro-öffentlichen Verkehrsmitteln und anderen Funktionen kombiniert und schafft ein flexibles Angebot, um den Mobilitätsbedarf in der Region zu decken (Planum 2017). Der multimodale Ansatz von tim soll dabei der Abhängigkeit des Privat-PKWs in den Gemeinden entgegenwirken. Die Erreichbarkeit zentraler aber auch dezentraler Orte der Region soll ohne Privat-Pkw ermöglicht und eine bedarfsgerechte und leistbare Mobilität für Alltagsnutzerinnen, Alltagsnutzer, Pendlerinnen und Pendler gestärkt werden. Die tim-Standorte in den Bezirken Graz-Umgebung und Voitsberg befinden sich an dicht besiedelten, öffentlich gut erschlossenen Orten, um die fuß- oder radläufige Erreichbarkeit des Angebots zu stärken. In vielen Gemeinden eignete sich der Bahnhof für die Implementierung, in anderen das Gemeindeamt oder ein bestehender Park and Ride Platz. Als Rückgrat dient überall der bestehende öffentliche Verkehr, in vielen Gemeinden ergänzt durch das Sammeltaxi GUSTmobil. Letzteres eignet sich vor allem als Zubringer zu den REGIOtim Standorten und kann daher ein zentrales Mittel darstellen, wenn mehrere Verkehrsträger innerhalb einer Wegstrecke kombiniert werden.

Entwicklungsprozess und Umsetzung der Projekte:

Das Regionalmanagement Steirischer Zentralraum hat in der Region bereits zahlreiche regionale, nationale, internationale sowie transnationale Projekte umgesetzt und schöpft somit aus einem breiten Erfahrungspool internationaler Kooperationsbeziehungen. Diese Netzwerke, gekoppelt mit dem regionalen Know-How war in den Entwicklungsprozessen der beiden Pilotprojekte von zentraler Bedeutung.

Zwischen 2012 und 2015 entstand im Rahmen des Alpine Space Projektes „RURBANCE" (Alpine Space Programm 2015) ein erster Meilenstein für den Mikro-ÖV in der Region. Zu diesem Zeitpunkt wurde erstmals die Erschließung disperser Gebiete und Tourismusdestinationen für einen Teilbereich des Steirischen Zentralraums nördlich von Graz mittels eines Sammeltaxis geprüft und in Erwägung gezogen. Im Format eines Best-Practice Workshops wurden vier bestehende Systeme aus ganz Österreich näher betrachtet und das Thema damit bei regionalen Stakeholdern ins Bewusstsein gerückt. Als 2015 im Bezirk Korneuburg das damals erste größer angelegte interkommunale Mikro-ÖV System mit 15 Gemeinden in Betrieb genommen wurde, festigte sich das Vorhaben ein solches System auch für den gesamten Bezirk Graz-Umgebung zu realisieren. Nach der Aufstellung eines Budgets für ein Implementierungskonzept, koordinierte das Regionalmanagement die Planungs- und Konzeptphase mit den regionalen Stakeholdern. Das Konzept des Projekts „GUSTmobil – Graz-Umgebung Sammeltaxi" konnte nach einer intensiven Vorbereitungszeit im Juli 2017 in 29 von 36 Gemeinden des Bezirks umgesetzt werden (RMSZR 2017).

2015 im Projekt „KombiMo II" (Holding Graz 2014), gefördert durch das BMVIT, entwickelt. Im Jahr 2017 konnte das Regionalmanagement Steirischer Zentralraum in Kooperation mit der Stadt Graz und Holding Graz das Vorhaben im Rahmen eines EFRE/IWB geförderten Projektes starten. In einer ersten Analysephase wurden für die Bezirke Graz-Umgebung und Voitsberg eine Kategorisierung und Prioritätenreihung potentieller Umsetzungsstandorte erstellt. Für diese Erhebung war die Adaptierung der städtischen Standortkritieren auf die Bedürfnisse des suburbanen-ländlichen Raums ausschlaggebend. Hierbei bestand die Herausforderung darin die vielschichtigen Rahmenbedingungen, benötigten Leistungen und Kooperationspartner für den Betrieb des Carsharings neu zusammenzusetzen. Ein vorhandenes System dahingehend zu adaptieren brachte zwar überwiegend synergiebringende Vorteile, schränkte jedoch die Flexibilität in der Ausgestaltung in manchen Punkten, wie zum Beispiel der Ladeinfrastruktur, ein.

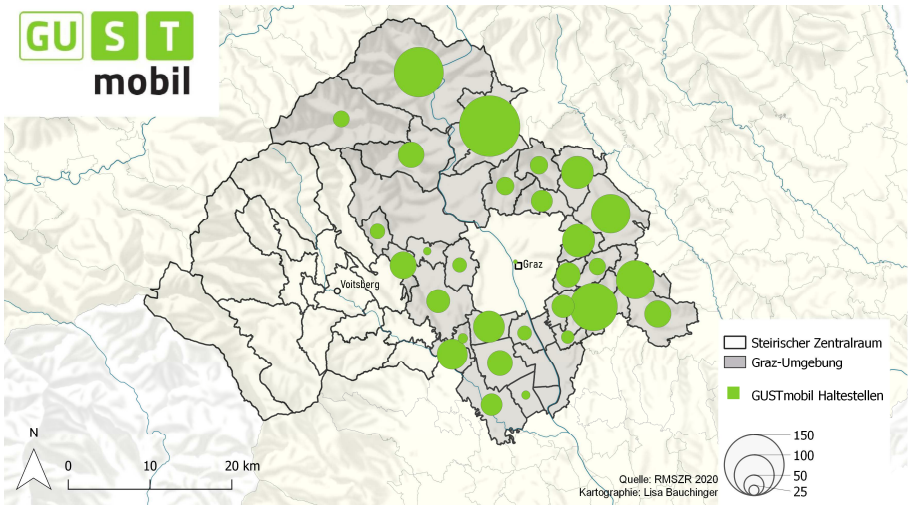

Abbildung 1: GUSTmobil-Standorte im Bezirk Graz-Umgebung

REGIOtim basiert hingegen auf die bestehende Struktur der tim Standorte in der Stadt Graz. tim Graz wurde Im Rahmen des Interreg Central Europe Projektes „Peripheral Access“ (Peripheral Access 2020) wurde der erste multimodale Mobilitätsknoten in einer suburbanen Gemeinde realisiert. Im November 2019 konnte nach intensiven Vorbereitungen ein REGIOtim Standort entlang des vom Regionalmanagement eigens konzipierten Betreibermodelles in der Gemeinde Hart bei Graz in Betrieb genommen werden. Kurz darauf folgte die Implementierung des Standortes in der Gemeinde Lieboch.

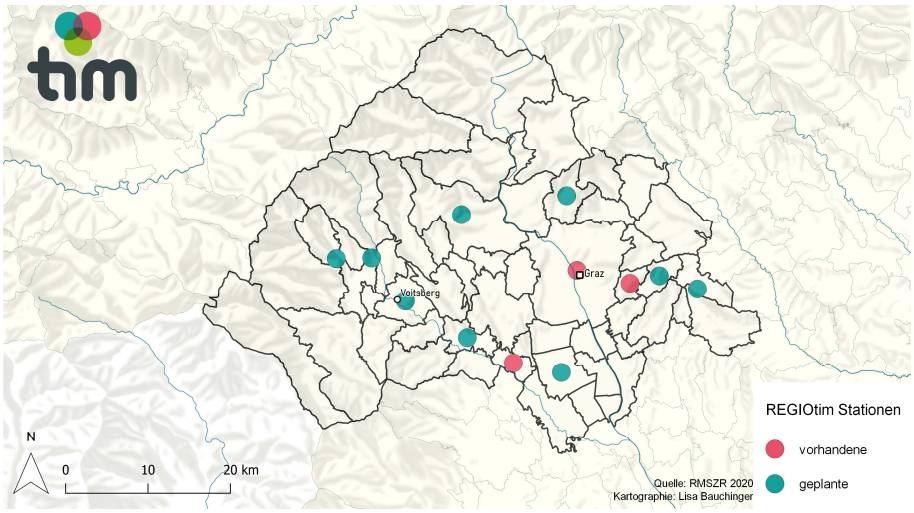

Abbildung 2: REGIOtim Standorte im Steirischen Zentralraum

Das Modell fußt auf drei Säulen: Betreiber-, Kundinnen- und Kundensupport, IT-System und Buchungsplattform sowie Lokale Service- und Wartungsleistungen. Im Bereich des IT-Systems wurde eine Kooperation mit der Holding Graz, insbesondere für das Serverhosting und die Betreuung der Betriebssysteme, geschlossen. Das Verknüpfen der Buchungsplattformen der vorhandenen und neuen tim Standorte ermöglicht den Kundinnen und Kunden ein Freischalten von allen Standorten der Region und stellt das Herzstück der Stadtumland-Kooperation dar. Die jeweiligen lokalen Service- und Wartungsleistungen zu denen Autoversicherungen, Instandhalten des Standortes und das einmalige Ausgeben der Kundenkarten zählen, übernimmt jeder Betreiber, also jede Gemeinde, selbst. Die Erfahrungen und das Know-How, im Speziellen für die technische Infrastruktur, die Kommunikation und das tim-Design werden im Projekt REGIOtim von der Holding Graz zur Verfügung gestellt. Das Regionalmanagement Steirscher Zentralraum unterstützt die Gemeinden bei der Koordination und Umsetzung der Projekte und zeigt sich für die Vernetzung der unterschiedlichen Akteurinnen und Akteure verantwortlich. Die Bildung einer Steuerungsgruppe zwischen Holding Graz und Regionalmanagement Steirischer Zentralraum ist maßgebend für den stetigen Abstimmungsprozess. In regelmäßigen Abständen werden die REGIOtim Gemeinden und Projektträger zu Workshops eingeladen, um wichtige Eckpunkte des Systems wie die Tarifgestaltung oder die Betreiberstruktur zu diskutieren.

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Darstellung der Nutzung von GUSTmobil:

Während REGIOtim sich noch im Umsetzungsprozess befindet, endet der dreijährige Probebetrieb des GUSTmobils im Juli 2020. Daher können bereits erste Darstellungen über die Auslastung und Nutzungsarten des Sammeltaxis dargestellt werden.

Seit Betriebsbeginn im Juli 2017 sind bis Ende Dezember 2019 86.251 Fahrtaufträge mit 103.223 Personen durchgeführt worden. Nach Bündelung einiger Einzelaufträge zu 58.286 Sammelfahrten ergibt das auf den 375.651 absolvierten Besetzt-Kilometern quer durch das Bediengebiet einen durchschnittlichen Besetzungsgrad von 1,77 Personen pro Fahrt. Betrachtet man die Aufträge mit drei oder mehr Personen im Fahrzeug, heben sich jene, die unter dem Wegezweck „Freizeit“ subsummiert werden können, mit über einem Drittel stark hervor. Dazu zählen Ziele wie Sport- und Freizeiteinrichtungen, Kinos, Museen, Kirchen, Gasthäuser und Buschenschenken. Auswirkungen auf den Besetzungsgrad haben zudem Kindergartensammelfahrten, weniger jedoch Pendelfahrten zur Arbeit (RMSZR 2020). Mobilitätseingeschränkte Personen können beim jeweiligen Gemeindeamt eine Hausabholung beantragen, wovon seit Betriebsbeginn rund 400 Personen Gebrauch machen. Die innerörtliche Erreichbarkeit zur Erledigung von Arztbesuchen oder Supermarkteinkäufen steht bei dieser Nutzergruppe im Vordergrund. Die Aufträge sind über das Bediengebiet zwischen den 29 Gemeinden sehr ungleich verteilt. Grundsätzlich kann aus der Testphase abgeleitet werden, je besser und flächendeckender der bestehende öffentliche Verkehr in einer Gemeinde ausgebaut ist, desto geringer ist die Auftragslage der Mikro-ÖV Fahrten, was dem ÖV-Konkurrenzierungsverbot des Landes Steiermark als Fördergeber entspricht. Auch die Siedlungsstruktur einer Gemeinde beeinflusst die Mikro-ÖV Nutzung. Je höher der Grad der Zersiedelung desto wahrscheinlicher ist eine Buchung einer Fahrt ohne Umstieg auf den öffentlichen Verkehr entlang der Wunschstrecke. Ein wesentlicher Punkt, der ebenso für die Auftragslage in den einzelnen Gemeinden verantwortlich ist, ist die Bewerbung, Kommunikation und eventuelle tarifliche Stützung.

Erkenntnisse aus den alternativen Mobilitätskonzepten:

Das GUSTmobil galt als wichtiges Pilotprojekt für die Steiermark und zeigte auf, dass ein interkommunal betriebenes System gegenüber kleinräumigen Lösungen durch die starke Werbewirksamkeit einer regionalen Marke und die Betriebskostenteilung Vorteile bringt. Das Regionalmanagement Steirischer Zentralraum denkt gemeinsam mit den beteiligten Gemeinden über die Form der Weiterführung im Sinne eines Dauerbetriebes nach. Eine noch bessere Abstimmung auf den öffentlichen Verkehr, eine tarifliche Verknüpfung mit dem Verkehrsverbund aber auch mit anderen Mobilitätsangeboten wie Carsharing sind für das Regionalmanagement strategische Eckpfeiler in diesem Prozess. Der Vorzeigeeffekt führte dazu, dass fünf weitere Bezirke der Steiermark regionale Sammeltaxi-Projekte in ähnlicher Form implementierten. Seit Herbst 2019 hat sich auch die Stadt Graz mit drei definierten Stadtrandgebieten mit unzureichender ÖV-Erschließung dem GUSTmobil als dreißigste Kommune angeschlossen und einen Probebetrieb gestartet. Eine Kooperation, die durch den Know-How-Transfer vom Land in die Stadt dabei als besonders in der Regionalentwicklung hervorzuheben ist.

REGIOtim wurde zunächst an einem Standort in einer suburbanen Gemeinde in Betrieb genommen. Bereits parallel zum Pilotprojekt in Hart bei Graz reichten 2017 zehn weitere Kommunen die Implementierung von tim Standorten durch die Unterstützung des Regionalmanagements bei Förderprogrammen der Europäischen Union und des Landes Steiermark ein. Darunter auch die Holding Graz Linien um deren tim Angebot um weitere vier Standorte bis 2021 zu erweitern. Das Projekt kann einen wichtigen Impuls für eine zukunftsfähige Mobilität geben, bei welcher der motorisierte Individualverkehr immer weiter in den Hintergrund rückt.

In Zukunft sollen die Mobilitätsangebote des Steirischen Zentralraums entlang eines „Mobility as a Service“ Ansatzes noch stärker miteinander verknüpft und als „One-Stop-Shop“ für die Bevölkerung multimodal nutzbar gemacht werden. Das Regionalmanagement stellt auch in diesem Bereich die Schnittstelle zwischen der Stadt, dem Land Steiermark und weiteren Schlüsselakteurinnen und Schlüssenakteuren dar.

4 DISKUSSION

Das Regionalmanagement Steirischer Zentralraum hat die Aufgabe, die Bedürfnisse der Stadt Graz, der suburbanen sowie ländlichen Räume zu koordinieren. Die administrativen Grenzen der Gemeinden sind fließend, Stadt und Land sind nicht klar voneinander zu trennen. Eine spezifische Herausforderung besteht

darin, trotz räumlicher administrativer Zuständigkeiten der Region und der Gemeinden, Ansätze zu schaffen, die den Anforderungen von Stadt und Land entsprechen. Der Steirische Zentralraum setzt mit der Umsetzung von flexiblen Angeboten an Verkehrsmitteln ein starkes Zeichen für eine klimaverträgliche Mobilität und unterstützt die spezifischen Mobilitätsbedürfnisse in der Region. Mit den innovativen Mobilitätskonzepten eines Sammeltaxis und eines multimodalen Verkehrsknotens können somit Lücken im öffentlichen Verkehr geschlossen werden.

Insbesondere GUSTmobil kann, nach einem dreijährigen Projektbetrieb, als ein gut etabliertes Mobilitätskonzept im suburbanen Raum von Graz bewertet werden. Das Sammeltaxi hat das Potenzial noch weitere Gebiete zu erschließen und somit einen wichtigen Teil im gesamtregionalen Verkehr einzunehmen. Im Bezirk Voitsberg erfolgt die Implementierung des Konzepts bereits im Laufe des Jahres 2020. Die Umsetzung des Projekts erfordert eine transparente Kommunikation und viel Öffentlichkeitsarbeit, um die Bewohnerinnen und Bewohner in der Region sowie die politischen Akteurinnen und Akteure zu sensibilisieren. Komplexe Regeln der Systeme sind gegenüber den Mikro-ÖV-Nutzerinnen und Mikro-ÖV-Nutzern nur schwer zu kommunizieren. Beispielsweise bildet die Abstimmung des GUSTmobils auf den bestehenden öffentlichen Verkehr, zu dem der Mikro-ÖV keine Konkurrenz darstellen darf, eine der größten Herausforderungen. Zudem ist die Bereitschaft der Mikro-ÖV-Nutzerinnen und Mikro-ÖV-Nutzer auf den öffentlichen Verkehr umzusteigen, besonders auf Kurzstrecken, die für Erledigungen oder Einkäufe im nächsten Ortszentrum gebucht werden, sehr gering. Aus diesem Grund steht das Regionalmanagement mit dem Land Steiermark im regelmäßigen Austausch, um die Kriterien für den landesweiten Mikro-ÖV einfacher und realitätsnaher auszugestalten.

GUSTmobil und REGIOtim sind Konzepte, die das Umsteigen auf umweltfreundliche Verkehrsmittel, wie den Fuß-, Fahrrad oder Öffentlichen Verkehr fördern und eine Mobilität ohne eigenen PKW ermöglichen. Gesamtregional könnte somit in Zukunft eine positive Verlagerung des Modal Splits auf klimaverträgliche Verkehrsträger erreicht werden. Gelingt es, alltägliche Mobilitätswege und Pendlerströme auf viele verschiedene Verkehrsträger zu verlagern, kann die Mobilität in der Region effizienter und ökologischer gestaltet werden und insgesamt zu einer Steigerung der Lebensqualität in der Region beitragen.

Die Erfahrungen und Ergebnisse von GUSTmobil und REGIOtim werden im EU-Projekt ROBUST als Best-Practice Beispiele präsentiert. Die Community of Practice im Bereich Öffentliche Infrastruktur und Soziale Dienstleistungen hat unter anderem das Ziel, die Herausforderungen und Chancen der Mobilität zwischen städtischen, stadtnahen und ländlichen Gebieten zu gestalten und innovative Konzepte in den Regionen zu erarbeiten. Die Projektpartnerregion Ljubljana hat bereits seit 2009 ein System einer Smart Card eingeführt, das die Attraktivität des Öffentlichen Verkehrs in der Region erhöhen soll. Die Projektpartner in der Metropolregion Valencia testen zur Zeit ein ländliches Taxisystem und in der Region Mid Wales werden Lösungsansätze gesucht, um die Lücken im öffentlichen Verkehr zu schließen. Die Erfahrungen aus dem GUSTmobil können für andere Fallstudien im ROBUST-Projekt, aber auch für andere Stadt-Land Regionen Anregungen und Ideen für neue Konzepte multimodaler und intermodaler Verkehrskonzepte liefern. In Österreich wurde das Konzept eines Sammeltaxis vom Unternehmen ISTmobil in acht Regionen umgesetzt. Die Erfolge des Projekts sind stark abhängig von der aktiven Beteiligung und Kommunikation der Gemeinden, den Förderungen seitens des Landes und der Region sowie vom Angebot des öffentlichen Verkehrs. Die Regionen des ROBUST-Projekts können anhand dieser Beispiele voneinander lernen und neues Wissen generieren. Es ist offensichtlich, dass der Druck auf Regionen immer größer wird, Alternativen zur herkömmlichen Verkehrsinfrastruktur und Modelle zur Ergänzung der ÖV-Verkehrssysteme anzubieten. Die Umsetzungserfahrungen tragen zur Diskussion über die Zukunft der Mobilität auf ländliche Regionen bei und zeigen wie ein breiteres Angebot an Mobilitätsmöglichkeiten durch multimodale Konzepte in ländlichen Regionen und Kleinstädten geschaffen werden kann (Litman 2020). Sie unterstreichen auch die Bedeutung von politischen Instrumenten zur Priorisierung multimodaler Konzepte (Dirks et al. 2019). Nachhaltige Stadt-Land Beziehungen können somit nur geschaffen werden, wenn die Erreichbarkeit der peripheren und ländlichen Gebiete durch flexible Mobilitätsangebote gesichert ist.

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🏆 *reviewed paper*

Nanjing Golou Campus as Interface of Public Space and Learning Environment

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1 ABSTRACT

Traditionally a campus comprises the buildings of a college or university and the surrounding area: its usage and interpretation mainly focused on its purposes and utilisation by students and faculty. Often perceived and interpreted as scholastic island the article illustrates the role of a campus as important item of the public realm and its importance for the surrounding neighbourhoods and everyday practices of its inhabitants. The article discusses the Golou Campus in Nanjing (China) as a best practice example to show how the facilities of a university campus can be intensively used by the inhabitants of the surrounding suburbs and the academic staff and students.

Keywords: University, Resilience, Public Space, China, Campus

2 INTRODUCTION

Planners, architects and designers believe that design matters and good design is supportive to achieve certain aims and aspirations. Many campus design strategies and master plans include a set of design strategies and implementation actions to achieve the universities goals regarding educational and research purposes and in parallel serve as flagship architecture facilitated for university branding (Acker & Miller, 2005; Hoeger & Christiaanse, 2007). Reviewing the campus debate shows that the discourse either focuses on the design from a practice perspective (Coulson, Roberts, & Taylor, 2010, 2014; Kenney, Dumont, & Kenney, 2005) sometimes tending to fall short regarding the evaluation of the actual functioning and service delivery of the design, or on campus as learning environments for learning purposes in a wider sense (Ellis & Goodyear, 2016; Hajrasouliha & Ewing, 2016; Scholl & Gulwadi, 2015). Increasing student numbers and changing educational and research practices, such as internationalisation, urges universities to broaden their educational approaches but also to diversify and take more care of the campus spaces (e.g. Ellis & Goodyear, 2016; Trujillo & Waxman, 2016)

Campuses are deeply associated with the notions of learning and scholarly education. Scholars are illustrating different perspectives of learning, such as (a) learning as acquisition, (b) learning as knowledge creation and (c) learning as participation (Paavola, Lipponen, & Hakkarainen, 2004; Sfard, 1997). While the first perspective is focusing on learning as a more static personal acquisition of i.e. knowledge and skills, the latter two are more dynamic readings of learning: learning as knowledge acquisition focuses on the co-creation of knowledge, skills, practices. It stresses that learning involves the cognitive and practical understanding how new knowledge, skills and practices come into being. Thus, participating in activities and developing knowledge by experiencing is becoming more important; where the students become members of a community when social relations and social interaction are conditioning the learning processes. Hence, the lens one is using to look at learning also conditions the spatial appropriation of such learning environments.

The perspective of learning as participation and social practice can be linked to the urban discourse of place, negotiating how social practices and everyday practices are turning a place into becoming (Hayden, 1995; Ingold, 2009; Shove, Pantzar, & Watson, 2012). The campus places are shaping the daily environment and are affecting how students, faculty, administrative personnel and visitors are moving through the space and how they meet and interact in space. Various scholars have illustrated the link between physical space and learning: for example, Pascarella and Terenzini (Pascarella & Terenzini, 1980) are illustrating the impact of the learning environment on social and academic engagement. Hajrasouliha and Ewing (Hajrasouliha & Ewing, 2016) analyse the relation between the campus physical environment and student retention rates. Strange and Banning (Strange & Banning, 2001) investigate the impact of design, arrangements and orientation of space and illustrate that those spaces are informal messengers to people that are using them. Different scholars are stressing the importance of the physical environment of the campus as canvas for social practices, social activities (Kenney et al., 2005) and their importance for community building, building networks of learning (Alexander, Ishikava, & Silversetein, 1977) and developing a joint institutional identity.

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To do so, they illustrate the importance of spaces to meet, to linger after class and to enjoy the presence of other peers, colleagues and visitors. They show similarities between campus and urban planning and that certain positive (i.e. compactness, proximity) and negative (i.e. sprawl) characteristics account for both domains. Aslo Hajrasouliha and Ewing (Hajrasouliha & Ewing, 2016) are examining campuses from an urban planning perspective, using a morphological approach by analysing seven different morphological dimensions, such as land use organisation, compactness, connectivity, configuration, campus living, greenness and context, proofing that greenness and urbanism are positively associated with students' satisfaction and their studying experience. They argue for mixed campus developments with the three major components of student housing, greenness and urbanity. They proof the higher livability and community embeddedness of students who are living on the campus. The greenness of the campus is supporting community building, as outdoor socialising and study environment, while the urban component is crucial for social connectedness with the surrounding areas and the city. Already in 1977 Alexander stresses the importance of the physical campus environment and suggests a mixed environment consisting of different patterns such as building complexes, pedestrian streets, arcades and open stairs. Thus, we see that campuses are hardly self-standing monoliths but rather networked integral parts of the urban tissue and embedded in the public: 'Certainly, (…) could never have the form of an isolated campus. Rather it would tend to be open and public, woven through the city (…) Establish a university as a marketplace of higher education. As a social conception this means that the university is open to people of all ages" (Alexander et al., 1977).

In this chapter, we are exploring the qualities of the Gulou campus of Nanjing University following the morphological dimensions of Hajrasouliha and Ewing (2016). The work is following a research by design approach, based on the conceptual thought that designing and design approaches can develop new knowledge, skills and insights into complex spatial problems (REF). Invited to the ISOCARP-NJU International Design Week we worked with a mixed group of Dutch and Chinese students (40 students) and international lecturers in a rapid design studio. Based on that rapid design studio outcome the authors further contextualised and discussed the material of the case study conducted in this week.

3 THE MORPHOLOGY OF NANJING CAMPUS

Nanjing University (NJU) is one of the oldest and most prestigious research and educational facilities in China. While established as a 'modern' university in the early 20th century its history can be dated back to CE 258. Nowadays Nanjing University is a top-rank university, member of the C9 League and regularly scores top positions in international university rankings and as a national university directly funded by the Ministry of Education of China. The university has two main campuses: Xialin Campus, is the new campus which opened in 2009 and is located in the northeast of Nanjing, hosting undergraduate and parts of graduate students. Gulou campus, the historic campus is located in the inner city of Nanjing. This location is rooted in the 5th century.

Fig. 1: Central Axis of the Golou Campus

3.1 Urban context and connectivity

The 'historic' campus is located in the Gulou district, which is a cultural and and educational hub of Nanjing. Gulou (Chinese for drum tower), an old drum tower, originally built in the Ming Dynasty is located in the North of the area. The campus is embedded in a bustling area of very dense mixed, commercial and residential areas with a very low service delivery of green spaces on neighbourhood and micro scale.

However, the dense network of narrow streets and lanes in the surrounding of the campus is becoming a hive of commercial activities: buying and selling, eating; serving a huge group of scholars and students and citizens from that neighbourhoods. A large number of businesses are related to catering students and are linked to academic activities and services such as copy and print shops, laundry services, restaurants and food delivery services serving the campus, which is very popular and intensively used by students and employees.

Changing patterns in the surrounding urban fabric occurs: while the western part shows initial signs of gentrification processes, such as the establishment of more hip and fancy restaurants, cafes and services targeting young urban professionals and international students with higher spending capacity the northern parts of the neighbourhood is illustrating the spectrum of services for local communities with low purchasing power to neighbourhoods of arrival with a higher degree of informality. The campus is in close proximity to different Metro Stations and is linked to the city's mobility system, which most recently experiences a shift in the modal split due to the introduction and skyrocketing popularity of a city-wide bike sharing system, that is flooding the city and campus with bikes and parked bikes everywhere, which is increasingly becoming a problem because parked bikes are cluttering sidewalks and access points to the campus. However, since the entire campus is walled and the access points are fenced, the appropriation and the design of the gates is important for the connectivity and transition areas between the campus and the surrounding neighbourhoods: currently the gates are organised as strong borders between the campus and are controlling the restricted car access, but they are also hubs where temporary food stalls are serving food or other services (i.e. bike repair) are located.

3.2 Configuration, land use organization and compactness

The campus is a mixed campus marrying a considerable number of different university-related and public functions on the site. On the campus but also in the surrounding area a broad variety and number of functions and services are offered. The campus is intersected by Hankou Road outlining two core areas of the campus: Nan Yuan, the South Garden, where many residential services and housing facilities for students and academic stuff are located; and Bei Yuan, the North Garden.

The North Garden is a mosaic of university related and public functions. This area hosts the institutes and departments, buildings for teaching and university administration, which are located in the historic buildings (north, west and east buildings) centred around the main lawn in the north-eastern area of the campus. Different recreational functions are provided and implemented in different parts of the Northern Garden, such as areas for different kinds of sports, small park-like areas, enclosed gardens or sitting areas.

Fig. 2: Northern part of the Golou Campus

While the core areas of the campus are dominated by public and academic usages, housing and housing related services are more at the fringe of the area. The north Gardens inner development is organised along two major north-south and east-west axes linking to traditional campus designs originating in the US and their relations to the 19th and 20th city beautiful movement. The axes are functionally and spatially linking the different areas of the Bei Yuan. The central axis is linking the North and South garden, but runs into the South Park Teaching Building and terminates there. Then the Southern Part is due to the appropriation for the dormitories in ribbon developments much less connected and communicating with each other. Thus, also the internal development and connection to the Guanghzou Road is flawed. The limited car access to the

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campus also contains surface parking to an extent as not to exacerbate recreational usages as well as slow mobility, such as walking or cycling.

3.3 Greenness and social usages

Entering the campus from the dense surroundings is like stepping into a green oasis. The major axes that are organising the campus are designed as broad boulevards with double tree lines providing shade along the daily routes and crossing the campus in north south and east west direction. The open spaces and spatio-functional units are also beautifully landscaped and endowed with lush greenery and trees to provide a green roof and shade, important for a campus in a hot and humid subtropical climate. The temporal distribution of social usages is owed to the daily practices, daily weather and climatic conditions: in the cooler morning the campus is crowded with elderly people doing gymnastics, practicing thai chi in the landscaped garden areas, and walking on the sports fields. Between 7.30 and 9.00 many elderly people bring their grandchildren to the campus for playing and covering the time before nursery school or kindergarten starts.

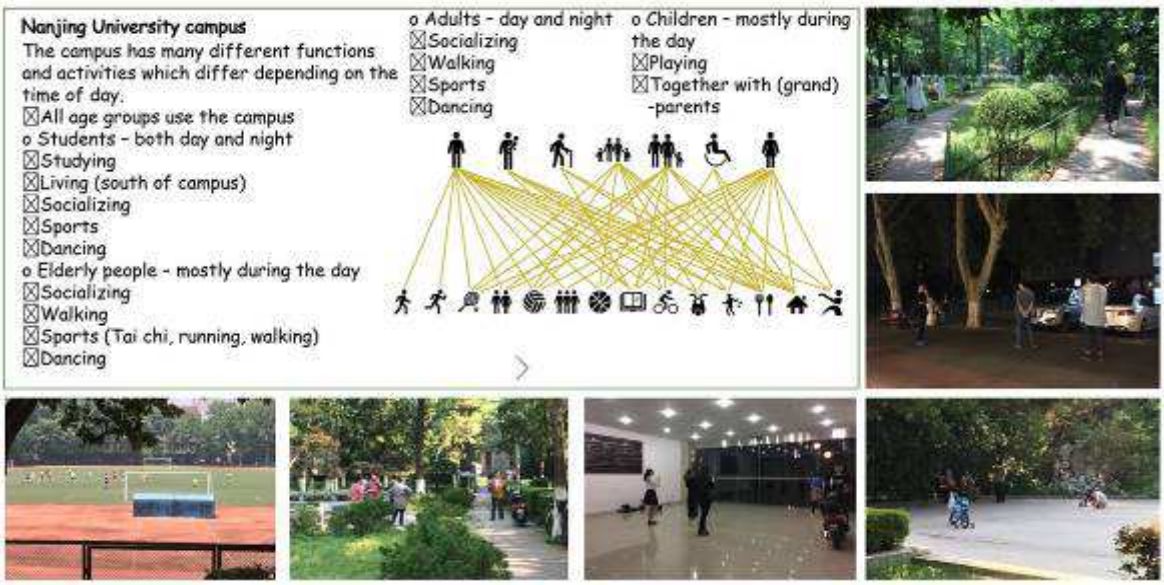

Fig. 3: Different Activities at NJU Campus

While during the day and the hot hours the density of the social usages is declining, in the evening and night hours the social and recreational usages are quickly increasing, including various sports activities, picnicking in the landscaped park areas, meeting friends and families, playful activities with children, practicing ballroom dancing and later in the evening students are meeting for romantic walks in darker areas of the campus. However, interestingly the green lawns around the historic buildings in the US-European university campus design show less tracing of patina and usage than the landscaped areas more designed in a Chinese fashion around the Southwest Building and between the Teaching building and the boulevard along the central axis of the Northern Garden. Covered areas and open entrances of the buildings play an important role during the rainy season and during rain showers at day and evening times, when outdoor functions are shifted to those places, such as students practicing street dance and music, Thai chi or child care activities. The diversity of different green and recreational spaces on the campus, its public functions and temporal distribution creates a vivid spatio-temporal mesh of activities and social usages that are crucial for its importance within the urban fabric. The case study illustrates clearly that the campus services the surrounding dense neighbourhoods with its green, recreational services. Due to its greenness and size (1,65 km²) it offers a green and somewhat cooler environment in a city that is suffering severe urban heat island effects (Xu & Chen, 2017; Zeng, Qiu, Gu, He, & Wang, 2009).

4 CONCLUSION

The Golou Campus of Nanjing is an example which showshow a campus can become part of the urban pattern if accessibility is ensured. Even if the access is only possible at a few points and is also restricted during night hours the extensive usage of the campus is not limited to the students and the university staff but is open to the surrounding neighbouthoods. The quality of this arrangement is that the campus is forming a

part of the neighbourhood and is contributing to the variety of the urban spaces. Due to the separated organisation of the usages in the campus (study in the northern and living in the southern part) and the almost car free access there are no obvious conflicts between the different suers, due to the variety of the functional uses. A central spot in the campus is formed by the athletic field where the different age groups and types of usage ae coming together, without causing interferences.

Fig.4: The central athletics field as a connector of ages and activities

Even if the campus becomes a part of the urban pattern the impression on being enclosed remains, due to the still existing clear borderline of walls and gates. On the one hand, this feels like a limitation, but on the other hand it preserves a transition between the different existing urban spaces.

Acknowledgements: The article is based on our work done together with students from Nanjing University, School of Architecture and Urban Planning, chaired by Prof. Hongyang Wang and students from the educational programme 'Spatial Planning and Design' at the University of Groningen; at the ISOCARP – NJU International Design week at Nanjing University, China in May 2017. A big thank you to the students from design line 2 Guangyao Wen, Jing Qiu, Yu Zhang, Xiantong Kang, Xiangyu Wei, Langjie Gusang, Lianjie Yang and Marijke Rommelse who supported us with their design work during the international design week in our research.

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🏆 *reviewed paper*

New Places for Urban Development – the Space between Historical City Centres and Post-War Expansions Areas

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1 ABSTRACT

This paper deals with the development and identification of urban zones, which used to function as a transition zone between the historical city and the outskirts. Usually these zones contained functions like car dealers, supermarkets, hardware stores, workshops, etc.. In summary these functions have in common that they need space and good connectivity, while their location nearby to the city was also of importance. During the last 20 years and encouraged by rising demand the pressure has increased on centrally located areas and plots, and forced a change of usage in these transition zones towards functions which are more profitable.

Besides the change of the functions a major challenge was the need to rethink established formal methods of urban planning, like legal strategic plans or city development master plans. The present paper will therefore examine whether such urban districts offer prerequisites for alternative (informal) development methods.

In this paper, a typology of urban districts will be generated to define a generic type. However, due to their size and heterogeneity, these urban districts can hardly be developed in their entirety with the help of the established, formal urban planning methods. It is therefore the task of urban planning to consider different informal and individual urban planning concepts and to act accordingly.

Keywords: urban development, historic city, post-war, districts, inner periphery

2 INTRODUCTION

For a long time, urban zones that are located between already redeveloped areas, like the old city centre and post-war housing areas, urban growth was not noticed as relevant for future-oriented planning. These intermediate zones have not been developed like other urban areas of the post wartime. These parts have arisen and were not planned, they were more or less left to their own devices, mainly functioning as transfer areas and have a heterogeneous structure.

Since the 1950s, cities in Europe have grown tremendously in space, which was not depending to the same extent on the enormous increase in population. The vast growth was more a result of the increase in land consumption, which was driven by the development of new housing estates, industrial development and traffic infrastructure. Based on this development, transport has increased in importance and enforced the segregational development of the cities. (Pålsson, 2017, p. 30f).

During the development of the cities, this movement has created areas which are located close to the city centre and have the ability to change their functionality. Based on the reurbanisation movement these parts of the city are under development pressure. Pålsson (2017, p. 127) points out that in addition to visible transformation zones like former old industrial, military and port facilities, the same attention must be paid to mixed residential and commercial areas.

The paper examines and develops a first approach to classifying the typology of these “inner peripheries”, which are increasingly under pressure.

3 THE INNER PERIPHERY

Based on the industrial revolution in the 19th century, the economic impact on society changed from agriculture to industry. This reinforced many changes in economics, technology and of society itself. Next to the development of these usages the relevance of transportation, especially based on railway, provided new opportunities for the mobility of people and goods. These vast developments were the starting point of what we now realise as the separation of functions, based on the division between housing and working. This fast development took place during a couple of decades and asked for quick reactions. (Reinborn, 1996, p. 21f)

Based on the enormous land demand for the development of space for new usages development occurred outside the former city boundaries and claimed former agricultural land. (Reinborn, 1996, p. 29) The

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introduction of the railway system changed the layout of cities. Often, new railway stations could not be built close to the centre of the old city. This led to locations which created new developments in between the city centre and the expanding city. The usage of these new developed areas was usually for commercial and industrial purposes. (Reinborn, 1996, p. 22).

In this development phase the cities became more attractive for new industrial development, which was followed by the demand to create housing estates for workers. (Mueller-Haagen et al., 2014, p. 17f). This phase had an enormous influence on the role of these districts for the cities.

After the Second World War the idea of urban development was focused on a social democratic idea, which aupported a generalist and comprehensive type of planning to serve the whole society with good living conditions. (Oswalt et al., 2014, p. 10). This trend of urbanisation led to monofunctional development which spread the different functions of housing, commercial and industrial areas to locate outside the cities. Housing was developed in terms of geometrically organised single family houses or as mass prefabricated housing estates. (Baum, 2008, p. 35-).

After the phase of rebuilding cities to replace war demolition and to create new housing supply, the phase of the 1970s and 1980s turned the focus back to the value of the existing city. Demolition and the consequence of neglect of the historical parts of the cities between 1945 and 1960 led to a rediscovery of the existing values. In particular, based on the rising awareness and the perception of responsibility for the past the historical old towns moved into the focus of urban planning. It started with the first revitalisation of hsitoric areas, which was followed by the reconstruction of buildings and urban repair projects of the old pattern. (Reinborn, 1996, p. 288ff)

Initially during this phase the focus was drawn more to the existing pattern, structure and buildings of the city centre, with the possibility to developing mixed use quarters. (Baum, 2008, p. 40). During this period, strongly regulated, overplanned central zones geared to economic returns were created directly adjacent to those occupied by low-capital actors and socially disadvantaged residents. (Oswalt et al., 2014, p.10). In many cases the areas located between railway stations and former factory districts which had decayed following the outsourcing of industrial operations often mutated into such urban planning and social hotspots (Reinborn, 1996, p. 23).

In the 1990s, the planning procedures became more process-orientated, which meant that plans and strategies were developed in a more adaptive way to react to changing needs and circumstances. Parallel to this city administrations outsourced these tasks, because they were convinced that professional companies could act faster and more flexibly than they themself. (Baum, 2008, p. 49).

Concluding this observation, an urban pattern can be identified with similar attributes which can be found in many other European cities. There the city centre consists either of an original old town centre or is (partly) new built following significant war damages. In the next spatial zone around the city centre buildings from the Gründerzeit period are usually connected in a more or less building block-like structure.

These districts or quarters are surrounded by districts in which a mix of small and large businesses, small industrial enterprises and residential uses could be found from the beginning of the 20th century till the 1960s. According to new generalist planning approaches introduced after the Second World War the mixed areas in peripheral locations were only partially workable. Therefore, in the 1960s and 1970s expansion tended to take place in the surrounding countryside where more easily accessible areas were found for the implementation of urban development projects. They now form the urban peripheries. Figure 1 schematically sketches a prototypical structure of Central European cities. The spaces considered in this paper are highlighted specifically.

4 CHARACTER OF THE INNER PERIPHERY

Characteristic features can be assigned to the prototypical districts resulting from the historical development outlined above which Sieverts describes as intrernediary city (Zwischenstadt) (Sieverts, 1999, p. 13). It is determined by a non uniformity of architectural styles and building typologies and is crossed by traffic routes. Due to its characteristics, Sieverts describes the ‘Zwischenstadt’ as an outer periphery.

Related to the outer periphery, Dissmann introduces the concept of the inner periphery which she defines as unplanned, characterised by the disorderly interaction of different urban planning measures and decisions. In

contrast to the outer periphery the inner periphery does not separate the city from the countryside (or the intermediate city), but rather the functioning, compact inner city from vacant plots, abandoned city districts and areas with a lost function. (Dissmann, 2011, pp 113-).

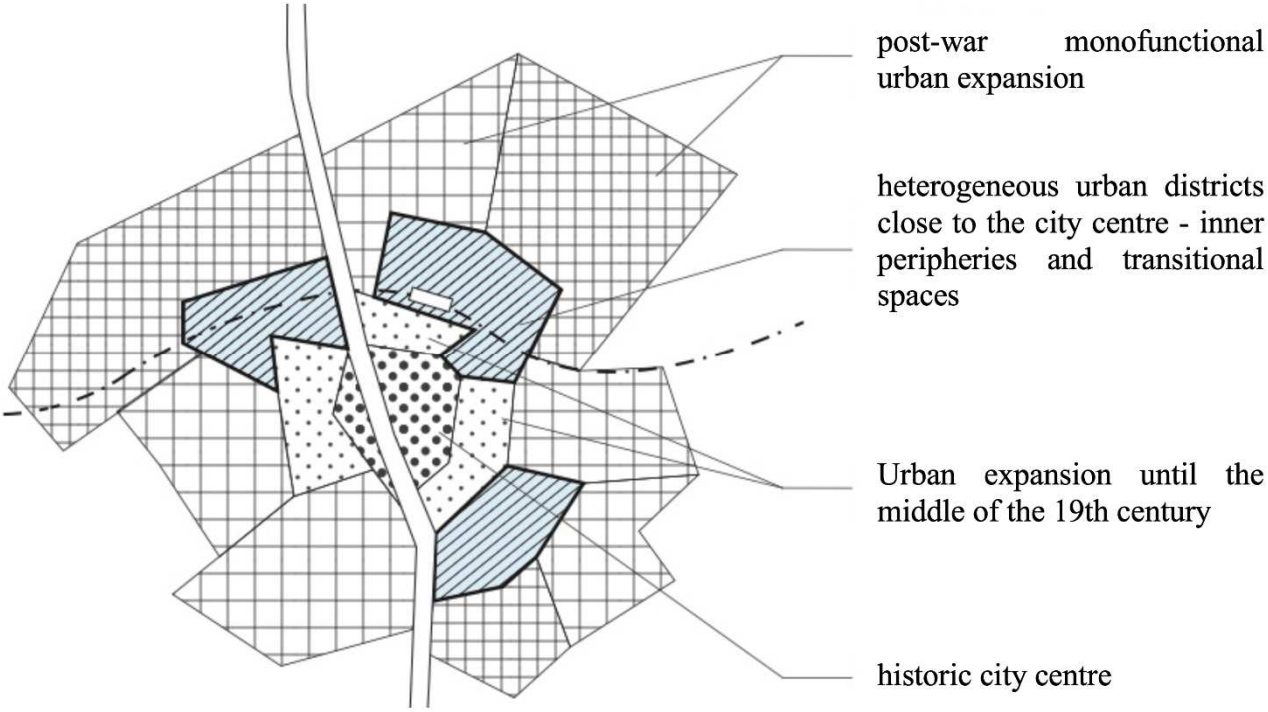

Figure 1: Schematic representation of the urban structure (own illustration)

In her definition of urban places, Baum explains their characteristics in her dissertation 'Urban Places; ('Urbane Orte') (Baum, 2008, p. 75) using different dimensions. She names the mixture of uses as an element of their functional dimension. In addition, Baum defines different characteristics of spaces, whereby, in particular, the functionally diffuse spaces occupy a central place in her considerations. She describes them as 'possibility spaces' (Möglichkeitsräume). The centrality of urban places also plays an essential role for Baum in their functional dimension. The concept of centrality refers to the relationship between individual locations and their environment. (Baum, 2008, pp 75-). Another important point for Baum is the significance of urban locations within the city. Today they are often located close to the centre or at least they have a potentially good connection to the surrounding districts. (Baum, 2008, p. 98).

Kees Christiaanse refers to such areas as 'Waiting Lands'. As characteristic features he cites a mixture of newer and historical structure or a contrasting mixture of large and small architectural building blocks, as well as a combination of nature, existing usage structures and remnants of earlier functions. According to Christiaanse, the intermediate layers require special development strategies. (Christiaanse, 2005, p. 154)

In the publication 'Handbook for the urban periphery' (Handbuch zum Stadtrand) – (Magnago Lampugnani et al., 2007, p. 30) Anne Brandl also refers the concept of suburban space to the 'Zwischenstadt' of Sieverts. The characterisations cited by Anne Brandl refer to suburban space, but from the point of view of this paper they should also be applied to the neglected areas between the city centres and the post-war expansion of the city. She accuses these suburban spaces of lacking a clearly perceptible feeling of spatial isolation and self-sufficiency, as well as a lack of interaction between urban planning elements (Magnago Lampugnani et al., 2007, p. 34).

Overall, the districts considered in this study have the following qualities: partly economic devaluation thus favourable conditions, partly protected building stock, spatial potentials and spatial qualities due to vacancies, symbolic potential from historical development, very good location and connections, openness to use (Baum, 2008, p. 98). As only in areas beyond economic control can temporary, informal and innovative practices emerge in urban planning. (Oswalt et al., 2014, p. 10), it is clear from the historical development of urban planning methods that such districts are difficult to grasp with the formal planning methods established to date in the second half of the 20th century, while informal methods offer a promising opportunity.

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5 SUMMARY

The formation of industrial and commercial districts around the historic city centres in Central Europe began in the middle of the 19th century, often in connection with the construction of transport infrastructure, such as railway and port facilities. Until the middle of the 20th century, the original functions were mostly preserved.

The division of the various functional areas - commercial, industrial, residential - was not subject to any clearly defined control at the time of their creation and therefore often appears unstructured. After the end of the Second World War, new urban planning methods were the reason for an outward expansion of the city. The former urban areas themselves were first neglected, but from the 1980s onwards at least the historic old towns were rediscovered. Their revival was primarily motivated by the creation of urban mixed-use neighbourhoods and easily marketable, economically valuable districts.

However, the spaces between the city centre and the outer districts which have always been mixed remained unaffected by this development. These areas had to, and still have to struggle with the migration of commercial and industrial enterprises, are not much sought-after as residential areas and are burdened by mostly superordinate transit traffic.

Such areas are difficult to define and process with the established, formal means of urban planning for the reasons mentioned above, while informal approaches to urban development may offer new opportunities. Since their establishment, formal urban development processes have not offered sufficient possibilities in their application to carry out what are often desired urban district developments. How to deal with such urban districts from an urban planning point of view has not yet been conclusively clarified.

6 ACKNOWLEDGEMENT

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🏆 *reviewed paper*

New Policies For The Development Of Informal Settlements

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1 ABSTRACT

Most urban areas of the world suffer from many urban problems resulting from population inflation and urban growth. Urban areas have seen many developments in the past decades, such as the migration of people from rural to urban areas, and the subsequent deterioration. Urbanization is growing rapidly, with no parallel investment in urban services, and housing policies, planning and land management systems failing to meet the needs of society. The concept of “informal” is usually defined negatively and simply, unlike typical “formal” characteristics, where it represents illegal, unauthorized, unplanned and unregulated characteristics.

In recent years, land-use change and urban growth models have become important tools for city planners, economists, ecologists, and resource managers. In most models, future land use changes, urban sprawl and limb expansion are expected. Today, urban areas use smart growth strategies. The study illustrates the use of urban infill as a new approach to dealing with informal areas. It considers the transfer of incompatible land uses beyond the city limits, the redevelopment, improvement and renovation of old urban areas, worn-out fabric and the reuse of abandoned land in new urban development.

The problem of informal settlements is one of the key issues. It is an economic, social and urban problem affecting the region itself and its surroundings. Informal areas have been imposed themselves as a form of planning for the majority of urban residents. The extreme neglect of this problem amplified it as it grew at more rates than the city itself.

The promotion and development of informal settlements have become self-imposed in national development policies. Although there are several ways to address them, their problems remain, and development projects continue to suffer from many deficiencies in their performance. Therefore, the importance of the study was to use a new policy to deal with informal areas in Egypt such as the urban infill policy as a new approach to deal with it and try to use and implement it and try to reach solutions to reduce the problem and increase the resulting problems.

Keywords: policies, informal settlement, infill, urban infill, infill development

2 INTRODUCTION

The scope of informal settlements extends beyond the informal concept to include everything that violates the law, and it is important to look at informal areas not in the informal housing or marginal residential areas but dealing with the informal areas as a whole, where the problem is exacerbated, which led to To the growth of informal areas in all directions. Then directing decision makers to consider new ways to deal with informal areas, and how urban infill policy can help change ways of thinking about dealing with these areas as one of the proposed approaches to their development.

The study aims to reach a set of criteria by which to determine the possibility of using and applying the urban infill policy as a new policy to deal with informal areas and their problems, whether urban or social or otherwise,

Besides a set of sub-goals from:

- Explain the main reasons for the emergence and growth of informal areas and their urban, structural, demographic, social and economic characteristics
- Study different types of informal areas and highlight different categories
- Learn about the different policies for dealing with informal areas to find out the appropriate way to deal with each pattern.
- Explain the definition of infill and urban infill and study its properties.

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- Determine the obstacles to implementing the infill development and deficiencies in previous strategies to determine the most important problems they have suffered.

Knowing the extent to which the urban infill policy can be applied and used as a new policy for dealing with informal areas through an analytical study of some local and international experiences.

3 MATERIAL AND METHODS

The study relied on several approaches to achieve the research objectives, which can be summarized as follows:

An inductive approach that addresses a reference study of the concept of informal areas, their manifestations, causes and problems, and a study of the positive and negative effects of this phenomenon. In addition to studying the concept of urban infill as a policy to deal with informal areas more over studying the obstacles that affect the implementation of this policy.

A study of the different categories of informal areas. And define the different policies and methods for dealing with these areas.

An analytical study that deals with the analysis of some local and international experiences, then studies the experiments to track the reasons for the success and failure of these experiences and to identify the problems that hinder the process of dealing with informal areas.

4 RESULTS

Urbanization works to create unplanned urban growth, resulting in many informal settlements with high building densities. Often at the expense of agricultural land

Non-formal areas have become sort of the city's fabric, and their concept is broad and uneven. Sometimes, the minimum basic services for various housing communities are not available, and the minimum quality is not achieved, which is necessary for comfort, health and safety.

- Non-formal housing areas have been found as a kind of self-sufficiency for individuals to solve their housing problems, which the state has been unable to solve. This is done outside the controls and legislations established by the competent authorities, causing the creation of an unfavorable urban environment that suffers from many planning, architectural problems, environmental problems,Social, economic and security.
- There are many definitions of informal housing ranges, which can be divided into several aspects of the legal and administrative aspects as areas that have arisen in the absence of the law. They are defined according to their definition and from the planning point of view they are areas that lack the basic social and economic services as overcrowded and low areas.
- The problem of informal housing ranges is a contemporary, interrelated problem, whose situation has grown over long time, where the root of the problem is rooted in many trends Social, economic or political conditions.

The research detect some important remarks on the study areas :

- The city can be classified as follows: spatially, according to its stages of development: The first stage: the deteriorated housing pattern witnessed by the old city due to overcrowding and housing due to its small size and old size, and it is still continuing despite its replacement and renewal operations.
- The second stage: represented by the natural secretion of the previous stage, and included the immigrant population, the poor, and the residents who could not reside in the heart of the city for several economic and social reasons that were found along the lines of the city.
- Stage Three: Linked to the informal residential areas in the growth slopes of rural assets on the edges of the urban block for land price cheaperities.
- Fourth stage: informal residential areas outside the city, which is in the villages of rural-urban edge, which emerged with the growth of the city.

5 CONCLUSION

Through the results of the theoretical study and the analytical study, the research concluded a number of recommendations.

Apply the proposed methodology to assist stakeholders in decision-making, take all appropriate measures and define the modalities of dealing with non-formal housing ranges, and follow the steps following decision-making from implementation, follow-up and evaluation.

The approach addresses complex management problems by a group of specialized experts, and through the use of formal communication tools to survey participants' opinions, with the potential for those responsible for final decision making within the group. People from informal areas can also be involved.

Some interventions proposed to build a database and basic data for informal housing areas that are accurate and integrated and contain all the details of urban, social and economic, and have the credibility to form the development process. Through a clear methodology to regulate the strengths that make it the basis of the information that has been proposed. This contributes to a precise illustration and analysis of the reality of the informal housing areas and then identifies the appropriate forms of intervention in these domains to be consistent with the realities. Taking into account the unexpected outcomes of periodic updating of these data.

The importance of prioritizing the solution of the problems of informal housing areas on sound foundations by improving a set of criteria that reflect the actual needs of the region.

Preparation of a list for the development and development of informal man-made areas containing a set of strategies and mechanisms to deal with these areas.

Attention to comprehensive development of informal areas to reach sustainable development projects. Development should not be limited to the development of facilities and infrastructure, but development and development should be directed to the integrated development of societies, socially, economically and otherwise.

Combine the official efforts with the research centers and the local community in the process of addressing and eliminating the informal housing areas because of this role in the development and prosperity of society, It is a multi-pronged process involving many parties, and the role of the private sector in this process is to be activated.

Recommendations on the principle of partnership in the development of informal residential areas:

The process of addressing informal housing areas touches a large segment of the population, as it is a long process that takes into account the population's understanding of it in terms of their understanding of the property expropriation processes that may not resemble, resist, contradict and resist.

It is recommended to develop a framework for organizing and distributing tasks and responsibilities among the parties involved in the processes of developing informal housing areas in order to succeed in the work and prevent conflicts of interests and visions, by working to support them.

Supporting the direction of the involvement of the private sector in the development process by adopting an encouraging policy that takes into account the development of society while achieving mutual benefit between it and the private sector, which leads to the acceleration of the development processes, as Al-Shamir As well as introducing new formulas to deal with development and development projects.

It is recommended to form independent bodies that have the capacity of popular participation for each neighborhood that is concerned with the management of urbanization, and it also acts as an intermediary between the people and the government agencies.

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🏆 *reviewed paper*

Nutzen der Digitalisierung auf eine nachhaltige Landschafts- und Raumentwicklung: Ergebnisse einer breit angelegten Delphi-Umfrage in der Schweiz

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1 ABSTRACT

Digitalisierung verändert die Anforderungen an den Raum, dessen Nutzungen und damit Raum und Landschaft selbst. Für Technik und Fachplanungen kristallisieren sich die Entwicklungstrends allmählich heraus. Doch wie sich die Digitalisierung auf den Raum und die Planung konkret auswirkt, ist momentan noch kaum erforscht. Auswirkungen der Digitalisierung werden in den Bereichen Mobilität, Energie und Versorgung besonders deutlich, aber auch in Bezug auf Freizeit und Erholung und die flächenhaften Nutzungen werden Trends in der Fachwelt diskutiert.

Hier erste Antworten und Hilfestellungen für die Planung in den Gemeinden und Regionen zu finden, um deren Handlungsfähigkeit im Zeitalter der Digitalisierung zu erhöhen, ist Ziel des Forschungsprojekts „NUDIG – Nutzen der Digitalisierung für eine nachhaltige Landschafts- und Raumentwicklung“ der HSR Hochschule für Technik Rapperswil / Schweiz. Als Grundlage werden im ersten Schritt aus der Literatur und aus beschriebene Auswirkungen der Digitalisierung vom Forschungsteam systematisiert und bewertet. Als Ergebnis der Desktoprecherche kann die Raumwirksamkeit der Digitalisierung und mögliche Steuerungsansätze phänomenologisch beschrieben werden, eine Evidenz oder sogar Empirie über die Raumwirksamkeit lässt sich hingegen nicht ableiten. Eine empirische Untersuchung der Raumwirksamkeit der Digitalisierung, die sich mit mehreren Disziplinen der räumlichen Planung und deren Wechselwirkungen befasst, scheint zumindest zum jetzigen Zeitpunkt nicht möglich. Um die Ergebnisse und die darausfolgenden Thesen der Literaturrecherche dennoch zu plausibilisieren wurde eine zweifstufige Delphi-Umfrage gestartet, wo Fachexpertinnen und Fachexperten der einzelnen Planungsdisziplinen gefragt sind, ihre Einschätzungen zu den Auswirkungen und dem Nutzen der Digitalisierung auf die Planung abzugeben.

Das zentrale Ergebnis der Umfrage ist, dass sich die Fachdisziplinen der Digitalisierung nicht verweigern können und die Raumnutzungen und die Wahrnehmung von Raum beeinflusst und verändert werden. Die Digitalisierung eröffnet für alle Raumkategorien und die unterschiedlichen Fachdisziplinen Potenziale für eine nachhaltige Entwicklung, wenngleich die einzelnen positiven und auch negativen Einschätzungen der Fachdisziplinen variieren.

Dieser Beitrag soll daher einerseits die Vorgehensweise der Delphi-Umfrage beleuchten sowie die relevantesten Ergebnisse und Schlussfolgerungen aus der Umfrage erläutern. Andererseits liegt der Fokus auf der Frage ob mithilfe der Digitalisierung und der dadurch entstehenden neuen planerischen Perspektiven, eine Trendumkehr, eine umweltverträglichere und ressourceneffizientere Raum-, Verkehrs- und Landschaftsplanung, unterstützt und wie dieser Aspekt von der Fachwelt beurteilt wird.

Keywords: Umfrage, Delphistudie, Nachhaltigkeit, Raumentwicklung, Digitalisierung

2 EINLEITUNG

Das Thema Digitalisierung ist ein allseits diskutierter Megatrend. Für Technik und Fachplanungen kristallisieren sich die Entwicklungstrends allmählich heraus, doch wie sich die Digitalisierung auf den Raum und die Planung auswirkt, ist momentan noch kaum erforscht. Welche Aufgaben können Orts- und Stadtzentren in Konkurrenz zum zunehmenden Online-Handel übernehmen? Können durch zunehmende Automatisierung im Verkehr die Strassenräume siedlungsverträglicher gestaltet und das Verkehrsaufkommen besser abgewickelt werden? Wie sieht die „digitale Freizeitnutzung“ aus, welche Infrastrukturen werden dazu benötigt? Können durch die Digitalisierung Siedlung, Verkehr und Landschaft nachhaltiger und zielgerichteter aufeinander abgestimmt werden? An der HSR Hochschule für Technik in Rapperswil / CH wurde dazu ein Projekt gestartet. Ziel von „NUDIG – Nutzen der Digitalisierung für eine nachhaltige Landschafts und Raumentwicklung“ ist es, auf diese Fragen Antworten zuhanden der Gemeinden und Regionen der Schweiz zu finden: was bedeutet Digitalisierung konkret für die Planung in den Gemeinden und Regionen? Welche Weichen sind wie und wann zu stellen?

Gegenwärtig wird das Thema Digitalisierung überwiegend aus Sicht der Wirtschaft diskutiert, wie Geschäftsmodelle angepasst bzw. neu aufgebaut werden könnten. In der Stadtentwicklung wird diese Diskussion unter dem Begriff „Smart City“ geführt. Eine eigenständige Sicht der räumlichen Planung, wie die neuen Ansätze, Technologien und Daten zu einer Weiterentwicklung des Raumes im Sinne eines nachhaltigen Gesamtsystems genutzt werden könnten, ist nicht feststellbar (vgl. Albino et al. 2015).

2.1 Kontext zu Verkehrsplanung und Moblität

Im Bereich Verkehrsplanung und Mobilität werden Entwicklungen diskutiert, die ohne Digitalisierung nicht vorstellbar wären: selbstfahrende Fahrzeuge, Daten für verkehrsplanerische Anwendungen und „Mobility as a Service“. Durch diese einschneidenden Entwicklungen wird ein erheblicher Wandel sowohl im Individualverkehr als auch im öffentlichen Verkehr erwartet. Die Auswirkungen der Digitalisierung können mit folgenden sieben Punkten umschrieben werden (vgl. Rees 2018): Vernetzung, Individualisierung, Sharing, Verortung im Raum verknüpft mit der Zeit, Echtzeitdaten, Erkenntnisgewinne durch künstliche Intelligenz und mit Umwelt bzw. dem Menschen interagierende Gegenstände.

Dabei könnten sich auch die Grenzen zwischen Individualverkehr und öffentlichen Verkehr auflösen. Die Entwicklungen werden von der Privatwirtschaft und insbesondere der Automobilindustrie getrieben, da ein neues und lukratives Geschäftsfeld erwartet wird (vgl. Fojcik, Proff 2018). Die öffentliche Hand diskutiert, wie auf die Entwicklung reagiert werden könnte. Die Entwicklungen werden dabei eher als Einzelfragen diskutiert und nicht unter dem Schlagwort Digitalisierung, für das es in der Verkehrsplanung noch keine allgemeine Definition gibt.

2.2 Kontext zu Raumentwicklung und Zentralitäten

Die Diskussion um Digitalisierung im Kontext der Raumentwicklung ist unter dem Stichwort „Smart City“ gestartet, wo technische Lösungen im Mittelpunkt standen. Selbst Fragen von Partizipation und Teilhabe wurden in dieser Diskussion häufig als ePartizipation, eGovernment oder eVoting unter technischen Aspekten definiert. Mittlerweile hat sich der Fokus der Diskussion verschoben und der Mensch und das Allgemeinwohl werden zunehmend in den Mittelpunkt gestellt (vgl. Bauriedl, Strüver 2018).

Diese Diskussion macht deutlich, dass Digitalisierung auf einer Ebene von Objekten (Apps, Sensoren, Daten, KI, …) greift. Nicht immer wird über dies Objektebene hinausgegangen und die Wirkungen dieser Objekte auf eine strukturelle Ebene, wie die Raumstruktur, betrachtet. Konkret greifen Trends wie AirBnb, e-Scooter Verleih oder Overtourism auf der Objektebene und lassen sich mit Instrumenten der Raumplanung auf einer Strukturebene nur unzureichend steuern (Seidl et al. 2018).

2.3 Kontext zu Landschaftsplanung

Digitalisierung kann im Bezug zu Landschaft und Freiraum ähnlich wie im Bezug zur Raumentwicklung gesehen werden, ist jedoch zusätzlich in Verbindung mit der Wahrnehmung von Landschaft zu verstehen. Auf der Objektebene wirkt Digitalisierung über Nutzung und Nutzende. Digitalisierung verändert zum einen direkt Landschaft und Freiraum (Infrastrukturen wie 5G-Antennen, Leitbauwerken autonomer Fahrsysteme etc.) und zum anderen auch die Nutzung der Landschaft selbst. Über diese Nutzungen wirkt Digitalisierung auf die Struktur und die Gestalt von Landschaft und Freiraum. Zudem wirkt Digitalisierung ausserdem auch

auf den Nutzenden wodurch die Wahrnehmung und Bewertung von Landschaft verändert wird (vgl. Weigend 2017). Um eine nachhaltige Landschaftsentwicklung zu verfolgen, müssen Interventionen nicht nur auf der Objektebene geschehen, sondern auch auf der Strukturebene.

3 UNTERSUCHUNGSMETHODE

Ausgehend von der Literaturrecherche wurden Annahmen zu den drei Fachdisziplinen getroffen. Um die Raumwirksamkeit der Digitalisierung abzubilden und Steuerungsansätze für Gemeinden und Agglomerationen abzuleiten, ist eine Evidenz dieser Hypothesen zur Raumwirksamkeit und entsprechenden Handlungsempfehlungen von Nöten. Daher wurde eine strukturierte Expertenbefragung gewählt, um Erscheinungsformen und Trends der Auswirkungen der Digitalisierung auf den Raum abzubilden. Dies wurde im Forschungsprojekt NUDIG mittels einer zweistufigen Delphi-Umfrage, im Zeitraum Oktober 2018 bis Januar 2019, geleistet. In drei Disziplinen der räumlichen Planung (Verkehrs-, Raum- und Landschaftsplanung) wurden Expertinnen und Experten in zwei Runden um ihre Einschätzung gebeten.

3.1 Vorgehen

Die erste Delphi-Runde fand als Online-Umfrage, die zweite Delphi-Runde in Form eines Expertenworkshops statt. Für die Bereiche Raumentwicklung und Zentralitäten, Landschaft und Freiraum sowie Mobilität und Verkehrsplanung wurde jeweils eigene Befragungen durchgeführt. In jedem Bereich wurden je 10-15 Expertinnen und Experten angefragt, die über spezielle Erfahrungen in ihrem Fach bzw. zum Thema Digitalisierung verfügen. Insgesamt beteiligten sich 33 Expertinnen und Experten an der Online-Umfrage der ersten Delphi-Runde.

Um die Aussagen der Expertinnen und Experten in einen Kontext stellen zu können, wurden zusätzlich über die jeweiligen Fachorganisationen der Schweiz auch die breite Fachmeinung abgefragt. Die Mitglieder des SVI (Mobilität und Verkehrsplanung), des FSU (Raumentwicklung) sowie des BSLA und weitere ausgewählte Landschaftsfachleute (Landschaft und Freiraum) wurden jeweils auch mit der Online-Umfrage bedient. An dieser Umfragerunde im erweiterten Kreis, beteiligten sich insgesamt 291 Fachpersonen.

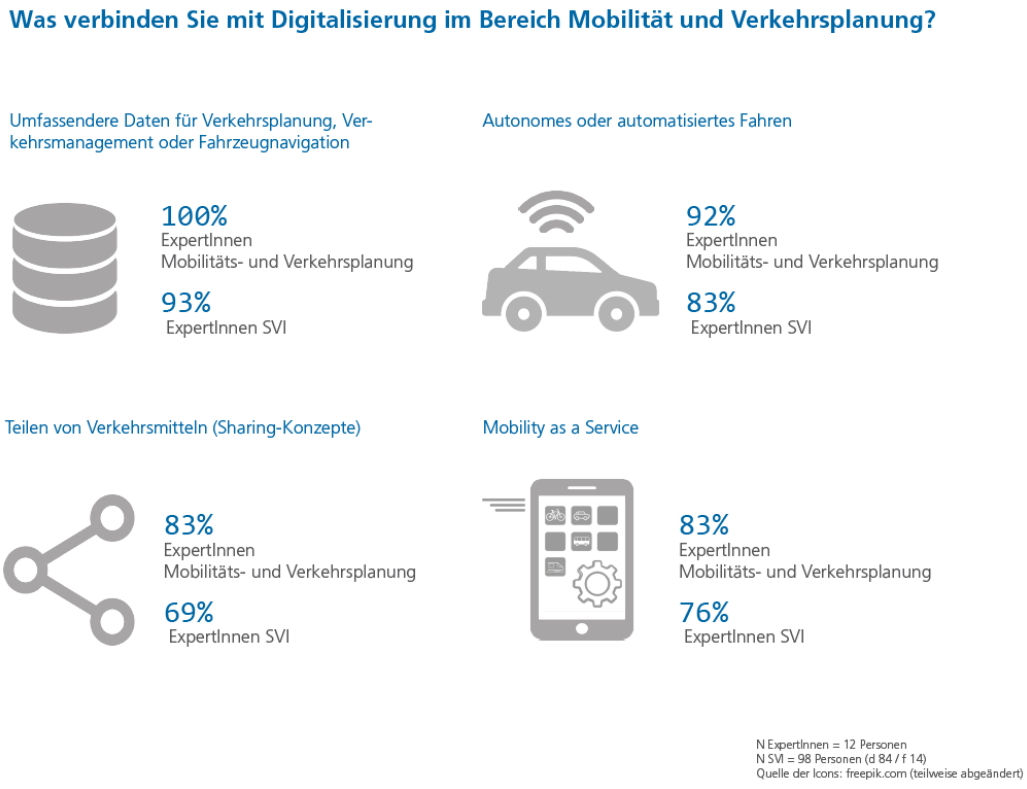

Abbildung 1: Was verbinden Sie mit Digitalisierung im Bereich Mobilität und Verkehrsplanung?

In der zweiten Delphi-Runde wurden die Einschätzungen der Expertinnen und Experten diskutiert. Zudem wurden an diesem Workshop auch die Ergebnisse der Kontrollgruppen der Fachdisziplinen mit den Einschätzungen der Expertinnen und Experten bewertet.

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Da in der Mehrheit der Einschätzungen die Beurteilung der beiden Gruppen (Experten und Mitglieder Fachorganisationen) in der Tendenz gleich sind bzw. sich nur in der Höhe der Zustimmung oder Ablehnung unterschieden, sind in nachfolgenden Abbildungen lediglich die Experten dargestellt.

4 ERGEBNISSE DER DELPHI-UMFRAGE

4.1 Verkehrsplanung und Mobilität

Digitalisierung in Mobilität und Verkehr wird stärker auf Projektebene diskutiert als in den anderen beiden Bereichen Raumplanung und Zentralitäten sowie Landschaft und Freiraum. Der Begriff „Digitalisierung“ wird in der Verkehrsplanung selten verwendet, in der Regel werden die Projekte unter dem Slogan „Mobilität der Zukunft“ diskutiert.

Mit dem Begriff „Digitalisierung“ werden gemäss den Ergebnissen der Umfragen „umfassendere Daten für Verkehrsplanung, Verkehrsmanagement oder Fahrzeugnavigation“, „Mobility as a Service“, „das Teilen von Verkehrsmitteln (Sharing-Konzepte)“ und „autonomes oder automatisiertes Fahren“ verbunden.

Von der Digitalisierung bzw. neuen technischen Lösungen erwartet die grosse Mehrheit der befragten Personen, dass die heutigen Verkehrsprobleme teilweise gelöst werden können. In der Diskussion wurde aber festgestellt, dass die Chancen, welche durch die Digitalisierung entstehen, nur dann genutzt werden können, wenn von der Planung klare Ziele verfolgt und steuernd eingegriffen werden kann.

Abbildung 2: Erwartungen an die Digitalisierung

Eine Serien- und Marktreife von vollautomatisierten Fahrzeugen (Fahren ohne menschliches Eingreifen) erwartet die Mehrheit der Teilnehmenden beim Parken innerhalb der nächsten 5 Jahre. Für das Fahren auf Autobahnen erwarten dies alle innerhalb der nächsten 20 Jahre, wobei ein beachtlicher Teil dies bereits innerhalb der nächsten 5 Jahre erwartet. Für den städtischen Verkehr wird eine Serien- und Marktreife von vollautomatisierten Fahrzeugen deutlich später erwartet.

Als Haupthindernis für die Serien- und Marktreife von vollautomatisierten Fahrzeugen sehen ca. 90% juristische Hürden (z.B. Haftung). Für eine Mehrheit sind eine mangelnde Akzeptanz und für 40% die Fahrzeugtechnik kritische Aspekte für eine Serien- und Marktreife.

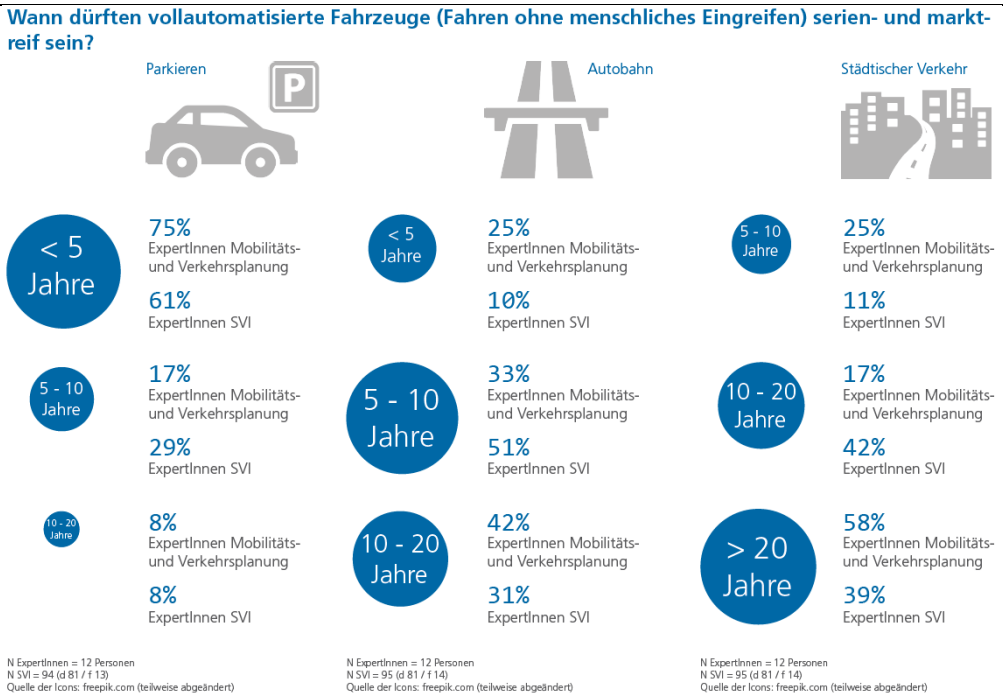

Abbildung 3: Marktreife von vollautomatisierten Fahrzeugen

4.2 Raumentwicklung und Zentralitäten

Ortsungebundenheit und neue Formen der Angebotserbringung sind raumrelevante Merkmale von Anwendungen der Digitalisierung. Die Ergebnisse der Umfrage zeigen, wie unterschiedlich die Auswirkungen der Digitalisierung in den verschiedenen Raumkategorien Kernstädte, Agglomerationsgürtel, periurbane und periphere ländliche Räume eingeschätzt werden. Grundsätzlich wird vermutet, dass alle genannten Raumkategorien von der Digitalisierung profitieren. Die Expertinnen und Experten heben in der Diskussion die ländlichen Räume besonders hervor. In dieser Raumkategorie kann die Digitalisierung eine grosse Chance zur Lösung von Versorgungsproblemen sein. Es wird angenommen, dass auch durch die Digitalisierung der Vorsprung der urbanen Gebiete bestehen bleibt.

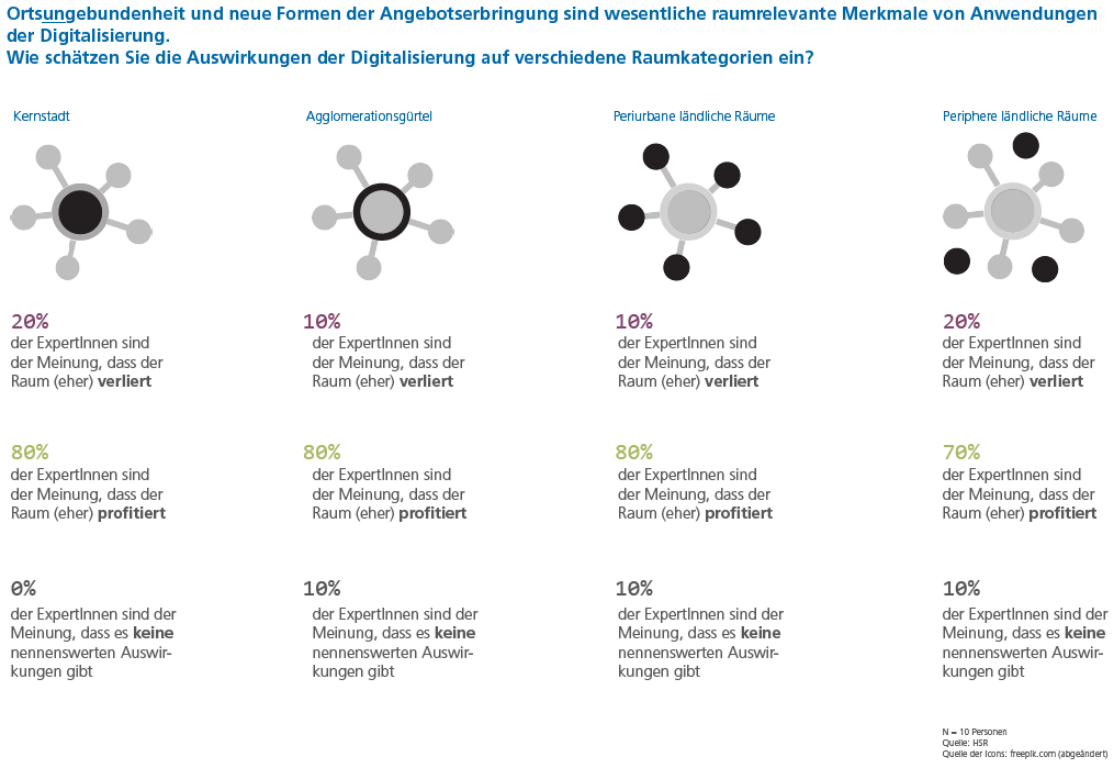

Abbildung 4: Digitalisierung in die unterschiedlichen Raumkategorien

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Die Einschätzung der Auswirkung des automatisierten Fahrens auf den fliessenden und ruhenden Verkehr aus raumplanerischer Sicht ist in nachfolgender Abbildung dargestellt. Die Mehrheit der Teilnehmenden schätzt, dass bisher bekannte Anforderungen (z.B. Parken) wie auch neue Anforderungen (z.B. Ein- und Ausstiegszonen) den Strassenraum und den öffentlichen Raum verändern werden. Ob dieser auch einen Umbau des Strassen- und des öffentlichen Raums bedingt, schätzen die Teilnehmenden hingegen unterschiedlich ein.

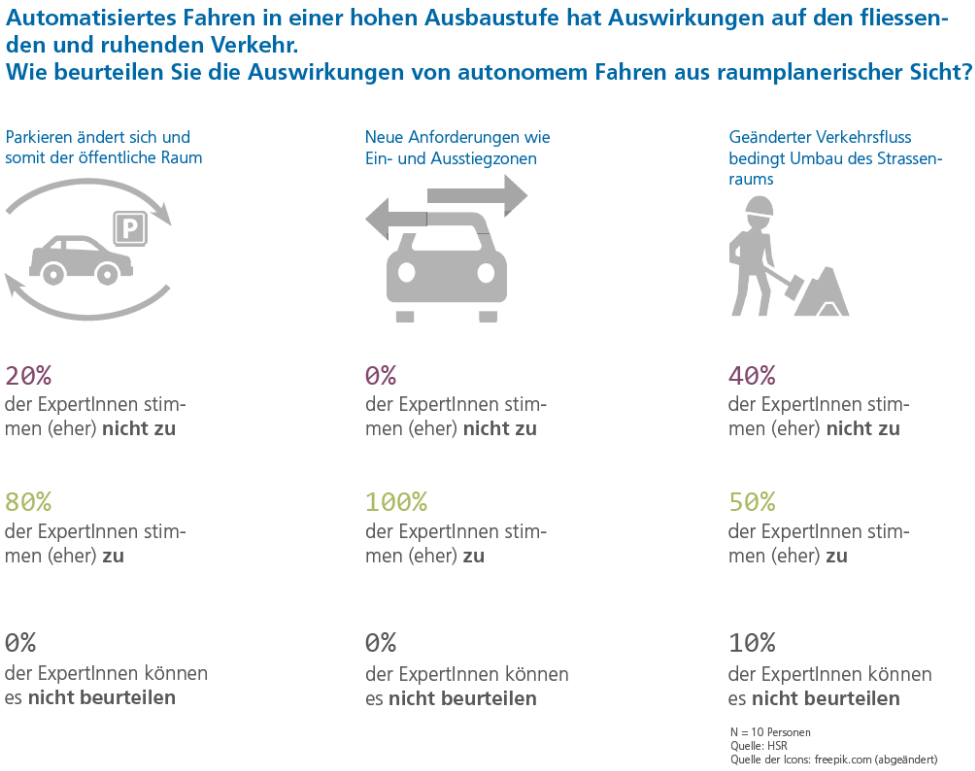

Abbildung 5: Ruhender Verkehr und Raumplanung

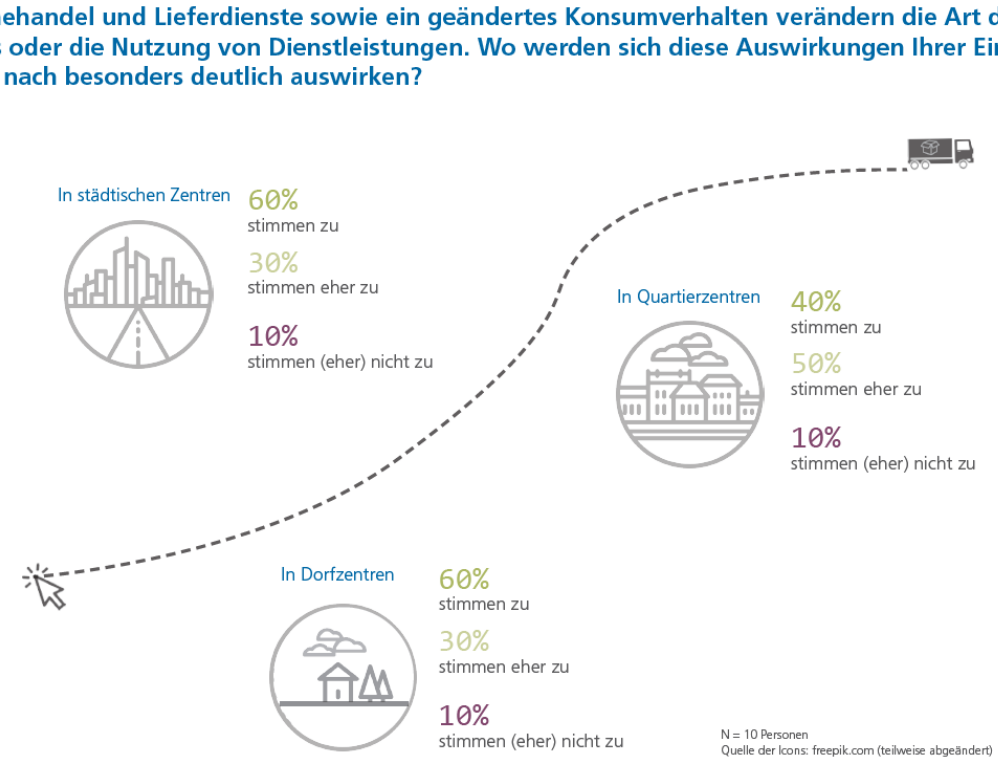

Abbildung 6: Auswirkungen des Onlinehandels

Auch zum Onlinehandel wurden die Expertinnen und Experten befragt. Alle Teilnehmenden stimmen überein, dass die Auswirkungen vom Onlinehandel sowohl in Stadt- als auch in Dorf- oder Quartierzentren deutlich werden. Dabei werden nach Einschätzung der Teilnehmenden die Auswirkungen in Stadt- und Dorfzentren deutlicher auftreten als in Quartierzentren. Wobei sie auch in letzteren Zentren noch deutlich sein werden. Nach der Meinung der Expertinnen und Experten liegt die etwas weniger deutliche Zustimmung bei den Quartierzentren daran, dass dort eine andere Struktur als in städtischen Zentren vorherrscht.

Die Veränderung des Konsumverhaltens und die Zunahme der Verlagerung von Einkauf und Dienstleistungen ins Internet bedingt eine wachsende Bedeutung der Logistik auf der letzten Meile. Neben der Belieferung an der Haustür als Endpunkt der letzten Meile gewinnen, gerade aus Sicht der Anbieter von Kurier-, Express- und Paketdienstleistungen (KEP), die KEP-Stationen zunehmend an Bedeutung. Die raumplanerische Bedeutung dieser KEP-Stationen wird unterschiedlich eingeschätzt und es ergibt sich ein differenziertes Bild bezüglich des Steuerungsbedarfs. Dass KEP-Stationen, zuweilen auch als Microhubs bezeichnet, hingegen ein Teil einer neuen Infrastruktur auf Quartierebene werden, darin sind sich die Expertinnen und Experten einig. Es wird der Bevölkerung allerdings eine gewisse Skepsis gegenüber den KEP-Stationen attestiert, da sie als Konkurrenz zur bestehenden Einkaufsinfrastruktur wahrgenommen werden. KEP-Stationen sollten daher, gemäss der Diskussion, an bestehende Strukturen angebunden oder mit Co-Working-Spaces kombiniert werden, um auch eine soziale Komponente beizubehalten.

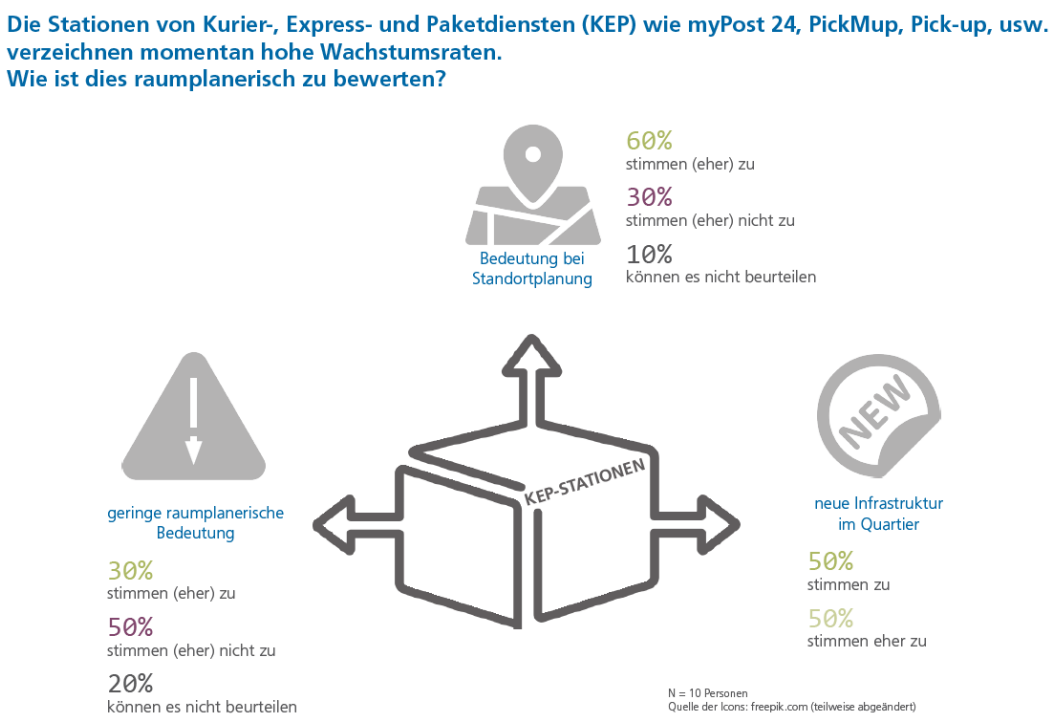

Abbildung 7: KEP-Stationen und Raumplanung?

Abbildung 8: Auswirkungen der Digitalisierung auf Landschaft

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4.3 Landschaftsplanung

Schon seit der Mechanisierung findet ein Anpassen der Landschaft an die technischen Gegebenheiten statt. Landschaft sollte nach Meinung der Experten aber für Menschen und Tiere und nicht für „Roboter“ gestaltet werden. Die Bedenken nach einer weiteren Intensivierung der Flächenbewirtschaftung durch Roboterisierung bestehen.

Neu ist nach Meinung der Expertinnen und Experten jedoch die Dynamik, die diese Anpassungen mit sich bringt. Entscheidungen bestanden und bestehen aus strukturierten Abläufen. Um einer flächendeckenden Ausdehnung der anthropogenen Überprägung infolge „digitaler Entscheide“ entgegenzuwirken, sind aktivere Beobachtung der Prozesse, Auswirkungen inkl. der Wahrnehmungsprozesse sowie steuernde strukturelle Entscheide von Bedeutung.

Abbildung 9: Entscheidungsträger und Digitalisierung

Der Einfluss der Digitalisierung auf die Entscheidungsträger und die Bevölkerung müsse nach Meinung der Experten weiter untersucht werden.

Kritisch hinterfragt wurde durch die Expertengruppe, ob ausreichend formulierte Ziele für die Landschaft bestehen und wer sich dieser annimmt (und über welche Instrumente). Die neuen digitalen Möglichkeiten zu nutzen, kommt auch in Gestaltung, Planung und Steuerung von „Landschaft“ und Landschaftsnutzungen zunehmende Bedeutung zu. Wer sich heute dem Digitalen widersetzt, läuft nach Meinung der Experten und Kontrollgruppe Gefahr, aussen vor gelassen zu werden; diese Tendenz wird sich zukünftig eher verstärken als abnehmen.

Abbildung 10: Gegenentwürfe zur digitalen Welt

Durch die digitalisierte Welt sind die Expertinnen und Experten zudem der Meinung, dass Gegenentwürfe stärker Beachtung finden und Orte, die nicht digitalsiert sind, an Bedeutung gewinnen werden.

Prioritär und zusammenfassend sind im Wesentlichen die drei Aspekte Landschaftsästhetik, Besuchermanagement und veränderte Ansprüche an Freiraum und Landschaft, welche sich nach Auswertung der Umfrage und Diskussion aus der Raumwirksamkeit der Digitalisierung in Bezug auf die Landschafts- und Freiraumplanung ergeben.

5 UMWELTVERTRÄGLICHERE UND NACHHALTIGE RAUMENTWICKLUNG DURCH DIGITALISIERUNG?

Das Ergebnis der Delphi-Umfrage zeigt die Ambivalenz der Akteure der Verkehrs-, Landschafts- und Raumplanung bei der Digitalisierung: Für die Steuerung der räumlichen Entwicklung stellt die Digitalisierung sowohl Chance als auch Risiko dar. Den Nutzen der Digitalisierung auf den Raum zu benennen, ist für Planerinnen und Planer zum jetzigen Zeitpunkt noch schwierig.

Um die Digitalisierung als Chance zu nutzen, sind in Gesellschaft und Staat Ziele zu definieren. Nur so kann die Digitalisierung für die nachhaltige Entwicklung genutzt und auf die Erreichung der Ziele hingearbeitet werden, ohne sich von technologischen Entwicklungen treiben zu lassen. Ob es allerdings gelingt, über die rahmengebende Ebene hier einen kongruenten Zielrahmen vorzugeben, wird von den Expertinnen und Experten skeptisch gesehen. „Smarte" Raumentwicklung kann gleichermaßen Beiträge zur Sicherung der Gleichwertigkeit der Lebensbedingungen – vor allem auch in peripheren strukturschwachen und entleerungsgefährdeten Räumen – wie auch zur Sicherung nachhaltiger Metropolenentwicklung leisten (vgl. Beirat für Raumentwicklung 2017).

Die Raumwirksamkeit der Digitalisierung betrifft alle Raumkategorien, sie wird sich aber nicht in allen gleich auswirken. Vor allem für die ländlichen Räume sind die Auswirkungen am wenigsten deutlich absehbar. Für die Agglomerationen lassen sich die Chancen klarer benennen. Dass die Entwicklung des Raumes aber mit den Instrumenten der Verkehrs-, Landschafts- und Raumplanung auch im Zeitalter der Digitalisierung aktiv gesteuert werden kann, zeigt das Ergebnis der Delphi-Umfrage. Perspektivisch sind hierzu die bestehenden flächenbezogenen Planungsinstrumente um eine auswirkungsbezogene Steuerung zu ergänzen. Im Transformationsprozess der Digitalisierung bieten sich auch neue Möglichkeiten in der Kommunikation, was die Mitwirkungsprozesse stark verändern kann. Planungen können nicht nur in bekannten Planformaten, sondern in verschiedenen Dimensionen dargestellt bzw. simuliert und Beteiligte mit in die Planungen eingebunden werden.

In diesem Sinn lassen sich Themen und Projekte identifizieren, die sich mit dem heutigen Wissensstand planerisch zu Konzepten entwickeln lassen. Die Auswirkungen dieser Themen und Projekte können anhand von Zukunftsbildern für konkrete Modellregionen dargestellt werden.

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🏆 *reviewed paper*

Optimizing the Performance of Public Open Spaces by Enhancing the Human Thermal Comfort

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1 ABSTRACT

Outdoor human comfort is a key parameter in the evaluation of city's liveability. In addition, it helps in promoting people's health and well-being, leading to the improvement of quality of life. Egyptian cities are impacted by urban heat island due to the dense urban fabric causing an obvious deterioration in the quality of their public spaces. Open public spaces provide various benefits to citizens; as they may intensify the economic, social and environmental aspects of the urban environment. Unfortunately, some cities' open public spaces are unattractive to human activity due to the challenges they face. The enhancement of microclimatic conditions in urban spaces can enable people to spend more time outdoors, with the potential to influence the social cohesion of a space and increase in the economic activity.

Therefore, the wider aim of this research is to develop a better understanding of the complex relationship between the microclimate and human behaviour. The study focuses on the open public spaces in Alexandria city's hot arid climate, It is intended to study the effects of socio-economic and cultural diversity on thermal comfort, behaviour and use of space. Field surveys are carried out during the summer of 2019 (19th of August). All of the surveys include, observations of human activities and clothing, along with microclimatic monitoring. The analysis consists of; microclimatic influence on thermal sensation, people attendance; and investigation of socio-economic and sociocultural characteristics for each space. The process is carried out in order to propose a set of recommendations and mitigation strategies, suitable to deal with public spaces. This set is driven by studying the prospects of successfully designed public spaces and mapping the variations in the environmental conditions using ENVI-met and RayMan software in two selected public spaces in Alexandria as a case study.

Keywords: Thermal Comfort, Public Spaces, Mitigation Strategies, Quality of Life, ENVI-Met

2 INTRODUCTION

2.1 City Overview: The Current Built Fabric

The situation of public spaces, specifically in developing countries has been a major issue of debate. The idea of public spaces has been a topic of great discussion in spatial as well as in social aspects, examining how places are successful in achieving a vital urban environment. Public spaces contribute in the general wellbeing socially and spiritually(Attia 2011). As the number of inhabitants in urban areas increase, the need for successful public spaces within cities increase too. Open spaces provide enclosure for all people in which they are free to use without permission or justification, in addition to, practicing their rights as citizens for gathering or recreation(Aljawabra and Nikolopoulou 2010). They are related with shaping the image of urban settlements in which they interpret both the physical setting and the distribution of activities. This role is intensified within city centres. Public open spaces become of particular significance, they are regarded as a fundamental component of the public realm, and as an important public facility (Abdel-Salam 1996; Gehl 2010). Alexandria, the second largest city in Egypt, and its main port on the Mediterranean Sea. It has continuously gone through varying social and economic conditions since it was established in 331 BC. The city started to develop from the early 19th century under the European influence until its current condition as one of the most cosmopolitan cities of the Middle East. Alexandria became an attraction point to nearly 3 million visitors each summer which increases its importance as a touristic city. The open space typology consists mostly of longitudinal roads with orientation east-west, parallel to the harbour, and perpendicular streets on them from north to south. Squares are only located on the borders of the area. Central streets, with width less than 20 m, are defined by continuous lines of buildings with varying heights creating an enclosure forming linear outdoor space. These streets have the functions of allowing people to move around, in addition to offering the only available outdoor space for other recreational purposes (Abdel-Salam 1996).

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Fig 1: The Main streets network in Alexandria's old districts (source: Researchers)

2.2 Problem Definition

The relationship between people and space outlines the identity and image of the city, which can be lost if this relationship is degraded. Unfortunately, the traditional function of city space as a meeting place and social forum for city dwellers in the Arab countries specifically has been threatened (Attia 2011; Gehl 2010).Considering the effect of public spaces in enhancing the quality of social life ,in many Arab cities, the public spaces designed and constructed aren't responsive to social needs and the improvement of the relations between citizens(Mehan 2016). Public spaces in Egypt suffer from great deterioration physically and functionally due to the lack of maintenance, informal street vendors, in addition to poor urban design, neglecting the basic human outdoor needs leading to pedestrians' discomfort. The decline occurring at all levels within Alexandria's districts, residential communities, public gardens, and even public squares, is the result of the place-making approach that has taken a firm ontogenetic approach , which was defined in (Kropf 2001)'s Conceptions of Change in the Built Environment as: the development of the physical form of single separate objects in their physical shape or condition, rather than its spatial type. However, this mode of development, limits the capacity for human flourishing and community led change, where this type of change for public spaces is chosen by the government and decision makers regardless the involvement of citizens' requirements. Public participation guarantees the consideration of human dimension and basic needs, making public spaces more liveable and user-friendly. Although spatial design can be a fast facilitator towards successful community spaces "physically", it can also produce controlled spaces with limited accessibility, consequently compromising people's rights to occupy publicly owned space. This might be due to the irrelevancy of the applied strategies to some spaces rather than others, as they have different characteristics concerning their morphology, location, function, type of users and social and cultural aspects which must be considered. This problem is greatly reflected in Alexandria's street patterns and the use of space, as well as the physical and social elements that can also form boundaries between private and public spaces.

2.2.1 Thermal Comfort in Public Open Spaces

Thermal comfort is an important parameter in enhancing the utilization of open public spaces(Cheung and Jim 2019; Lai et al. 2014) because their benefaction is associated with the outdoor thermal condition(Cheung and Jim 2019; Coccolo et al. 2016). Therefore, Optimizing the thermal condition of urban public spaces is crucial to the success of landscape design and urban planning(Blazejczyk et al. 2012; Cheung and Jim 2019). Public spaces with high quality encourage people to stay longer with the opportunity to practice a wide range of activities. The quality of spaces depends mainly on the degree of usage, which can be measured according to the fulfilment of citizens' needs and requirements.

High quality public spaces are an outcome for people's interaction with urban environments. Several studies stated that public spaces are one of the most important urban elements that contribute in promoting the quality of life (Mehan 2016). Public open spaces such as parks and green spaces, provide opportunities for a variety of physical activity behaviours, such as recreational walking and playing sports. Activities in the

public open spaces are highly influenced by microclimate and specified by urban spatial settings (Koohsari et al. 2015).Thermal comfort is defined by (ASHRAE 2016) as “the condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation”. Participants differ in their evaluation of comfort. In order to provide a valuable review for the performance of the outdoor built environment, comfort has been a primary indicator for good public space design and the assessment of its quality(Peng, Feng, and Timmermans 2019). Moreover, the culture and climate that people are used to, their emotional state, visiting purpose and their use of public spaces may potentially also link to individuals' subjective evaluation of outdoor comfort. The resting condition of individuals gives more specific evaluation of their comfort, as they spend more time than just passing by or walking through streets which does not take much time as the sitting situation (Nikolopoulou and Steemers 2003). Another key factor, the “PET” physiological equivalent tempreature, which acts as a fundamental indicator for the human thermal comfort. This has been taken into consideration. However it’s being reffered to in a later section of this paper (3.2.2).

2.2.2 Urban Heat Island Phenomenon

The UHI is a phenomenon where a difference in temperature can be observed within a city or between a city and its surrounding rural areas (Kolokotroni and Giridharan 2008; O’Malley et al. 2015) and the densest part of the urban areas are expected to have maximum temperature. Some studies propose that the impact of UHI may be more significant in small to medium- sized cities. Therefore, Alexandria city which is inhabited by over 5 million citizens and a medium size in comparison to other Egyptian cities (General agency of public and mobilization and statistics,2019), is subjected to a medium impact UHI phenomenon. Consequently, some regions in the city suffer from elevated temperatures especially at night, areas with high rise buildings, extensive use of AC and regions that lack any shading elements or vegetation, are likely to be more subjected to the phenomenon.

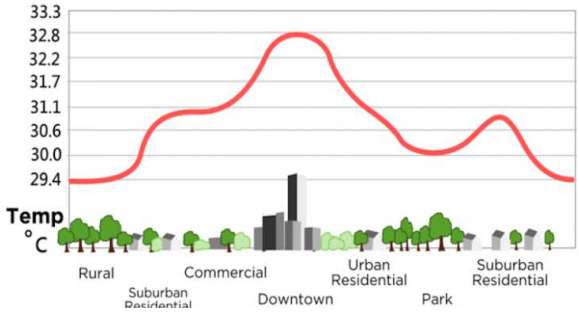

Fig 2: Typical UHI profile (source: Elgizawy 2017)

Anthropogenic heat emissions are considered on of the the main causes of UHI. Also, pollution and energy consumption within a city(O’Malley et al. 2015), intensive land use and high density in urban areas combined with buildings with high heat retaining properties can amplify this phenomenon(Harlan and Ruddell 2011). Moreover, reduced speed of wind caused by design and layout of the built environment can create urban hot spots (O’Malley et al. 2015; Santamouris et al. 2001) Furthermore, lack of green areas and presence of materials with reduced permeability(Chen et al. 2009; O’Malley et al. 2015), and presence of low-albedo materials on buildings external facades and road sur-faces (Giannopoulou et al. 2011) also are known to be the most significant causes of UHI.

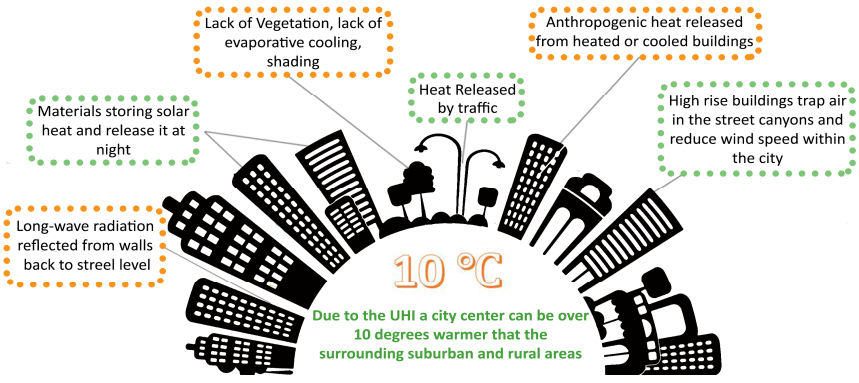

Fig 3: UHI causes, (source: Researchers, adapted from https://www.emaze.com)

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Urban heat islands do not only affect the health of the environment and local wildlife, but also the health of humans. Increased city temperatures can be fatal during summer heatwaves, particularly for senior citizens(Salata et al. 2017). Urban inhabitants also suffer during heat waves because the urban heat island prevents night-time temperatures from decreasing as they do in rural areas. Research has found that urban heat islands not only increase temperatures during heat waves but also prolong their duration(Kolokotroni and Giridharan 2008).

3 METHODOLOGY AND TOOLS

3.1 Case study Observations and Field Surveys

The observations were carried out in three selected public spaces with different demographic and physical conditions. The Roman Museum square has the best physical condition and the highest social level, while Sidi Ali Al-Temraz square which is located in a relatively poor area which has the worst condition. Measurements and observations were recorded every 3 hours starting at 12:00 AM, on the 19th of August 2019, in Alexandria, Egypt. The observations and field surveys show that thermal comfort conditions, affect people's use of outdoor spaces. Responses to the microclimate might have been unconscious but have resulted in a different use of urban space in different climatic conditions.

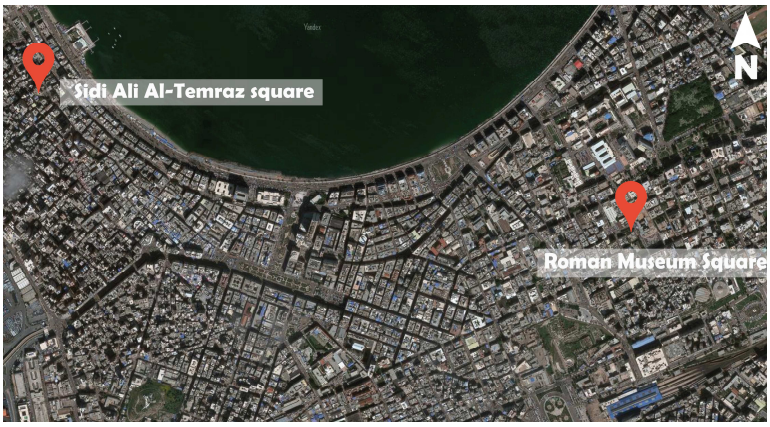
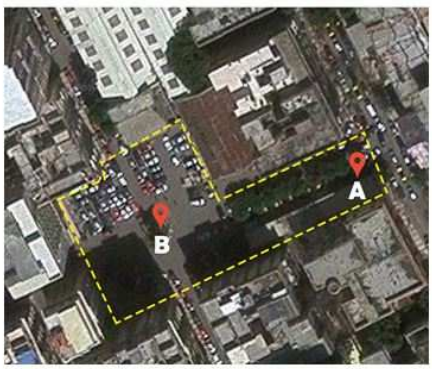


Fig 4: Location of the selected spaces for study on Alexandria's map (source: Researchers)



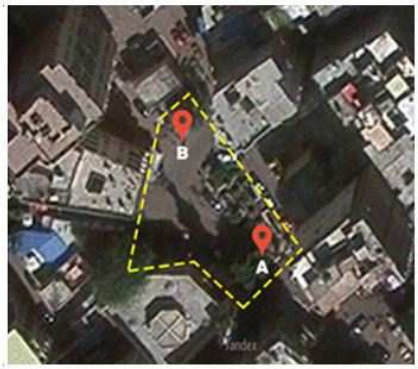


Fig 5: The selected 2 points in the Roman Museum space (source: Researchers). Fig 6: The selected 2 points in Sidi Ali Al-Temraz space (source: Researchers)

Examining the number of people using the selected spaces for study, shows that the different spaces at various time intervals, reveals that warm conditions, the presence of the sunlight and humidity are the significant factors in the use of the space. UHI showed a significant effect on the human presence which was obvious at 9:00 PM which recorded high temperatures in addition to elevated relative humidity. Moreover, the cultural, social and religious aspects which showed the absence of females at late hours of the day. Social activities were recorded as shown in Table 1 as an example, two points were selected in each space for the measurements and observations, the average was taken between each two points for the space.

The Roman Museum space is surrounded by buildings mainly corporations, while Sidi Ali Al-Temraz space is surrounded by residential buildings in addition to shops and recreational activities, therefore it was more active at night, rather than the other space which had a significant activity in the morning hours.

Time	Clothing	Activities		Number of visitors		
		Types	/10	Total	M	F
12:00 AM	average	people sitting on the sidewalks chatting car flow	5	**8**	8	0
3:00 AM	average	car flow only no sign of any pedestrian activity	0.5	**4**	0	4
6:00 AM	average	cars waiting causing traffic jams	0.5	**3**	0	3
9:00 AM	men wearing tuxedos (work /over-heat)	parking/ pedestrians/ corporation's activity	6	**18**	4	14
12:00 PM	summer light clothing for	parking/ pedestrians/car repair	7	**29**	4	25
3:00 PM	Over-dressed due to wok conditions	heavy car flow and pedestrians (end of work hours)	6.5	**12**	0	12
6:00 PM	average	car flow only / less pedestrians/ calm	6	**12**	0	12
9:00 PM	Light for males(shorts) conservative for females	mechanics repairing cars in the street making it more crowded and active	8	**29**	6	14

Table 1: The observations recorded for Point B at Roman Museum space (source: Researchers)

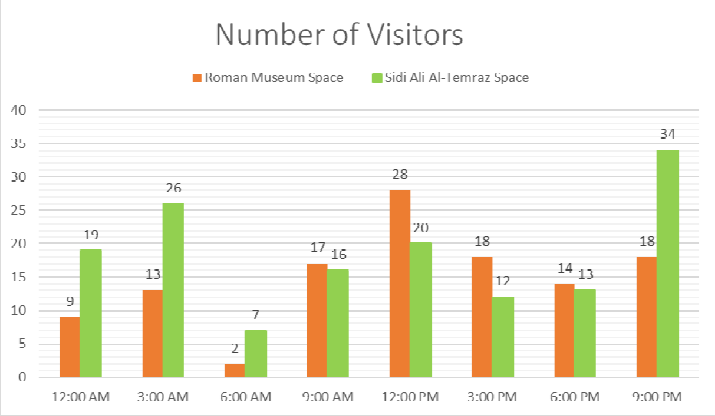


Fig 7: Total number of visitors for each space (source: Researchers)

While studying the human activity, there was more concern about resting areas, since people choose to sit somewhere, rather than a pathway which is less likely to be chosen, in order to avoid discomfort. Streets and pathways will not cause them serious discomfort, since the time of exposure to the specific environmental conditions is short. However, while resting the situation is different, as poor climate conditions may distress people and drive them to avoid using public open areas.

The bigger problem is the lack of street furniture presence, this is affecting the spaces' liveability in the case of the Roman Museum space. However, Sidi Ali Al-Temraz space is more active but in an informal way where coffee shops' owners place chairs and tables on the sidewalks, which cover the whole width. Also, randomly parked cars diminishing the space's physical dimensions.

3.2 Results and Discussions

3.2.1 Field Studies and Measurements

The environmental monitoring focuses on measuring three classical thermal parameters that are well-known for their impact on thermal sensation. These parameters are air temperature, wind speed and relative humidity. Measurements carried on one of the hottest summer days in 2019, shows that the highest relative humidity is recorded in the evening, which validates the theory that states that the UHI phenomenon is more

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obvious and affects the thermal sensation in the evening (Cheung and Jim 2019; O'Malley et al. 2015). Moreover, Air temperature with high values is recorded at noon, which makes the need for shading elements and mitigation solutions to decrease the effect of direct sunrays is crucial, in order to enhance the thermal comfort and encourage pedestrians to spend more time outdoors.

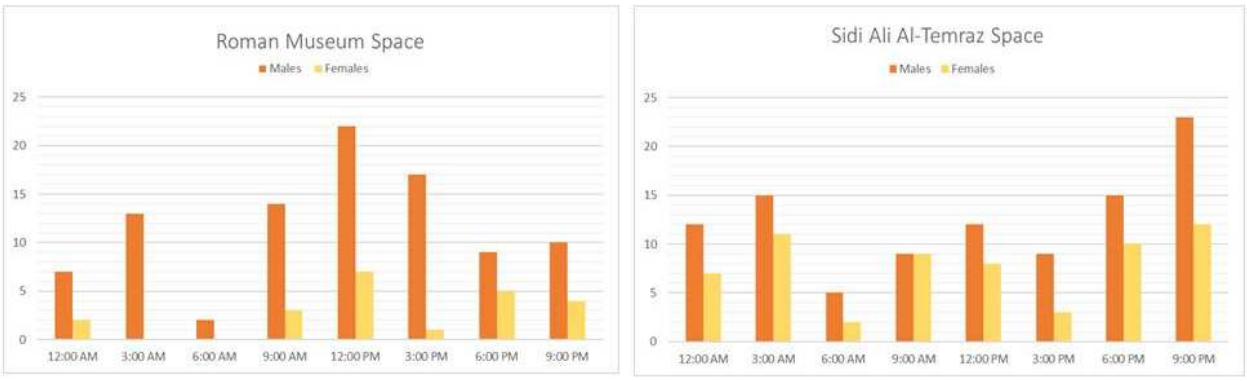


Fig 8: Classification of visitors according to gender for each space (source: Researchers)

Fig 9: Roman Museum space during day hours showing medium activity, cars parked (source: Researchers). Fig 10: Roman Museum space during night hours showing nearly no activity, cars pass by only (source: Researchers). Fig 11: Sidi Ali Al-Temraz space in the morning showing activity, people going to work, and cars parked randomly (source: Researchers). Fig 12: Sidi Ali Al-Temraz space in the evening showing high activity, people sitting, walking and also cars parked randomly causing chaos (source: Researchers)

Fig. 13: fisheye lenses used for mobile phone (source: Researchers). Fig.14: Testo device used for measuring Wind Speed, RH and Air Temperature (source: https://www.testo.com/en-US/products/)

3.2.2 Physiological Equivalent Temperature "PET"

It is the air temperature of a reference environment in which the heat budget of the human body is balanced with the same core and skin temperature as under the complex outdoor conditions in the environment to be assessed. Ranges between (18 - 24°C)(Evola et al. 2017).

"PET" is a popular thermal index which have a scale classified into nine thermal stress categories designed for outdoor thermal assessment. It integrates the effects of all physiologically relevant weather parameters (Air temperature, relative humidity, wind speed and mean radiant temperature) and personal parameters (metabolic rate and clothing insulation level) to a single temperature index (Cheung and Jim 2019).

Time	Air Temperature □			Wind Speed m/s			Relative Humidity %		
	Max.	Min.	Average	Max.	Min.	Average	Max.	Min.	Average
12:00 AM	28.9	28.3	28.3	0.4	0	0.1	65.1	63.1	63.4
3:00 AM	28.5	27.9	28.5	0.6	0	0.5	60.3	54.4	68.5
6:00 AM	28.8	28	28.5	0.7	0	0.4	61.1	59.1	59.9
9:00 AM	29.1	28.9	29	1	0	0.6	57.4	40.3	56.3
12:00 PM	39.6	37	38.5	0.7	0	0.6	39.6	38.7	39.5
3:00 PM	36.3	34.4	34.7	1	0	0.8	45.7	42.5	43
6:00 PM	28.6	28.4	28.6	1.2	0.4	0.7	65.6	48.5	62.2
9:00 PM	30	29.4	29.9	1.3	0	0.8	62.5	59.7	62.2

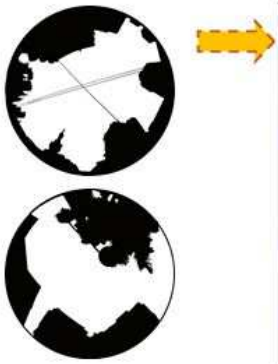
Table 2: Point B, Roman Museum Space, On-site measurements (source: Researchers)

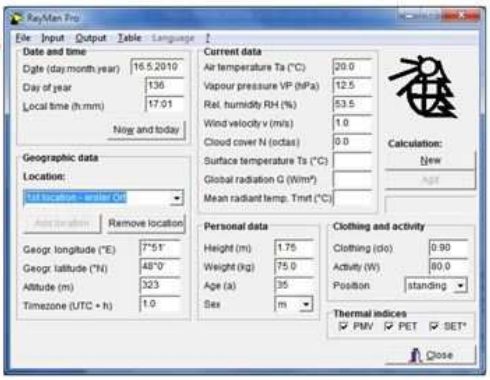
PET	Thermal perception	Grade of physiological stress
4°C	Very cold	Extreme cold stress
8°C	Cold	Strong cold stress
13°C	Cool	Moderate cold stress
18°C	Slightly cool	Slight cold stress
23°C	Comfortable	No thermal stress
29°C	Slightly warm	Slight heat stress
35°C	Warm	Moderate heat stress
41°C	Hot	Strong heat stress
	Very hot	Extreme heat stress

Table 3: "PET" Ranges (Source: https//: www.semanticscholar.org)

3.2.3 RayMan Software

The "RayMan" model, which appears in (Fig.14), is developed to calculate short wave and long wave radiation fluxes affecting the human body. "RayMan" estimates the radiation fluxes and the effects of clouds on short and long wave radiation fluxes. The model, which takes complex building structures into account, is suitable for various planning purposes in different micro to regional levels(Matzarakis and Rutz 2006).





Time	Roman Museum		Sidi Ali Al-Temraz	
	point A.	Point B	point A.	Point B
SVF	0.667	0.526	0.577	0.592
12:00 AM	24.2	24.4	24.1	25
3:00 AM	24.5	24.3	23.4	24.6
6:00 AM	24.6	23.2	24.1	24.8
9:00 AM	25.6	25.7	25	25
12:00 PM	26	28.6	31	31.1
3:00 PM	28.3	27.8	28.8	30.6
6:00 PM	27.7	26.8	26.3	24.7
9:00 PM	24.7	25.5	25.7	25.8
12:00 AM	24.8	25	24.4	25.4

Fig.15: Silhouette of fisheye photos for the 2 spaces (Source: Researchers). Fig. 16: RayMan software user interface (Source: Matzarakis and Rutz 2006). Table 4: The output of "PET" values for each point from RayMan (source: researchers)

"RayMan" is capable of generating the "PET" for a specific location at any time of the day, it could be done by calculating the "Sky view Factor" for the selected area of study, which was done within the study. "SVF" is generated by importing a silhouette of a fisheye photo for the open sky created through photoshop CC, the top of the fisheye photo is directed to the north direction. In addition to the fisheye photo, the on-site measured environmental parameters are added (Table 2). The purpose of this process is to obtain a table of the expected "PET" values measured in ℃ for each of the selected spaces at each hour of the study. The generated table acts as a reference to follow when re-designing an urban space, which should be reached, in order to achieve the human thermal comfort, consequently making it more appealing to human activity.

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3.2.4 ENVI-Met Simulation

ENVI-Met is a prognostic model based on the fundamental laws of fluid dynamics and thermodynamics. It also provides the evaluation of the interrelation between buildings, vegetation and various surface coverings, and of their effects on the perceived microclimate (Evola et al. 2017). ENVI-Met is used in the study to provide an adequate simulation for the current climatic situation of both studied spaces, in order to locate the spots with highest temperature and humidity which cause discomfort.

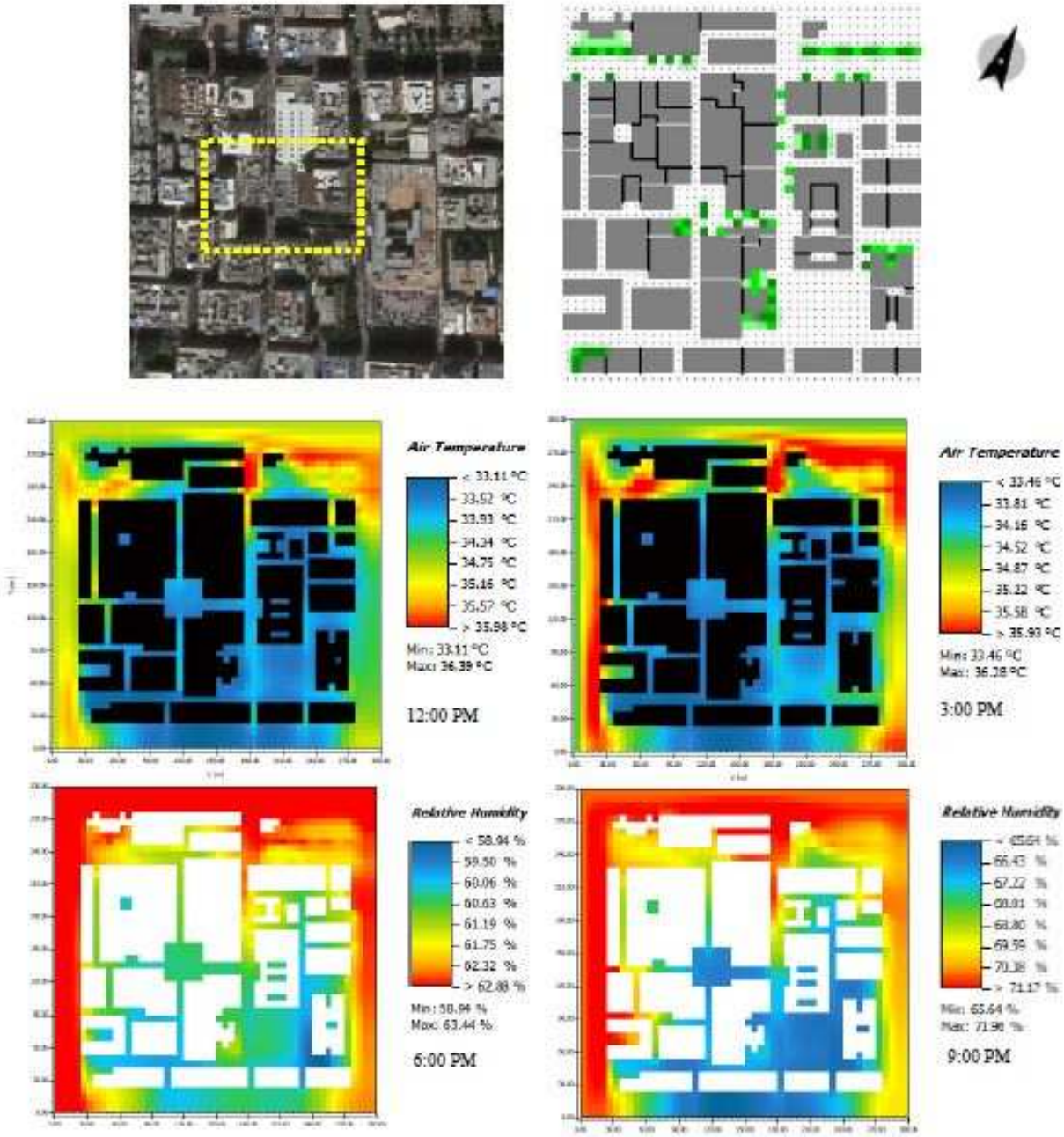

Fig17: ENVI-Met Simulation for the current situation of Roman Museum space

3.2.5 Pilot Study of Mitigation Prospects

All the current studies state that the most-promising strategies that help to reduce the UHI effect are urban green (trees and vegetation), cool roofs and cool pavements. The benefits of vegetation are obvious since it provides shadow, it introduces a cooling effect owing to the evapotranspiration, and increases the overall albedo (Evola et al. 2017). For evaluating the impact of possible actions that can be carried out to diminish the adverse microclimate effects, different mitigation actions have been evaluated, which involve the adoption of cool pavements and green elements in the recognition of the high thermal stress spots in both spaces. The reasons behind the selection of the previously mentioned strategies can be listed as, First, the

selected strategies are among the most common design solutions preferred by urban planners, architects and landscape architects. Moreover, they are favoured by the general public, or at worst they are the least objected solutions by the general public for their limited impact on the plethora of different elements, issues and determinants in urban spaces. And finally, they seem to be the most affordable strategies both at the design stage technically, financially and aesthetically. The proposed strategies show a significant improvement in the air temperature and relative humidity based on the ENVI-Met simulation shown in (Figure 19 & 20).

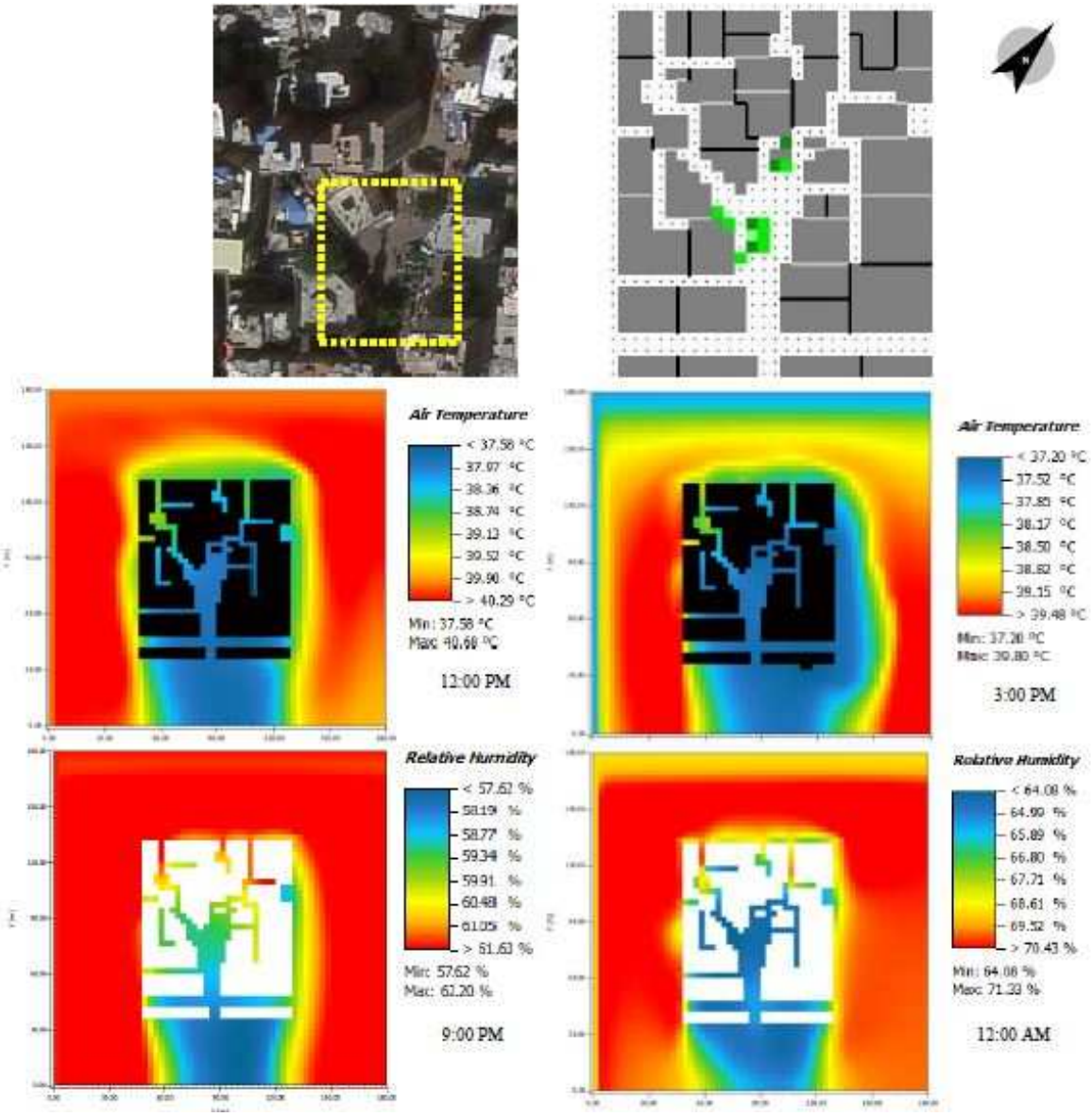

Fig 18: ENVI-Met Simulation for the current situation of Sidi Ali Al-Temraz space

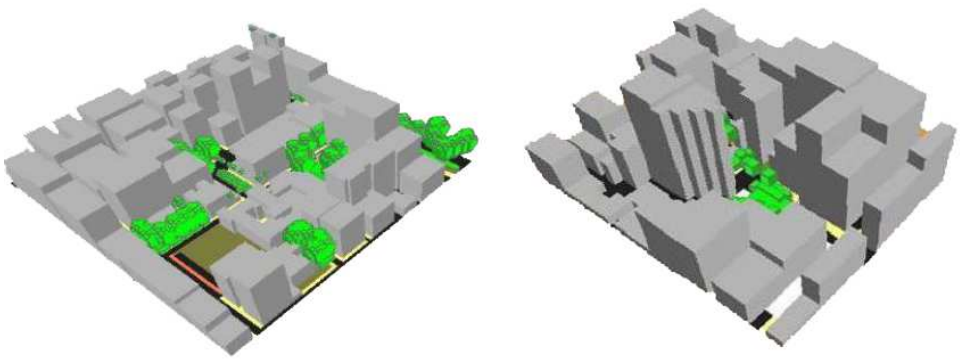

Fig 19: 3D Model using ENVI-Met for the proposed mitigation scenario for the Roman Museum Space. Fig 20: 3D Model using ENVI-Met for the proposed mitigation scenario for Sidi Ali Al-Temraz Space

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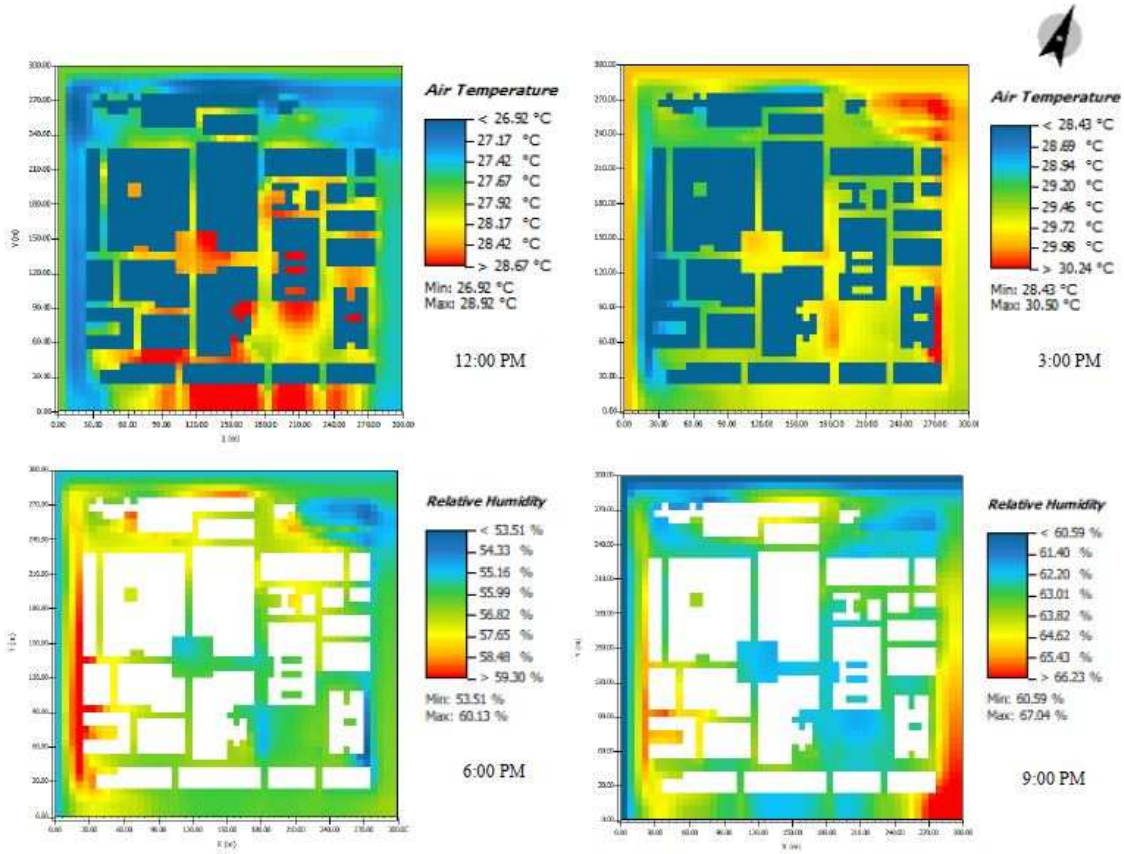

Fig 21: ENVI-Met Simulation for the proposed mitigation strategy for The Roman Museum space

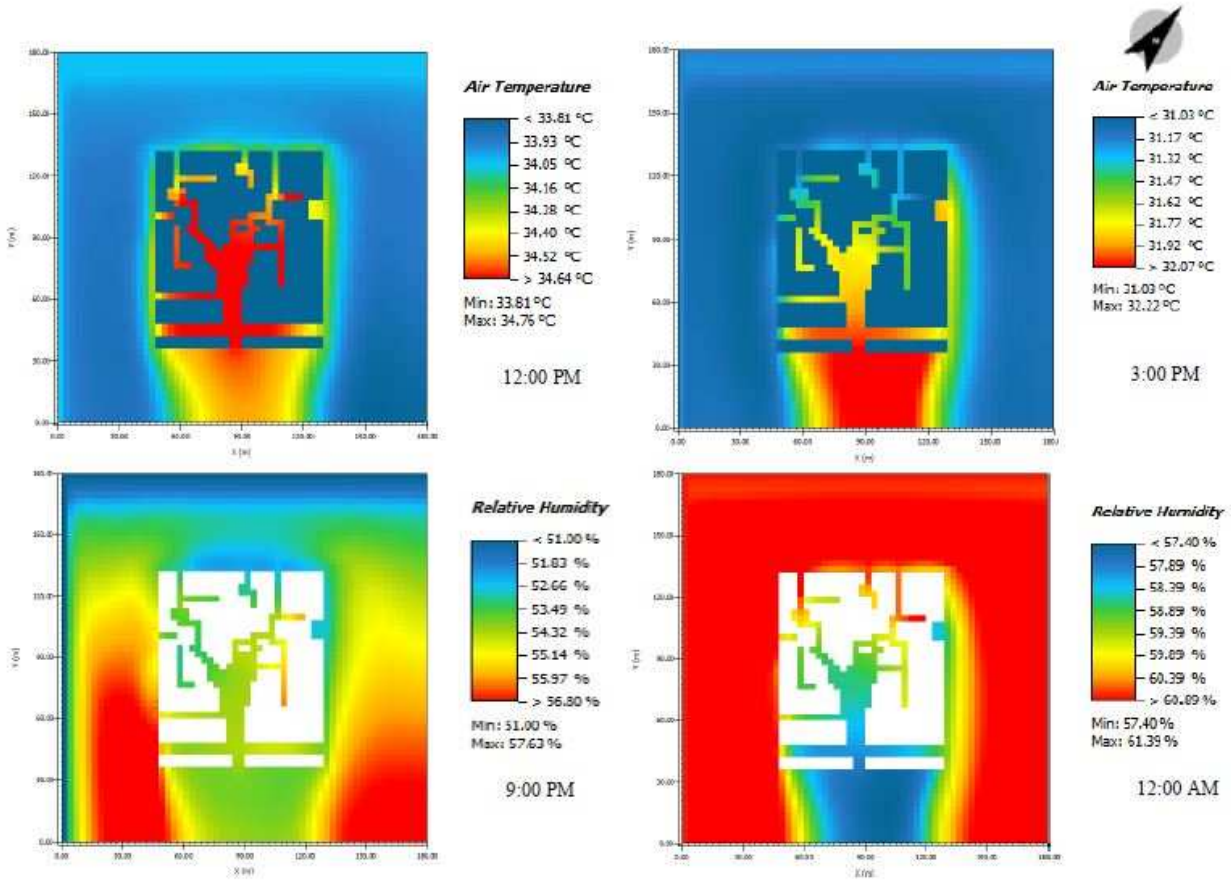

Fig. 22: ENVI-Met Simulation for the proposed mitigation strategy for Sidi-Ali Al-Temraz Space

4 CONCLUSION

This paper has focused on the complexity of parameters affecting the thermal comfort in outdoor urban spaces, particularly in areas recognised as resting places, contrary to walking pathways. The study has included a concurrent meteorological measurement and human activities observation, surveys were carried out in 2 public spaces in Alexandria city with different social standard, activities and morphology. A quantitative approach to the physical parameters has demonstrated according to the previous measurements, studies and generated thermal maps, that microclimatic parameters, will influence thermal sensations.

Consequently, the public attendance is negatively affected, in addition to, human activities. This results in a decline in the social cohesion and economic activity. Therefore, a proposal for mitigating the environmental issues using ENVI-Met software was illustrated, accommodating the change in the vegetation type and location, the ground cover and the addition of shading elements in the areas recording high thermal stresses in the current situation simulation. The previous strategies have given improvements comparable to the values available in literature and "PET" values from RayMan. The design of open spaces is crucial for the urban environment and understanding the wide range of effects influencing thermal comfort in these spaces will assist in designing spaces encouraging public use at different seasons of the year, leading to a considerable optimization in their livability.

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🏆 *reviewed paper*

Participatory Mapping of Citizens' Experiences at Public Open Spaces: A Case Study at Bologna Living Lab

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1 ABSTRACT

In recent years public open spaces (POS) are considered as potential settings for urban regeneration strategies. A POS is successful when it is incorporated into the activities of the citizens, is accessible to people from different social and economic backgrounds, suitable for recreation and also supports people's security and comfort (Eyles, 2007). Thus, planning process should include citizens' experiences, opinions and needs. The aim of this paper is to gain insights on the citizens' experiences and opinions during their presence in POSs by using global positioning systems (gps), geotagging techniques and participatory approaches, while experimenting in the living lab of Bologna established within the framework of the European Union Horizon 2020 project "Regeneration and Optimisation of Cultural heritage in creative and Knowledge cities" (ROCK). For that purpose, a participatory data collection was conducted in Bologna, Italy. The participation of 42 residents was facilitated via Bologna Urban Living Lab (U-Lab). Via Zamboni, Via delle Belle Arti, Via S. Giacomo are the most visited routes in the area. In total 273 subjective experiences were registered, mainly at Via Zamboni, Piazza Verdi and Piazza Scaravilli. 75% of these experiences were associated with positive feelings while 25% were associated with negative. Respondents reported that problems/issues at POSs occurred mainly due to insufficient accessibility and neglect of POSs. U-Lab exploited the results of data collection and organised participatory meetings in order to co-create solutions to transform negatively experienced POSs into positively experienced ones. The paper concludes with the discussion of how this approach can be used as evidence-based design tool for regeneration of POSs.

Keywords: participatory mapping; experiences; public open spaces; accessibility; living lab; gps; geotagging; place-specific data

2 INTRODUCTION

Due to the population growth in urban areas, policy makers and planners are paying more attention to the attractiveness of the urban environments to contribute to the quality of life of citizens. In that sense, public open space (POS) is a vital element of the urban environments as it covers over fifty percent of our cities. POS offers space for social and/or leisure activities (Madanipour, 1999) and can be defined as freely accessible open space (i.e. urban parks, squares, plazas and pedestrianised streets), usually located in an inner city (Zamanifard, 2019). In contemporary cities, POSs usually face the risk of deterioration due to misuse, insufficient facilities and neglect that originates from design, management and regulation issues (Hajer & Reijndorp, 2001). In cities that fail to tackle the rapid growth rates and societal changes, the maintenance of POSs become a public burden (Gehl & Svarre, 2013). Due to deterioration of POSs but also their potential to improve city's attractiveness, in recent years POSs are considered as potential settings for urban regeneration strategies.

According to Carr et al. (1992), to avoid their deterioration and to ensure their regeneration, POS should be planned as responsive, democratic and meaningful. Planning process should include citizens' experiences, opinions and needs. A POS is successful when it is incorporated into the activities of the citizens, is accessible to people from different social and economic backgrounds, suitable for recreation and also supports people's security and comfort (Eyles, 2007). With such qualities, POSs can be experienced positively, and can contribute to the quality of life in urban environments.

Knowing how environments evoke subjective responses provides a basis for understanding the interaction between people and places (Roe & Aspinall, 2011). This comprehension can lead to better design and management of POS. However, existing studies usually focus on the use of POS and the condition of its

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physical attributes, rather than its relation with citizens' experiences (Zamanifard, 2019). In recent years, citizens' subjective assessment of cities and their participation in planning practices has gained more importance as people are reclaiming their right (Harvey, 2008) to be included in urban planning processes. For exploring citizens' experiences in POS, it is necessary to actively involve citizens for data collection and knowledge production. Produced place-specific data can reveal perceived spatial facts about citizen experiences that can be mapped, which otherwise could remain as tacit and social knowledge (Pfeffer et al. 2013).

The aim of this paper is to gain insights on the citizens' experiences and opinions during their presence in POSs by using global positioning systems (gps), geotagging techniques and participatory approaches. For that purpose, a participatory data collection was conducted in the urban living lab of Bologna, Italy. This study was done within the framework of the European Union Horizon 2020 project "Regeneration and Optimisation of Cultural heritage in creative and Knowledge cities" (ROCK). ROCK project aims to develop an innovative, collaborative and circular systemic approach for the sustainable regeneration and adaptive reuse of historic city centres. In this project, the City of Bologna focuses on the regeneration of a highly dense historic district in the city centre which also hosts the University of Bologna. The participation of 42 residents was facilitated via ROCK Urban Living Lab (U-Lab). ROCK U-Lab exploited the results of data collection and participatory meetings in order to co-create solutions to transform negatively or less experienced POSs into positively and more experienced ones, especially focusing on the accessibility issues. With this mixed approach, we contributed to the demand of comprehending the complex relationships between spatial structure and people's experiences and opinions, and also how this approach can be used as evidence-based design tool for regeneration of POSs.

The paper is organised as follows. First a background is given to clarify the citizen experiences, quality indicators of POSs and participatory mapping practices of citizen experiences. Then the case study area and methodology is explained. After that the results are discussed. The paper concludes with a discussion on the effectiveness of the participatory mapping of citizen experiences in a living lab setting and with future ideas.

3 BACKGROUND

Experience has two dimensions: objective and subjective (Cele, 2006). Objective experience relates more to an individual's use of place (i.e. where people go and which places they visit) and this is the type of experiences that can be observed and visible to others. Subjective experience relates more to the interaction process within an individual triggered by the individual's physical and social environment (Dane et al., 2019). Subjective experience refers to mental observations of individuals such as feelings, opinions and memories, and therefore they are difficult to observe by others. This paper focuses both on objective and subjective dimension of experiences of individuals.

According to the studies of environmental psychology, experiences that individuals associate with their environments influence how they evaluate places (Gifford 2014). When people develop positive feelings, images and opinions about a place, they are more likely to revisit these places (Lynch 1960). Mehta (2013, 2014) developed an index for evaluating the social functionality of public spaces. He proposed a Public Space Index in which the variables regarding individuals' perceptions on 'accessibility'; 'maintenance of the space'; 'safety from the presence of surveillance cameras, security guards, guides, ushers, etc.'; 'safety from crime during daytime/after dark'; 'safety from traffic' and 'attractiveness and interestingness of the space'; are taken into account. Zamanifard et al. (2019) further improved this index and investigated the image of a POS by considering its maintenance (i.e. dirt and neglect) and asked respondents to evaluate the likeability of a POS regarding its image. Moreover, comfort regarding the ease of access, safety, security, and walkability of a place were also explored in the same study. According to Carmona (2014), comfort refers to the feeling of safety and at ease to conveniently move around a place in a stress-free manner. In compliance with these studies, individuals' opinions regarding the state of POS can be determined mainly by its perception on accessibility, maintenance (dirt, bad smell, neglect) and safety factors. However, these studies focus only on the subjective experiences of individuals at predetermined POS locations, ignoring objective experiences.

In planning practices, participatory mapping is used to inform the planning processes with knowledge of the public, by inviting citizens to provide their opinions and experiences about urban areas. Citizens are usually intimately familiar with patterns and anomalies in their communities. Participatory mapping is a bottom-up

approach that gathers such local knowledge from citizens (Warner, 2015). Data that is mapped with such an approach can be both tangible (i.e. location of bus stops, roads) and intangible (i.e. perceptions of safety, accessibility). Intangible data are part of local knowledge that requires close interaction between people and place, therefore their subjective experiences. In recent years, with the advancement of geospatial technologies and citizenry mapping possibilities, the new (digital) ways of participatory data collection and integration of spatial knowledge into urban planning is being investigated. In that context, Martino et al. (2010) states that due to new technologies and platforms such as gps, wifi and social media, citizens can contribute actively or passively to spatial (place-specific) data collection and knowledge production. These technologies enable citizens' participation to be particularly on-site and empower them to respond to urban problems. When people actively join the data collection with use of new technologies, it is possible to capture and map their subjective feelings and experiences that are attached to places. In this regard, participatory mapping can be empowered with digital geospatial technologies within a given context and area, and therefore can support place-specific knowledge production. If such knowledge can be effectively gathered, it can also have a positive impact on research and planning regarding urban problems.

Active data collection with citizens entail participatory processes which enable to integrate the citizen experiences into urban planning process. In the literature, participatory approaches for generating place-specific data is usually employed with the use of methodologies such as surveys, sketch maps, interviews and walking interviews (Evans and Jones 2011). Surveys, sketch maps and interviews require participants to explain their "lived" experiences as they are not conducted on-site. However, participants might forget some of the previous experiences or the experiences might not be directly associated with the physical environment. According to Evans and Jones (2011) walking interviews is a place-responsive methodology that can generate both quantitative data on objective experiences (i.e routes taken by visitors) and qualitative data on subjective experiences (i.e. conversational exchanges). Walking interviews tend to be more spatially focused, engaging more with physical environment rather than with the autobiographical narrative of interviewees. However, interviews are risky as people might feel the urge to give suitable answer for the study or steered by the questions of interviewers. In that sense, new technologies (i.e. gps, wifi and social media) enable more efficient and less interfered place-specific data production.

4 METHODOLOGY

4.1 Case Area: Bologna Urban Living Lab (U-Lab)

Bologna is one of the ROCK project replicator cities which develops new models of urban regeneration in the light of successful implementation strategies of role model cities. In ROCK project, the aim is to transform the demonstration sites of replicator cities into a creative and sustainable districts with the planned interventions (i.e greening and changing use of public spaces).The City of Bologna focuses on the regeneration of a highly dense historic district in the city centre of Bologna which also hosts the University of Bologna. The demonstration site of Bologna, named U-Zone, is inside the Medieval city walls and it is composed around a major street, via Zamboni, where a multiplicity of institutional buildings, cultural facilities, heritage, gardens and other streets are linked. The transformation of U-Zone is aimed to be done together with citizens and not just for them. Thus, the collaboration between residents and the city is fundamental in actions. Figure 1 represents the U-Zone and its significant POSs.

The U-Zone has characteristics of a mixed and dynamic neighbourhood. The majority of the population of the area consists of students. There is a high presence of institutions, service facilities and linked jobs. Moreover, rich intangible and tangible cultural heritage is widespread in the area. It is a piece of a city that is constantly updated as a consequence of the actions carried out by those who live and pass through it, who are not specialists in the project but are nevertheless its actors and agents. Students, residents, shopkeepers, city users, creative and cultural forces interact in this part of the historic centre and contribute to the creation of value for POSs. Due to these characteristics, the university area, is crossed by processes of degradation and conflict between user groups that mostly involve the student community, causing phenomena that turn a positive and vital presence into a problem. The presence of the student community that inhabits public spaces over time has produced a single prevalent typology of commercial businesses - food, craft and otherwise - whose target are mostly students. This is summed up with the presence of widespread elements of physical and cultural inaccessibility, including architectural barriers at the entrances to historic buildings, failure to indicate routes of cultural interest and communication, poor lighting and consequent perception of insecurity

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in some specific areas. Moreover, although it is among the areas most guarded and manned by the police, it remains a central place for many inhabitants who are represented as "excluded" (Scandurra et al. 2009) from the daily dynamics of the city.

U-lab is the tool (Living Lab) provided by the ROCK project and its partners to build knowledge from the experimentation area, to co-design priorities and requirements for its development and to plan detailed activities to be aggregated into the city schemes. It is framed as a transversal activity to the project, linking the localised experimentations in different spaces, public, private and collective, held together by the dimension of 'platform'. U-Lab of Bologna has been established and opened with the purpose of fostering the involvement of citizens, local communities, institutions and businesses to identify and solve urban problems. The path of U-lab within the ROCK project, is an attempt of methodological orientation to the co-design of a cultural district. U-lab starts from the themes of protection and enhancement of contingent forces, but aims to support the innovative drives (already present and not enhanced) that must necessarily intertwine with the users of these pieces of the city. For these purposes, U-Lab emphasises the integration of both expert and local community knowledge in order to make urban planning solutions more effective and socially acceptable. Living Labs' main role is to co-create urban transformation solutions in a sustainable perspective, (i.e. facing urban regeneration of under/misused spaces), to develop new ideas and new start-ups and services, and to increase the sense of belonging of citizens. The Living Lab, promoted by ROCK and installed in the demonstration site, is virtual and physical space for operational meetings that allow to share initiatives and decisions with the local participants to regenerate the demonstration area. The living lab has eventually constituted a first step in the definition of a process of mutual institutional learning (among the municipality, the University and the local stekeholders), during which it was possible to define objectives and priority strategic lines of planning action, political orientation and incremental and adaptive actions on POSs. For this study, U-Lab enabled the participation of residents to the experiment by announcing the experiment and also calling out for participants. The experiment aimed to connect the traditional cultural functions of the University area, with spaces for interaction, collaboration and co-design of new products and services. The intention of the Living Lab was not to provide an exhaustive solution of a complex topic, but to outline some discussion points and carry out some experiments involving the practices and cultural operators of the area in the construction of a medium-long term vision oriented to guide the implementation and transformative choices for the historical centre.

Fig. 1: Bologna U-Zone and significant POSs.

U-lab act in a laboratory logic, managing different ingredients and intercepting multiple resources, building networks and defining collaborations, broad partnerships, co-design methods to achieve a series of main objectives:

- to define a set of shared priorities for the university area, opening opportunities for meeting and exchange and helping to build the agency of the actors who use, live and work in the experimentation area;
- to build an ecosystem of stakeholders with whom to collectively promote a series of activities to promote the area. In this sense, all actions are aimed at facilitating development and consolidating relations at various levels;
- to envisage different development scenarios on which to orient planning tools and propose alternatives, helping to build new meanings for the public sphere, as an intermediate 'space' in which to experiment with solutions to global issues with a strong local impact;
- to experiment non-conventional uses of public spaces.

U-lab activities were carried out in two stages during 2018 and early 2019. This paper analyses the results of the second stage of activities, concerned with the experimentation and prototyping of the proposals that emerged from the previous participatory meetings.

The second phase of U-lab, carried out starting from February 2019, started from the knowledge base produced on the university area, with the aim of deepening some thematic axes that emerged from the meetings, through the prototyping of a service to be tested and then implemented as part of the offer for the area. The chosen theme concerned accessibility for all, understood as a holistic approach that takes into account the theme of accessibility from its various dimensions: physical, semantic, cultural, social and economic. Accessibility therefore becomes an approach to the design of the city, an opportunity to broaden its use by different categories and users. Accessibility became the umbrella topic from which to start analysing the area through urban explorations and participated data collection.

4.2 Data Collection Procedure & Sample

Data collection in Bologna was performed by employing the GPS logging devices and a geo-survey. GPS devices allowed tracking the participants in order to capture their objective experiences such as which routes they have taken and how much time they have spent at certain locations. Geo-survey enabled participants to geotag their subjective experiences and answer location related questions and add comments. Moreover, geosurvey enabled collecting background information on participants such as age and gender. Combination of both tools provided high-resolution data on the location of both objective and subjective experiences. The data was collected on 12 April 2019 from 42 people in order to investigate the experiences of people in the U-Zone. The participants are divided into three groups and each group visited the site at different hours (10:00, 12:30 and 15:00). For each group, the visit took between one to three hours.

The GPS loggers were distributed at Piazza Antonino Scaravilli, located in the core of the U-Zone. For the geo-survey, the link was shared with participants via quick response (QR) code. Participants were asked to walk within the U-Zone and record their experiences. Once a respondent had a feeling about a place, they were required to respond to the geo-survey. Geo-survey included questions regarding the experience that a location (POS) triggered which they would like to report about. Then participants could geotag the experience location on the map and indicate how they felt about the POS in general (interesting, fun, joy, inspired, relaxing, surprising, confusing, disgusting, irritating, boring, fear, other), and whether there is a problem regarding the accessibility, maintenance (dirt, bad smell and neglect) and safety of POS. In that sense, feeling triggering locations are considered as point of interests (POIs) and participants are asked to report any problems regarding these POIs. Participants were allowed to choose their own route within the given area. According to Kusenbach (2003), this enhances the understanding of participants' authentic interpretations. Because, predetermining the routes can lessen the informality of the experience.

The total number of participants in Bologna was 42. During data collection 42 people used the GPS loggers which enabled gathering their objective experiences. However, only the data of 36 respondents were available via geo-survey which enabled gathering their subjective experiences and background information. According to the geo-survey, 47% of the respondents were female while 53% were male. 56% of the

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participants were between 18 and 30 years old, 17% of them were between 31 and 50 years old and 37% of them were 50 years and older. Regarding their occupation, 44% of participants were students, 33% were employed and 23% were retired.

5 RESULTS

In order to process the gps and geotagging data, a geoprocessing tool was developed by Eindhoven University of Technology. The development of this tool is accomplished within the ModelBuilder environment in ArcGIS software. ModelBuilder is a graphical environment with a user-friendly interface and helps to create, edit, and manage models. A benefit of ModelBuilder is the ability to improve the sub-models by developing python scripting. For this project, the designed GIS tool contains 14 sub-models, which were developed to a) read the GPS data and visualise them on a map; b) extract the data for a given area, and calculate the entrance and exit time; c) investigate the spatial behaviour of visitors in a given area; d) identify the Area of Interests (AOIs) which define the places that people spend certain amount of time and calculate the exact amount of time spent in different AOIs; e) count the number of experiences at AOIs; f) demonstrate the location of experiences specified by visitors (POIs); and g) visualise the most taken roads with the number of visits. The details of the models can be found in Derakhshan (2019).

5.1 Objective Experiences

42 people used the GPS loggers. On average, their visits lasted 76 minutes. The duration (dwell time) of participants' visits at AOIs are shown on Figure 2. On average 11.2 minutes were spent at Piazza Scaravilli, where the experiment started. This was followed by Giardino del Guasto, Piazza Verdi and Piazzetta Molinari pradelli. On these POSs, participants spent on average 6 minutes. In addition to this, the most visited POS was Piazza Scaravilli as all participants started the experiment at that location. This is followed by Piazza Verdi, Piazzetta Raviola, Piazza Rossini, Giardino del Guasto, Piazzetta Molinari Pradelli and Piazza di Porta Ravegnana. The amount of participants that visited these locations can be seen on Figure 3. Finally, the routes that participants took during the data collection can be seen on Figure 4. The thicker lines represent the higher frequency of visitation. According to Figure 4, Via Zamboni, Via delle Belle Arti, Via S. Giacomo, Via Marsala, Largo Respighi and Via del Guasto were the routes that have been taken the most by the participants.

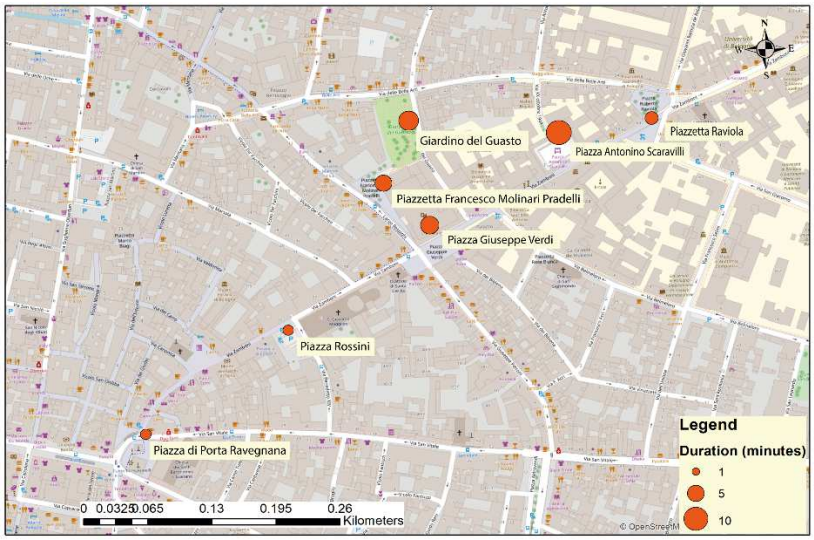

Fig. 2: Duration of participants' visits at area of interests (AOI).

5.2 Subjective Experiences

In total 273 subjective experiences were registered. Looking at the feelings of participants at POIs, 80% of subjective experiences were positive (interesting, fun, joy, inspired, relaxing, surprising) while 20% of them were negative (confusing, disgusting, irritating, boring, fear). Most feelings were registered at Via Zamboni, Piazza Verdi and Piazza Scaravilli. These places can be considered as the most feeling triggering places for participants. Figure 5 shows the location and the number of all experiences at POIs. Figure 6 represents the distribution and ratio of positive/negative experiences at each POI.

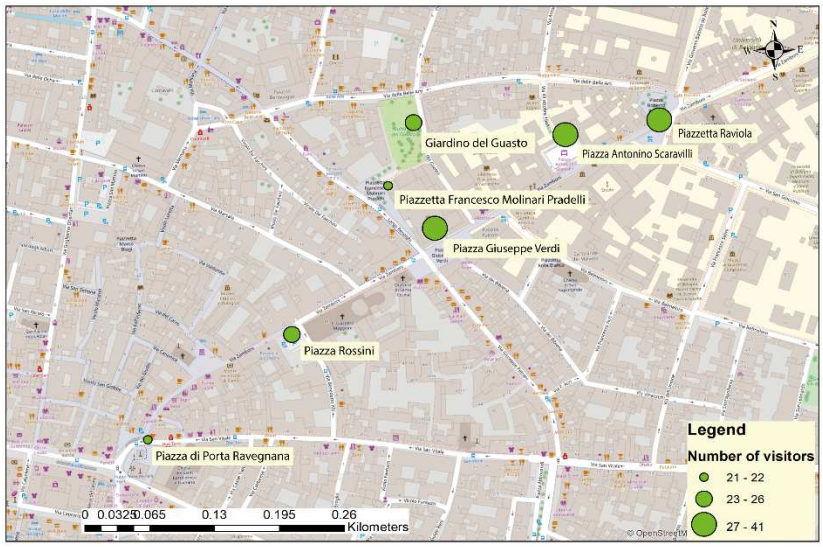

Fig. 3: Number of participants at AOIs.

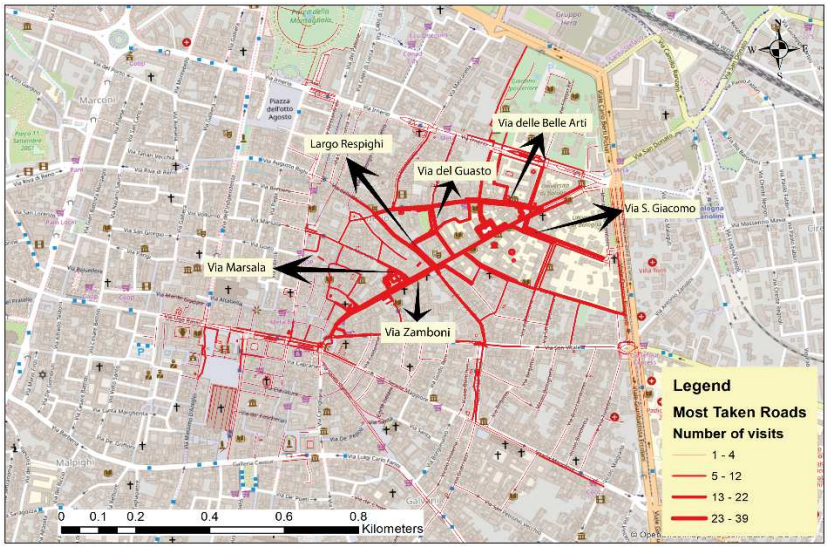

Fig. 4: The taken routes by participants.

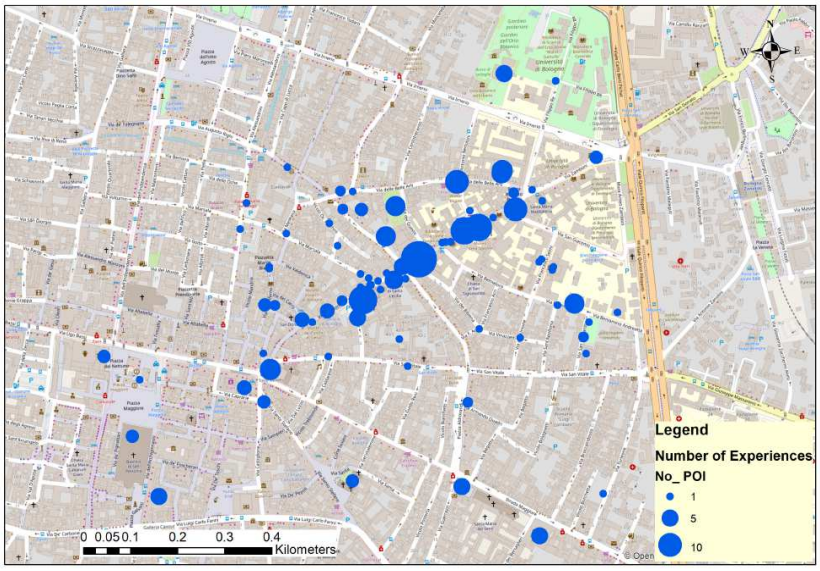

Fig. 5: Number of subjective experiences of participants at POIs.

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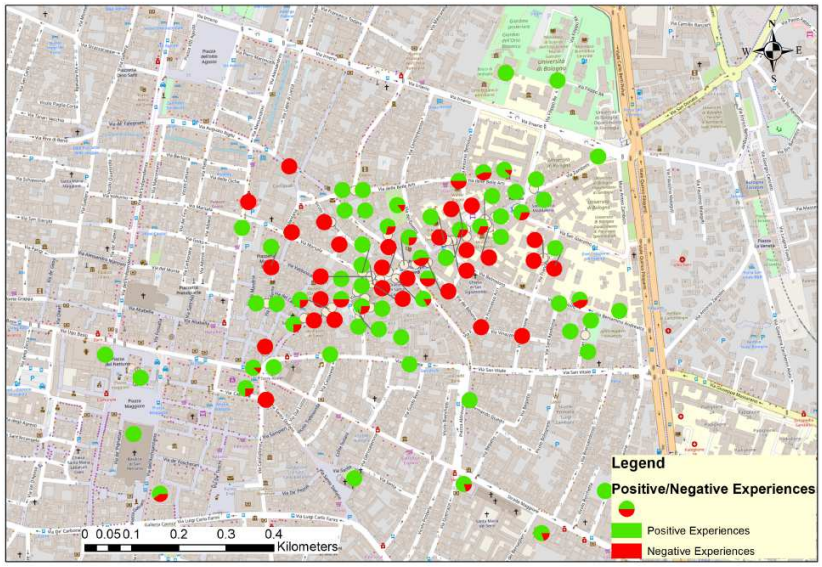

Fig. 6: Distribution of participants' positive/negative experiences at POIs.

At these feeling triggering locations, people were also asked to report the issues relating to accessibility, dirt, smell, neglect and safety. Each participant could report more than one issue at the location. In total 106 accessibility, 53 dirt, 21 smell, 75 neglect and 28 safety problems were registered. These problems were mostly registered at Piazza Verdi and Piazza Scaravilli. One interesting finding is that although participants had positive feelings at a certain location, they still reported problems/issues, as shown on Table 1.

Feelings		Issues				
		Accessibility	Dirt	Smell	Neglect	Safety
Positive	201	62	36	12	51	11
Negative	72	44	17	9	24	17
Total	273	106	53	21	75	28

Table 1: The comparison of the number problems/issues at POSs to the triggered feelings (pos & neg).

5.3 Discussions of Results at U-Lab

As mentioned above, the outcomes of the first phase of U-Lab were taken as an input for a two-fold strategy. After a series of participatory meetings on thematic tracks a public call for project was launched to finance a series of activities following the guidelines elaborated during the local participatory meetings. Among the forty-seven proposals received, sixteen projects were financed. Projects included theatre laboratories, events, public discussions, presentations and collaborative mapping activities, which constituted not only applications of the guidelines developed in the first phase, but also their verification, as well as new occasions to gather onsite data and insights. The experimentation narrated in this paper concerned an activity realised to support the follow-up phase of U-lab, specifically concerning the topic of accessibility. In March 2019, a new call for ideas was launched, with the aim of designing and prototyping a service to be tested and then implemented for the accessibility of the area. The gps mapping of April 2019, was the occasion of strengthening some preliminary assumptions and providing evidence on criticalities and opportunities related to the accessibility of POSs. In particular data related to accessibility and level of attractiveness of different POSs were the basis for defining a service concerning a series of suggested visits that are accessible to people with different disabilities and that connect different historic, cultural and scientific points of interest. The proptotype making of this service involved approximately 50 local actors that took part in two discussions and co-design U-lab meetings with a group of 7 accessibility experts selected through a public call. Prototypes of touristic guided tours and of a multi-accessible printed guide of the area were defined within U-Lab and are currently being tested by the local tourist office.

6 DISCUSSION & CONCLUSIONS

In recent years POS are considered as potential settings for urban regeneration strategies. In order to create successful POS, it is necessary to incorporate them into the activities of the citizens, make them accessible,

secure and comfortable. In that sense, citizens are the key component for designing and regenerating the POSs. Thus, planning process should include citizens' experiences, opinions and needs. Therefore, the aim of this paper was to gain insights on the citizens' experiences and opinions during their presence in POSs by using global positioning systems (gps), geotagging techniques and participatory approaches, while experimenting the living lab setting in Bologna.

42 residents participated to the data collection and their involvement was facilitated via ROCK Urban Living Lab (U-Lab). According to the data, it was seen that participants usually took the main axes of the area with prominent squares, and spent more time at the POS along these axes where lively facilities (i.e. cafes, restaurants, museums) exist. It is possible that the less visited areas are not part of a traditional route typically crossed by the participants, or the less visited areas might present some barriers and physical obstacles that they are already aware of. In total 273 experiences were registered, mainly at Via Zamboni, Piazza Verdi and Piazza Scaravilli which are prominent POSs of U-Zone. Regarding the feelings of participants at these locations, 75% of these were positive while 25% were negative. This indicates that most of the POSs in U-Zone that wee visited triggered pleasant feelings. The reason might also be that people visited the POSs that are attractive to them. However, although these places were found to be pleasant, participants still reported issues mainly related to accessibility and neglect. The gps and geotagging method enables understanding the prominent locations and problems attached to them. However, more in-depth understanding is required in order to find solutions. Therefore, participatory meetings at the living lab setting were organised in order to discuss the issues represented on maps.

U-Lab exploited the results of data collection and participatory meetings in order to discuss the results and to find solutions for transforming negatively experienced POSs into positively experienced ones, especially considering the accessibility issue. The results of this mapping activity formed the basis for the definition of the pilot actions, such as small-scale experimentations, prototypes of services, events, temporary urban transformations. During their implementation, new needs and desires, as well as the presence of unforeseen barriers, emerged. Therefore, the process implied a constant need for reflection upon the results already achieved. The effectiveness of the pilot actions were then monitored through the evaluation framework which had been previously agreed upon. In turn, the outcome of the evaluation phase became a new input for the management principles of the local cultural assets and the development of future action plans.

With these first exepriences, ROCK wants to start a permanent open laboratory able to define in time and in an interactive and collaborative way, appropriate spaces for listening, narration, representation and production of new urbanity for the university area and consequently for the historical centre.

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Places Representation on Social Media – A Study to Analyze the Differences between the Virtual Communities and the Offline Environment

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1 ABSTRACT

We are living in a digitized world with a fast base of changing and adapting. Our ways of communication have been translated to online platforms with high standards (E.g. emails, WhatsApp, Facebook, etc.). According to that, virtual communities have been developed to mimic the "offline" world. Social network platforms are trying to imitate the physical environment around us to offer their users an online experience as real as they can. One will find several technologies to explore new places with embedded data (E.g. others reviews, ratings, suggested activities, price, opening hours, etc.). This type of data has a direct and effective way to raise awareness about certain places and shift interest towards others. This fact is dramatically changing how people interact with their cities and how places have been represented and produced. That's why analyzing online behaviour is one of the key factors for city development.

Platforms are developing technologies to provide a digitized place-making; technologies like geotagging services, geo-reference content, commenting mechanism, reviews, and ratings, along with a big list. These new trends have opened a new dilemma between the offline and online world and how the two affect each other. In this research, literature has been made to identify the meaning of "place" and its component in the "offline" world. Also, the research will examine the different ways in representing places on the "online" world. Then, a framework will be proposed to measure the fulfilment of places' representation in these platforms (Facebook, Twitter, and Google). In the end, the research will suggest further work on how to represent a physical place into a virtual communication platform. This study can be a start point for scholars who seek to retrieve data from social media regarding places.

Keywords: virtual place, real-time data, Data-based solutions, location-based social networks (LBSN), urban computing, digitized place-making

2 INTRODUCTION

Edward Relph (1976) in his book place and placelessness argues that without the full understanding of "place", it would be difficult to identify what is special about a place and it would be impossible to find out how to repair existing places in need of modifications. In light of that, the research has been searching for the meaning and differences between these terms: space, place, public place, location.

People in their daily live interact with different levels of spatial context, which leverage their communication with the environment around them. As people start to affect the environment around them, they are turning it from space to place, in which they are burnishing their culture complexes onto it.

3 PLACE

In this chapter, we will approach the concept and meaning of the word "place" in terms of the research question. We start with some definitions, to differentiate between place, public place, and public space. Then, our focus will be concentrated on the place, regarding (1) "sense of place", which represents the intangible relationship between people and places, the aim of this part is to give us guidance to evaluate the intangible aspects in virtual spaces, and (2) place models, to fully comprehend the components of any place. According to the place models, a place identification matrix was developed, which is the base for the identification and differentiation of virtual places in contrast to "real-life places".

3.1 Definitions

The geographer Yi-Fu Tuan (1977) defines place as a humanized space. Phenomenologists like Manzo (2003) and Alan Gussow (1971, cited in (Relph, 1976)) they supposed that experience is the most important element in perception and in turning any environment to a place. Gussow has a very famous quote regarding experiencing places, he described it as "The catalyst that converts any physical location – any environment if

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you will – into a place, is the process of experiencing deeply. A place is a piece of the whole environment that has been claimed by feelings".

In other hands, Norberg-Schulz (1985) argued that place is the result of space along with the character, also he discussed the importance of architecture in adding an attribute to spaces and playing an important role in effecting the users' mental and physical well being. Norberg-Schulz emphasizes that architecture should not focus only on the meaning but also on the physical attributes. Relph (1976) explained that "places are the significant centers of our immediate experience of the world". In order to study place in a more comprehensive way, a number of scholars have suggested a place model to propose the place components from their point of view.

3.1.1 Public place

This terminology has a legal definition and is used in many laws. A public place is generally an indoor or outdoor place, whether privately or publicly owned, that is accessible for the public under or free of conditions and with or without fees (Nedim, 2015).

3.1.2 Public space

Public space is any space that is generally open and accessible for people (E.g. roads, public squares, parks, beaches, public libraries). Public spaces definition has been varying according to the differentiation between access and ownership. Public space is one that shows the diversity and encourages people to do activities together effortlessly, it is where social and economic exchanges occur (Project for Public Spaces, 2019; Pacheco, 2017; Karaçor, 2016)

3.2 Sense of place

Users experiences with places would generate a phenomenon called "sense of places". Relph (1976) argued that the concept of sense of place is not very clear to describe, but he described it as the ability to create and develop places' identities through a long-time connection between users and places. Sense of place is an important element which can strengthen the relationship between users and places. It can be influenced by personal values, beliefs and behaviours (Naiafi & Shariff, 2011). Sense of place is that feeling of belonging, identity and attachment that the individual or group of people hold about a particular place as a result of their cultural interactions with it (Tuan, 1977). Phenomenologists describe the sense of place as the emotional connection between users and places via understanding its symbols and meanings.

Your relationship with a place develops in three stages as Relph (1976) explained, the first level of sense of place is familiarity with the place, which represent being in a place without realizing its meanings and having no feeling of belonging towards it. The second level is an ordinary familiarity with the place, it is more cultural than personal, where people have deep and strong participation with the place. They will contribute to social activities by paying attention to the place's symbols. This level is most experienced in familiar and sacred places. The third level is profound familiarity with the place. It involves the 'existential insideness' of a person. In this level, a person is integrated with the place. In addition to that definition, Shamai also discussed that sense of place is comprising of three stages (1) belonging to a place, (2) attachment to a place, and (3) commitment to a place (Shamai, 1991).

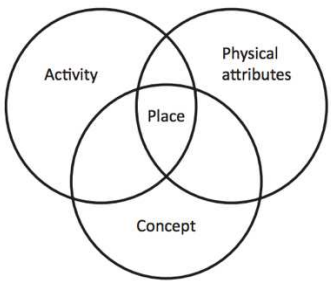

Figure 1: Canter's model of place (Canter, 1977)

3.3 Place model

Relph (1976) suggested that place is an interaction of three items, which are “physical setting”, “activity”, and “meaning”. Canter’s model (1977) offered a balanced view between the tangible and intangible attributes of a place. He showed that a place is a relationship between “action”, “conception”, and “physical attributes”, as shown in figure 1.

Punter (1991) suggested another diagram with the aim of enhancing the identity of place as shown in figure 2. His model showed a relationship between “activity”, “physical setting”, and “meaning”, to form a “sense of place”.

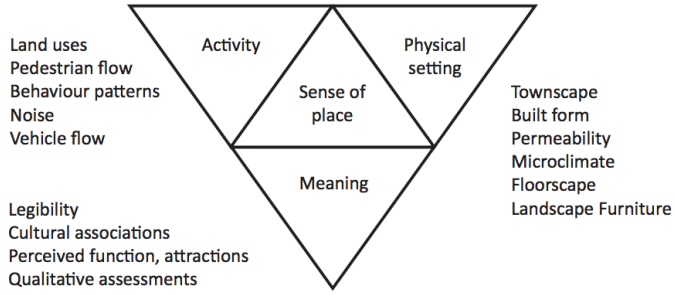

Figure 2: Components of the sense of place (Punter, 1991) (Montgomery, 1998)

Later, Montgomery (1998) reworked the diagram of Punter to add more elements above Punter’s model as shown in figure 3. On the other hand, Steele mentioned several elements that contribute in sensing the place, these elements are: “the size of setting, scale, proportions, diversity, distance, texture, ornaments, colour, smell, sound, temperature and visual variety” (Steele, 1981).

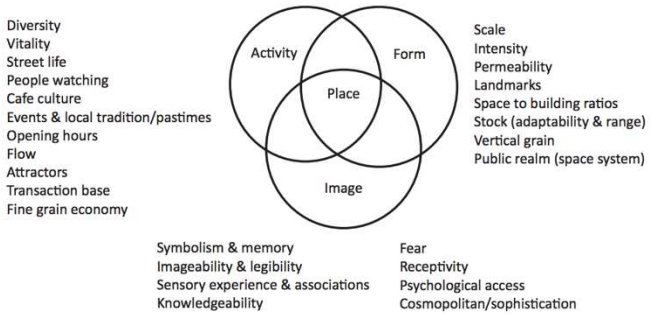

Figure 3: policy direction to foster placemaking (Montgomery, 1998)

3.4 Place identification matrix

According to the suggested place models by the above scientists, the components of a place can be organized as follows: (1) cognitive: which represent the emotional connection with place via understanding its symbols and meanings. This connection is forming from a long-term relationship between place and people among different generations to assist in reinforcing the cognitive elements (E.g. meaning, concepts, identity, traditions, myths, symbols, ritual); (2) physical characteristics: it represents the physical attribute which people experience with their five senses (sight, hearing, smell, taste, touch) to form a sensual experience with a certain place. The physical attributes are playing a very important role in improving the mental and physical well being of their users; and (3) activity: Places are associated with people's works, actions or leisure activities. Therefore, activities connect human to places (Naiafi & Shariff, 2011).

Accordingly, a place identification matrix (Figure 4) was made with an attempt to list the place components to help in assessing the fulfilment of place representation in the online platforms.

The matrix was divided into three categories: (1) cognitive: which represent the intangible elements, (2) physical characteristics: which can be divided into two groups, (2.1) form characteristics and (2.2) landscape, and (3) activity: which represent the relationship between people and places.

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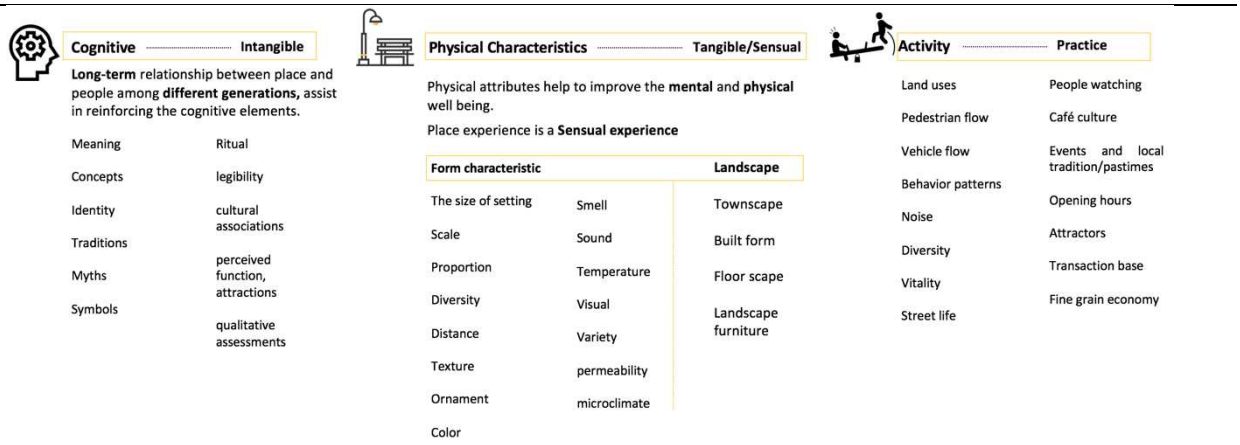

Figure 4: Place identification matrix (Relph, 1976; Canter, 1977; Punter, 1991; Montgomery, 1998; Steele, 1981)

4 THE ONLINE WORLD

Computer developers have been trying to mimic the real world over the internet, to imitate emotions, feeling and sense of place, to an extent that the online behaviour is no longer distinct from the offline behaviour. Developers have invented technologies that allow people to attach their thoughts, ideas, information, suggestions, ratings and reviews to a certain place, to give the virtual places a human dimension and presentation's depth. Technologies like geotagging, location-based applications and hashtags etc. These technologies enable people to keep memories of a place and document their experiences for themselves or others. These online metadata-sets can change people's spatial practice. This kind of representing thoughts has been playing a very important role in raising awareness about certain places or shift the attitude toward others. These capabilities are very critical for improving the built environment, but furthermore to forecast people's needs (Humphreys & Liao, 2011).

By using wireless networks, users leave traces behind them called "digital footprints" or "tracks". These tracks reveal users' interaction with infrastructure such as a mobile phone network or by uploading an image to one of the social media platforms (Girardin, Calabrese, Dal Fiore, Ratti, & Blat, 2008). These user-generated content has been given several names, the most known ones are Crowd Sourcing (Surowiecki, 2004), Citizens as Sensors, and Volunteered Geographic Information (VGI) (Goodchild, 2007), User Generated Context (Elwood, 2009).

The user-generated spectrum varies from active user actions "volunteered" to passive actions "Citizens as Sensors". Volunteered User Generated Content (UGC) happens when the user contributes content in data sets, such action as Wikipedia the Open Encyclopedia or OpenStreetMap, an open topography dataset which enables users to contribute in the area of spatial infrastructure. Also reporting platforms (e.g. www.fixmystreet.com), participation platforms, as well as own Weblogs, are UGC. In contrast to this explicit and active contribution, a passive contribution happens when a fruitful meaning is extracted from raw data, for example when researchers identify cities' landmarks from Flickr photo collections or when using mobile signals to estimate traffic flow and enable real-time route planning (Richter & Winter, 2011; Crooks, Croitoru, Jenkins, Mahabir, Agouris, & Stefanidis, 2016). Today's advanced analytics technologies and techniques enable organizations to extract insights from data with previously unachievable levels of sophistication, speed and accuracy. Data itself has become an important strategic and competitive asset (Hinssen, 2012; IBM Big Data and Analytics, 2014).

5 REPRESENTATION OF PLACES ON SOCIAL MEDIA

The term social media is typically used to express the several forms of electronic communication between members of the public to share information, ideas, personal messages and other content (images, videos, etc.). Social media platforms, such as Facebook, Twitter and Instagram have elevated and fostered social interactions in cyberspace, making a revolution in spreading information and offering an alternative for community formation (Merriam-Webster, 2011; Crooks, Croitoru, Jenkins, Mahabir, Agouris, & Stefanidis, 2016). Social Media is a group of "Internet-based applications" which are using Web 2.0 technologies as

their foundation. Also, these applications play a role in creating an environment for User Generated Content (UGC) to be created and exchanged (M. Kaplan & Haenlein, 2010).

5.1 Facebook

Facebook is an American company, which is offering an online social networking service. Facebook was founded in 2004 by Mark Zuckerberg, Eduardo Saverin, Dustin Moskovitz, and Chris Hughes, all of them were students at Harvard University (Hall, 2019). In the third quarter of 2012, the number of Facebook active users has exceeds one billion users, which made Facebook the first social network to do it. In September 2019, Facebook announced that they have over 2.45 billion monthly active users (Noyes, 2020; Clement, 2019).

Facebook has a "Facebook for developers" platform, which is a set of services, tools, and products provided by Facebook for third-party developers, in order to enable developers to create their own applications and services that access data from Facebook. This action is made using Facebook Graph API, which is a way to get data into and out of Facebook. It's an HTTP-based API that applications can use to programmatically query data, post new stories, manage ads, upload photos, and perform a wide variety of other tasks (Facebook).

5.1.1 Places' representation in Facebook

Inside the Graph API, there is the place information page, which represents the way Facebook understand and save places. Facebook represents places using several fields, which will be listed in the table below (Facebook, Place Information). For further information https://developers.facebook.com/.

Field	Type	Description
ID	numeric string	The Place's ID
about	String	Information about the Place
app_links	AppLinks	AppLinks data associated with the Place's URL
category_list	list<PageCategory>	The Place's sub-categories
chekins	unsigned int32	Number of checkins at the Place
cover	CoverPhoto	Information about the CoverPhoto associated with the Place
description	string	The Place's description
engagement	Engagement	The Engagement associated with the Place. Default Engagement fields are count (like count) and social sentence
hours	list<KeyValue:string,string>	A list of objects that indicate daily operating hours.
is_always_open	bool	Indicates if the Place is always open
is_permanently_closed	bool	Indicates if the Place is permanently closed
is_verified	bool	Indicates if the Place has been verified by Facebook
link	string	The Place's Facebook URL
location	Location	The location associated with the Place
name	string	The Place's name
overall_star_rating	float	The Place's overall star rating, based on a rating survey from Users on a scale of 1-5. Value is normalized and not guaranteed to be a strict average of User ratings
page	Page	The Page node associated with the Place
parking	PageParking	The ParkingPage associated with the Place, indicating parking information
payment_options	PagePaymentOptions	The PagePaymentOptions associated with the Place, indicating payment methods accepted by the Place
phone	string	The Place's phone number
price_range	string	The Place's price range. Can be $, $$, $$$, $$$$ or Unspecified
rating_count	unsigned int32	The Place's rating count, which is the number of publicly accessible ratings on the Page associated with the Place
restaurant_services	PageRestaurantServices	Services the Place provides
restaurant_specialties	PageRestaurantServices	The Place's restaurant specialties
single_line_address	string	The Place's address in a single-line format
website	string	The URL of the Place's website

Table 1: Places Information on Facebook (Facebook, Place Information)

5.1.2 Using the place identification matrix

The research started to classify Facebook places' elements using the place identification matrix. A new column will be appeared in the matrix to contain the place information, which cannot be inserted below the

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three main columns of the matrix. The cognitive column will be containing: (1) the overall star rating, (2) engagement, and (3) rating count. These elements represent the public thoughts depending on the personal experience. If we calculated the ration that the cognitive elements represent, it will be 11.5% of the total elements. The physical characteristics column will contain (1) location, (2) parking, and (3) cover photo, which can give a sense of the visuals and colours of the place. The physical characteristics will represent 11.5% of the total elements. The activity column will contain: (1) hours, (2) is always open, (3) is permanently closed, (4) payment options, (5) price range, (6) restaurant services, (7) restaurant specialities, and (8) check-ins. The activity ration is 30.8% of the total elements. The new appeared column „place information“ will contains: (1) ID, (2) about, (3) description, (4) name, (5) page, (6) phone, (7) website, (8) app links, (9) category list, (10) single-line address, (11) is verified, and (12) link. This column's ratio is 46.2% of the total elements.

Cognitive	Physical Characteristics	Activity	Place Information
engagement	location	hours	ID
overall_star_rating	parking	is_always_open	about
rating_count	cover photo	is_permanently_closed	description
		payment_options	name
		price_range	page
		restaurant_services	phone
		restaurant_specialties	website
		chekins	App_links
			category_list
			single_line_address
			is_verified
			link

Table 2:Facebook Places' classification (own figure, using (Facebook, Place Information))

The columns ratio (Figure 5) revealed that the most important elements are the informative ones, then the activity elements. The cognitive and physical elements have the lowest ratio.

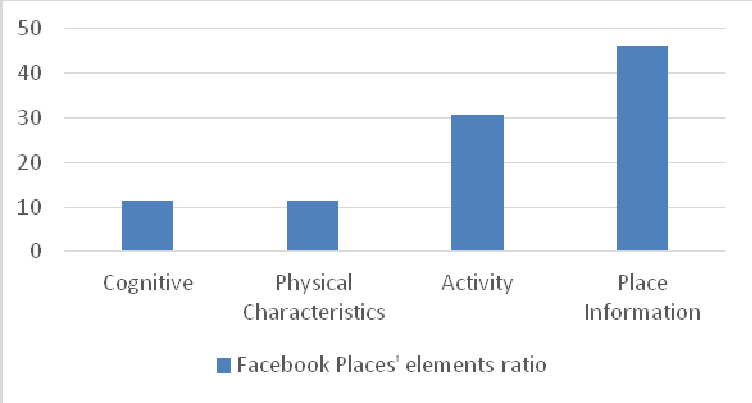

Figure 5: Facebook place's elements ratio (own figure, using (Facebook, Place Information))

5.2 Twitter

Twitter is an American microblogging and social networking service on which users post and interact with messages known as "tweets" (Wikipedia, 2020). It was founded by Jack Dorsey, Noah Glass, Evan Williams, and Biz Stone, on 21 March 2006. Twitter in the first quarter of 2019 has reached 330 million monthly active users (Clement, 2019). Twitter has a developer platform[1] with its API, like Facebook. Developers can use the available data on twitter to publish and analyze tweets, create unique customer experiences and build applications above these data. When working with geographical metadata, twitter classifies the location-based content into two classes (Twitter, 2020):

- Tweet location: when the user enables sharing location feature while posting a tweet
- Profile Location: it represents the user "home" which he provides when creating his profile

[1] https://developer.twitter.com/en.html

5.2.1 Tweet location

Twitter enables users to specify a location for individual Tweets. Tweets with a specific location can be classified into two general categories (Twitter, 2020):

(1) Tweets with a specific latitude/longitude "Point" coordinate: which comes from a GPS enabled devices. This location doesn't contain any contextual information about the referred location (E.g. associated city, country, etc.) unless the referred location can be associated with a twitter place

(2) Tweets with a Twitter "Place": this represents the general area (the "Place") from which the user is posting his tweet. After choosing a twitter place, the place will have a display name, type (E.g. city, neighbourhood), and country code

5.2.2 Twitter place

When a user started to assign a location to his tweets, he will encounter a list of candidate twitter places to choose from. These places are specific and named locations with geo coordinates. It is important to note that, tweets associated with a location does not necessarily be written in that location, but could be also about that location. Twitter uses different fields to represent a place, which will be described in the table below (Twitter, 2020).

Field	Type	Description
id	String	ID representing this place. Note that this is represented as a string, not an integer. Example: "id":"01a9a39529b27f36"
url	String	URL representing the location of additional place metadata for this place. Example: "url":"https://api.twitter.com/1.1/geo/id/01a9a39529b27f36.json"
place_type	String	The type of location represented by this place. Example: "place_type":"city"
name	String	Short human-readable representation of the place's name. Example: "name":"Manhattan"
full_name	String	Full human-readable representation of the place's name. Example: "full_name":"Manhattan, NY"
country_code	String	Shortened country code representing the country containing this place. Example: "country_code":"US"
country	String	Name of the country containing this place. Example: "country":"United States"
bounding_box	Object	A bounding box of coordinates which encloses this place.
attributes	Object	When using PowerTrack, 30-Day and Full-Archive Search APIs, and Volume Streams this hash is null. Example: "attributes": {}

Table 3: Twitter places (Twitter, 2020)

5.2.3 Using the place identification matrix

When reclassifying the twitter place's fields according to the place identification matrix, the table below (Table 4) will be the output. Also, the place information column will appear, to contain data that cannot be inserted under the other three main columns.

Cognitive	Physical Characteristics	Activity	Place Information
	bounding_box		id
			url
			place_type
			name
			full_name
			country_code
			country
			attributes

Table 4: Twitter place using place identification matrix (own figure, using (Twitter, 2020))

It is clear now, that twitter places are considered as check-in or geo-reference, and it doesn't give any insights about that place regarding (cognitive data, activity). It is only geo-data associated with the tweets. Figure 6 shows that the cognitive and activity data has 0% of the total elements that Twitter provides, while the physical characteristics represent 11.11%, and place information represents 88.88%.

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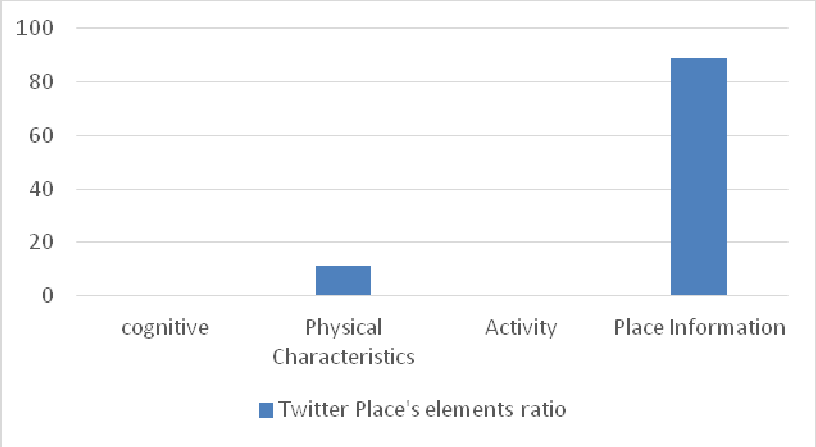

Figure 6: Twitter place's elements ratio (own figure, using (Twitter, 2020))

5.3 Google

Google LLC is an American multinational technology company, which offers internet-based services and technologies (E.g. search engine, online advertising, cloud computing, etc.). It was founded in September 1998 by Larry Page and Sergey Brin while they were PhD students at Stanford University in California (Google; Wikipedia, 2020). Google has a developer platform[2], to offer developers plenty of tools and services to use in building new applications. Google maps platform, is the platform responsible for representing places and demonstrate all its fields and how to use the API. Google API is not free of charge, so, they have divided the place results into three billing categories, with different price ranges according to which field the developer requests. The three categories are: (1) the basic category, (2) contact, and (3) Atmosphere (Google, 2020; Google Cloud, 2020).

5.3.1 Google Places

Every category of the three categories has its own fields, which can be listed as follows: (1) basic: address_component, adr_address, formatted_address, geometry, icon, name, permanently_closed, photo, place ID, plus code, type, url, utc_offset, vicinity; (2) contact: formatted_phone_number, international_phone_number, opening_hours, website; and (3) atmosphere: price_level, rating, review, user_ratings_total. Table 5 is listing part of the fileds in details (Google Maps Platform, 2020; Google Maps Platform, 2020).

Basic		
Field	Type	Description
address_component	array	an array containing the separate components applicable to this address
adr_address	string	a string containing the human-readable address of this place
geometry	PlaceGeometry	contains the following information: location: contains the geocoded latitude, longitude value for this place Viewport: contains the preferred viewport when displaying this place on a map, as a LatLngBounds if it is known
[…]		
Contact		
Field	Type	Description
opening_hours	PlaceOpeningHours	contains the following information: open now is a boolean value indicating if the place is open at the current time. Periods are an array of opening periods covering seven days, starting from Sunday, in chronological order. Each period contains: open contains a pair of day and time objects describing when the place opens

[2] https://developers.google.com/

		day a number from 0–6 time may contain a time of day in 24-hour hhmm format close may contain a pair of day and time objects describing when the place closes.
website	string	lists the authoritative website for this place, such as a business' homepage
[…]		
Atmosphere		
Field	Type	Description
price_level	number	on a scale of 0 to 4: 0 — Free 1 — Inexpensive 2 — Moderate 3 — Expensive 4 — Very Expensive
rating	number	contains the place's rating, from 1.0 to 5.0, based on aggregated user reviews
user_ratings_total	number	The number of user ratings which contributed to this Place's
[…]		

Table 5: Google places (Google Maps Platform, 2020; Google Maps Platform, 2020)

5.3.2 Using the place identification matrix

When reclassifying the Google place's fields according to the place identification matrix, Table 6 below will be the output. Also, the place information column will appear, to contain data that cannot be inserted under the other three main columns.

Cognitive	Physical Characteristics	Activity	Place Information
rating	address_component	Price_level	icon
reviews	adr_address	opening_hours	name
user_ratings_total	formatted_address	permanently_closed	place ID
	geometry		url
	photo		utc_offset
	plus code		formatted_phone_number
	vicinity		international_phone_number
	type		website

Table 6: Google place using place identification matrix (own figure, using (Google Maps Platform, 2020))

Google offers a lot of information about a certain place. Figure 7 shows that the cognitive fields represent 13.6% of the total elements. Also, activity has the same ration as cognitive 13.6%. The physical characteristics and place information are equal in their ratio, which represent 36.3% for each.

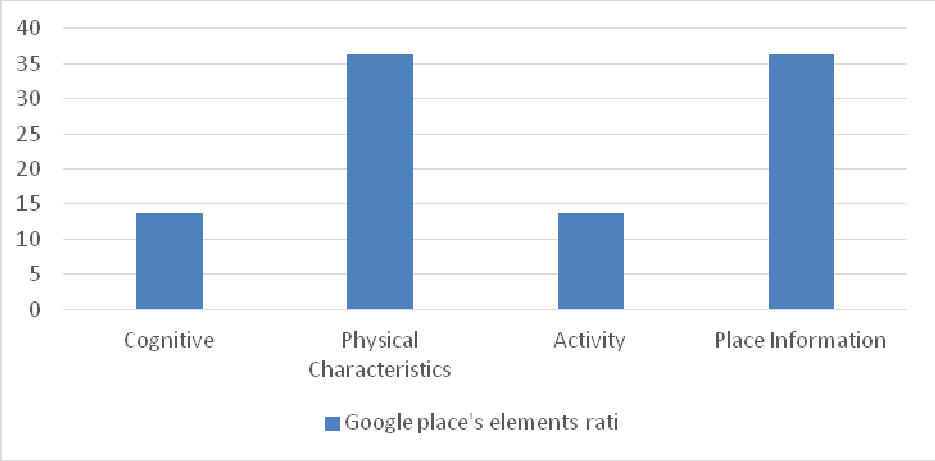

Figure 7: Google place elements ratio (own figure, using (Google Maps Platform, 2020))

6 CONCLUSION

This research was developed to tackle the first stage of using social media while building data-based applications in several domains (E.g. urban development, city management, city branding, etc.). Scholars who seek to retrieve data from social media to do further analysis and research should pay attention to how

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these platforms represent places, and what kind of data they use to identify places. It is shown from the research that Google is the most organized platform regarding places and it has a clear classification for place's fields, but it is not free of charge and you pay according to the number of requests and the category you are targeting. Facebook is concentrating on representing the place information and activity more than the cognitive and physical characteristics. Twitter is considered as a geo-referenced platform for the published content on it. It doesn't have any data for the cognitive and activity fields.

Besides all the euphoria, the negative aspects of using UGC must also be pointed out. Like Georgadiou et al. (2018) correctly and critically noted and describe the now higher difficulties „The Snowden revelations and the Cambridge Analytica scandal were probably the biggest contributors to citizens' changing perceptions of privacy". Whether researchers can still use personal data in the future is an open question. It is true, however, that the "data treasure" that many users often unknowingly make available through the uncritical acceptance of EULA (end-user license agreement) regulations must be better protected.

7 FUTURE WORK

The next steps in the research would highlight the linking between the perception of places in the real-world and the representation of these places in social media. This link will present the translation language between the offline world and the online world. The research will also examine this question: how could cities make benefit from this link?

Also, the research will work on suggesting a prototype for a platform that gathers data from different data sources. Several projects represent places in an advanced way in one field. If a platform gathered different data from different platforms to present places as layers (E.g. cognitive layer, physical characteristics layer, activity layer, place information layer), then places will be presented in a more complex and comprehensive way in the virtual environment. Part of these projects can be listed as follows:

- Smart citizens project[3] give a detailed insight about the environment, it is a piece of hardware comprised of sensors to measure: carbon monoxide (CO), nitrogen oxide (NO2), temperature, humidity, light, and sound
- what3words[4] is a project to identify any place with three words. They assigned each 3m square in the world a unique 3 word address that will never change. For example ///filled.count.soap marks the exact entrance to what3words' London headquarters

Smart citizens can be associated with the physical characteristics layer to give measured details about the environment. What3words can be associated with the cognitive layer to represent how people identify places.

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[3] https://smartcitizen.me/

[4] https://what3words.com

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🏆 *reviewed paper*

Planning in Self-Planned Informal Cities

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1 ABSTRACT

Post-colonial urban informality is subject to binary interpretations, entrenching or inverting existing practices. There is a renewed attention in urban studies literature to view cities as self-organising systems rather than as an outcome of a top-down hierarchical planning process. With case studies from Khulna city, Bangladesh, the argument presented in this paper reiterates the self-organising system theory where the built-environment is a juxtaposition and spatial negotiation of numerous (micro)informal planning organisations. Land-owner association, housing societies, private land developers, mosque committees, local ward counsellors, young environmental activists, or even individual actors are the true (micro)planners and decision-makers who negotiate everyday spatial arrangement and service provision of post-colonial cities. Such negotiations and arrangements are not necessarily responses to planning failure, but are democratic, aligned to stakeholders' aspirations, and testify the need to incorporate such inputs into the planning code. I then argue, that, qualitative negotiations and arrangements, as such informality,need to be incorporated as planning rule in cities of urban informality.

Keywords: advocacy, negotiated space, urban informality, Khulna, Bangladesh

2 INTRODUCTION

The post-1950s planning theories consist of two main branches: town planning and urban design. While the former deals with the procedural aspects of institutional and professional decision making, the latter deals with the structure and norms of society using qualitative models. In this discourse, theorising the built environment is often overlooked. Plans prepared by municipal planning agencies and private developers can hardly control a city. The current procedural planning approaches are incapable of regulating urban form; thus, they should stop avoid making long-term, wide-ranging plans and focus instead on immediate and small scale results (Alfasi and Portugali, 2007). The most recent approach to re-linking town planning and urban design is a uniform code of substantive planning by Alfasi and Portugali (2007). Their model proposes self-organisation of cities where planning decision making rests within the legal and professional boundaries, yet reflects 'bottom-to-top' dynamics of planning at the small-scale built environment.

There is pressure for planningtends to evolve from the modernist processin which planning is a universally accepted valid instrument of progress into a communicative procedural process. This shift indicates a more politically engaged, inclusive, empowering, and integrated process In this conception of planning, theorisation of city planning is termed as "a city that plans" rather than "the planned city." Therefore, a City that plans encompasses and considers every aspect of urban planning, i.e., land use, education, infrastructure, employment, culture, and natural resources. In line with this discussion, the UN-Habitat World Cities Report 2016 highlights adequate shelter and sustainable urban settlements by evaluating it through five lenses: (1) the transition from master planning to grassroots equity/advocacy community visioning; (2) rethinking land use and public space; (3) policy-sector integration and new tangible realities; (4) geographic (scalar) integration; and (5) planning capacity (UN Habitat, 2016, 124).

In this paper, I discuss three of the UN-Habitat lenses with case-studies from Khulna city, Bangladesh. First, I discuss how the shift from master planning to grassroot involvement in the urban built environment is happening. Secondly, I discuss the geographic (scalar)integration process and the evolution of the built environment wheew planning organisations and authorities are failing in their newly defined roles which include implementation, monitoring, and enforcement of urban plans. Thirdly, the UN-Habitat brings in sustainability whereby the rights and responsibilities of citizens to manage resources is a grounded concept that varies in different urban settings. I, therefore, argue that in the absence of concrete planning guidelines, the rights and responsibilities of citizens, and their capacity to plan, is a fluid concept.

Against this background, the second section of the paper explains the evolution of procedural planning as well as the shift from master planning to procedural planning in Khulna city, Bangladesh. The third section presents case studies of geographic integration of the built environment and how ever-changing community

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settings influence the built environment. The fourth section explains the new form of urban planning in Khulna, Bangladesh, and how it differs within the country in different settings. The final section is concluding remarks.

3 PROCEDURAL PLANNING AND KHULNA CITY

Two fundamental properties characterise the modern planning system. One is a top-down hierarchical process comprised of three significant tiers of planning bodies. The national planning bodies prepare national plans, regional planning bodies prepare their respective regional plans under the umbrella of national plans, and urban planning authorities prepare urban plans. Depending on the devolution of planning powers, down the hierarchy the city ward councils or communities too can plan their plans. The planning system is thus basically a top-down approach where main ideas come from the top and allow very little space to the community to manoeuvre its built environment. Secondly, current planning theory and practices are relying heavily on predicting the future using scientific techniques when collecting comprehensive data, i.e., demand for housing, transportation, service, and facilities (Portugali, 2011). Planning authorities are aiming at future demand and can dictate the future organisation of cities. New housing estates, i.e., new/satellite towns, transportation, and infrastructures, i.e., rail stations, bypass road to avoid traffic congestion are some of the typical large scale initiatives of the urban planning authorities.

As top-down planning, i.e. master plans, etc. tend to benefit overwhelmingly a minority of urban residents and are often failing to secure socially just cities by comprehensive rationality, demand for a creative and participatory process of urban planning has evolved. The prime example is a shift from master planning to procedural planning, i.e. structure or strategic planning. The procedural form of urban planning is an adaptive, non-rigid methodology which enables the participation of urban stakeholders in urban governance towards sustainable urban development and to account for future uncertainties and changes (Steinberg, 2002). The precondition for sustainable urban planning is to ensure institutionalised and meaningful participation of stakeholders. In the era of competitive market-based policy frameworks, procedural structure planning seems to be a sustainable approach because of its collaborative actions and not aiming at a finite goal. Interactions among the stakeholders, notwithstanding power relations, leave enough space for maneuverability; thus, the procedural structure plan has scope for creating enough space for socially just urban planning (Rahman, 2016; Levy, 2007).

The city planners in current municipal authorities have roadly three key responsibilities. Firstly, they are responsible for initiating planning policies, such as future growth trends in the peripheral area of the city. Part of this job description is to prepare a master- or development/structure plan- or land-use/detail area plan. The success of these plans is questionable, at least in developing countries where urbanisation pressures spill out beyond the planned areas. Secondly, they authenticate their policies with the support of the representatives from public and private bodies, NGOs, and civil society, while they themselves are also part of the liberal democratic policy. Participation remains the key to this step as incorporated in procedural planning. Thirdly, they approve or reject proposals of development/construction schemes based on their approved plans, as they are the sole guardians of city development. In this paper, all developments are foreseen according to plans, yet the urban built environment is often different from what figures on the planning papers.

The planning system practiced in Bangladesh was imported directly by the British during colonial times. The master plan approach applied to urban planning on the Indian sub-continent during the 1950s (Rahman, 2016). The master plan is criticised as blueprint land use plans as it cannot tackle the dynamic nature and complexity of urban growth. Change in the political and bureaucratic system after the liberation in of Bangladesh in 1971 demanded a new form of urban planning, and structure or strategic planning systems were introduced to supersede the British planning system. The strategic planning system counters the limitations of the master plan as it provides an open-ended policy framework (Rahman, 2016; Chowdhury, 2005). Following the master plan of Khulna in 1960, the strategic plan was introduced in 1980. However, the strategic plan is called Khulna Master Plan 2001. The plan is a three-tier hierarchy containing a structure plan, a master plan and a detailed area plan. The structure plan elaborates future development trends and direction of growth, as well as significant development proposals in indicative form (Rahman, 2016). The approach of the structure plan is not to detail out lot-by-lot land use, but to identify where growth and change need local and action plans. The duration of the plan was twenty years, which ended in 2001, and no other

plans have so far been produced for Khulna city. Rahman (2016) argues that the structure plan hardly had any implications on Khulna urban development but is being used as an instrument of planning permission and development control.

4 URBAN SETTINGS OF KHULNA

Khulna is one of the seven divisional cities of more than 6.64 million population in 2011 (BBS, 2011). Though Bangladesh has experienced rapid growth of the urban population, 15 percent over a decade from 2001 to 2011, Khulna has lost 39.45% of its urban population between the census periods (UNFPA, 2015). Khulna is a dying city as its leading economic activity, the jute processing industry, has experienced significant layoffs in recent times as the national economic activities have shifted towards garments and shrimp. About half of the city population (46%) is in the informal economy, and 58.9 % are living in 5080 poor conditions, mainly in slums and squatter settlements (UPPRP, 2011).

Recently, however, there has been a concerted effort to rejuvenate Khulna's economy, infrastructure, and connectivity. The construction of Padma Bridge connects Khulna with the capital Dhaka to reduce travel time significantly. Infrastructural improvement of Mongla port, Rampal power plant, expansion of Khulna rail station, rail and road networks connecting Khulna city, Mongla port, the Asian highway and Kolkata, India are some of the mega-improvement projects that have been prioritised by the current government. However, there has been no understanding by the Khulna Development Authority (KDA) about how these projects affect the urban structure of Khulna city. One of the main objectives of the Khulna city plan is: "tthe structure plan will interpret the urban strategy and development policies to create the context of Khulna city development" (KDA, 2001). In reality, there is no sign in the Khulna master plan of how it is going to assimilate the national Five Year Economic Development Plan. Subsequently, the plan has no direction on how the mega-infrastructure projects affect industrialisation, population in-migration, demand for housing, waste management, peripheral land speculation, and development.

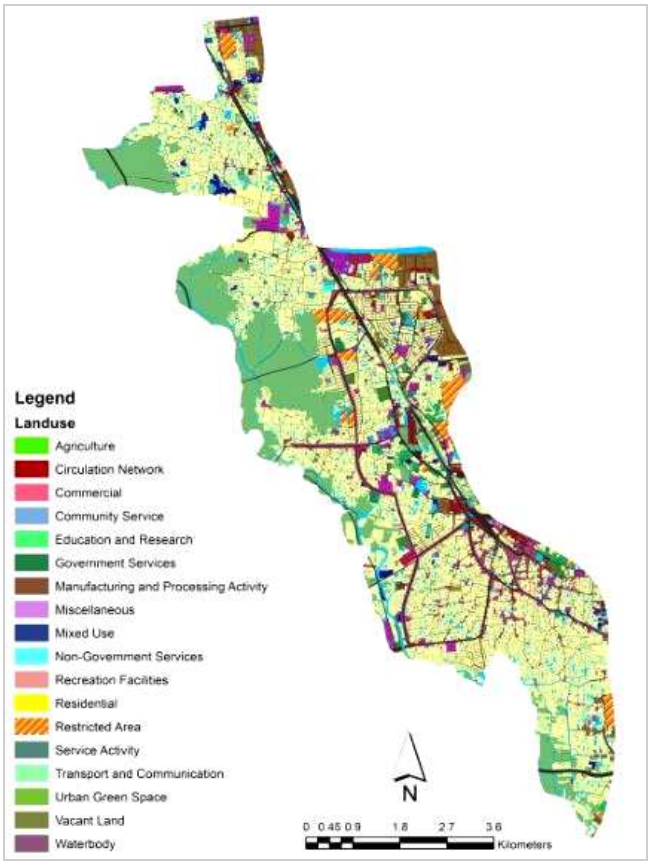

Fig. 1: Land use master plan of Khulna city

Allen and You (2002) explored the political sustainability of procedural planning by acknowledging people's participation in urban planning. Participation in planning is seen to be subject to ensure efficiency planning by addressing and understanding communities' demand where community consensus is a driving force for

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sustainable urban planning (Swapan, 2014). The evidence from Khulna city suggests that participation in the Khulna master plan is tokenism and include only relevant public departments, urban planners, university teachers, civil society organisations, business groups, media, and elected political leaders. Therefore the consequence of such tokenism is increasingly evident in its mass rejection by stakeholders leading to total violation of planning and planning regulations. We discuss such violation and self-organisation and planning in the later section of the paper.

There have been increasing interests in portraying urban planning as a consensual decision-making process (see, for example, Davies, 2001). However, even after repeated efforts from planning administrations, the level and nature of community/stakeholder participation in urban planning remain unanswered (Swapan, 2014), and institutional forms of participation considering the realities and capacities of the community remain unexplored (Njoh, 2007; Rahman, 2016). The UN-Habitat World Cities Report (2016, 124) notes: "rights and responsibilities of citizens, to land, resources and otherwise, as well as systems for determining and acting on the public interest, are vital to such a conception of planning." The report notes that no one political framework can ensure the participation of a wide variety of urban stakeholders; instead, the culture of participation can be developed and preserved by empowering the citizens and changes in the planning system; thus, procedural planning can lead to new patterns of urban governance.

In the current scenario of Khulna city, where close to half of the urban population are in the informal economy, and more than half are living in impoverished settlements, and with the culture of fending for themselves, ensuring participatory and consensual planning is hard to come by. Rahman (2016) notes that the Khulna city plan draws proposals for slum development and low-cost housing, that is, however, neither clarified nor is there any dedicated land for housing for the poor. The infrastructure based policies are causing social fragmentation in several ways. First, the plan has proposals for new roads that are attracting land speculation by the private land and housing developers, making peripheral land out of reach for the urban poor. Secondly, several land development projects are planned and implemented by KDA, which budgets no land for the urban poor but only for the advantaged groups, i.e., business persons, public service holders, and professionals. Thirdly, social infrastructures, i.e., parks and playgrounds, are allocated disproportionately in the middle and upper-income residential neighbourhoods. Fourthly, essential sanitation services, waste disposal, and access road for the poor communities are beyond the scope of the Khulna master plan. Finally, apart from public and private sectors, NGOs are playing a significant role in providing health, sanitation, and social infrastructure in slums and poor communities of Khulna city; nowhere in the Khulna master plan, is their contribution acknowledged, nor is a framework outlined for NGOs to participate in urban planning.

In general, the planning in Khulna city rests on three groups of agencies: public, private, and NGO/donor agency planning. Below I show with case studies how all three are self-organising or planning, yet informal/violation of the planning code is embedded in all of them. In this section, I have highlighted the shift from master planning to procedural and participatory structure planning in Khulna city. In the following section, I explain the second and third objectives with case studies.

5 SELF-ORGANISED URBAN PLANNING AND BUILT ENVIRONMENT

5.1 Self-organisation and Planning

Building constructions in most cases in Khulna city is a three-step process. First, the landowners and developers submit a building plan and structural design according to the guidelines. Secondly, after approval, the construction is done in violation of the submitted plan. Thirdly, although the building permission authority – Khulna Development Authority (KDA) – is aware of the violation, it hardly takes any action against such construction.

Building Construction Act 1996 dictates that for 134-200 sqm area:

- Setback: front – 1.5 m, 1m in both sides and 1 m in the back
- Car parking ramp – slope 1:8 and minimum 3m away from the main road

Below I describe two cases of residential land development – one KDA planned (Nirala) and one privately developed (Nirjon) – where these building construction regulations are not followed. Most of the land and housing owners in Nirala and Nirjon residential area are migrants who are located in Khulna due to

education and/or job placement. With a few exceptions, they are highly educated in Bangladesh standards and supposedly responsible citizens. Yet, almost all housing in Nirala and Nirjon residential area violated the setback regulations. The two figures present a stark violation of Building Construction Act regulations in Bangladesh.

Fig. 2a. Violation of setback regulation, Fig. 2b. Car parking ramp connected to the road

Based on the setback mentioned above, all but the undeveloped lots have violated the Building Construction Act, 1996 (figure 2a). The regulation is applied to all urban areas (except Dhaka city) without taking into consideration social, economic, environmental, and cultural factors. However, after consultation with owners, the following self-organisation factors are unveiled. First, in figure 2a, the landowners have learned from previous experiences that the planning authorities are hardly following up the initially submitted plans. Secondly, if the neighbouring lots have not followed setback regulations and have left very little space, it is unwise from their side not to do the same. Thirdly, such a setback is to ensure the airflow and privacy of the dwellers. However, many of the landowners nowadays do not rely on natural airflow but install cheaply available air-conditioners to deal with the nine-month summer in Bangladesh.

Additionally, all newly constructed buildings use Thai-glass on windows, and indoor is completely invisible from the outside. I found several cases where dwellers never open their curtains for religious purposes. Demand for large rooms and impetus for maximum utilisation of land eventually acts as a catalyst for such setback violations.

In figure 2b, the car parking ramp is directly connected to the front road, which is a violation, and also, the slope of the ramp is steeper than recommended. However, in-depth consultation with the house owners reveals several inherent factors of such illegality. First, heavy rain often innundates the area, and rainwater may enter the basement or car parking area if the plinth of the building is not high enough; thus, the slope of the ramp needs to be higher than recommended. Secondly, deteriorated roads are often refurbished by adding layers every few years. Therefore, the decrease between road and plinth elevation in the future needs to be accounted for during building construction. Thirdly, this is a low-density residential area with low car ownership. The road width is enough for current and future needs. Therefore it is not necessary to leave space for footpaths in this area. This scenario raises the question about the applicability of borrowed planning standards from western developed countries where car ownership is higher than in Bangladesh.

Usually, such planning code violations are tolerated by urban planning authority - in this case, by the KDA - without any repercussion. The KDA is fully aware of the dissimilarity between the permitted building plan and the actual development but puts a blind eye to such a setback violation. Additionally, landowners have formal housing committees and are organised in powerful groups. KDA is neither aufficiently staffed nor willing to go against the housing committee. Only when there is an accident like a fire hazard, KDA takes up its duty by stating that the buildings have violated the planning codes. Very often, there is a disagreement between two landowners or disputes regarding land development. However, these disputes and disagreements are solved by the housing committee and are rarely taken to court. Such a neighbourhood and housing development is typical for both public and private domains and is an example of self-organisation, co-learning, and inadequacy/inapplicability of planning regulations in the context of Khulna city.

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Conversely, in Dhaka, there are residential areas where car ownership is high, and builders and developers dedicate the complete basement and first floor to car parking, even though the minimum requirement is just one parking space per dwelling. The allocation of more parking space than required is due to the demand by renters for car parking; otherwise, house rent is often low. At the same time, in low-income residential areas, where car ownership is low, developers budget less space for parking; the same applies to the availability of elevators and heights of buildings. Therefore, building design is dictated by grounded reality and local demand, which a unified building code cannot ensure. This study points to the scalar arrangement in urban geography where the built environment is a function of local economy, environment, culture, and demand. Such scalar adjustment in urban geography needs to be incorporated in the formal planning process of a self-organizsd city.

5.2 Self-organiation and waste collection

Lack of public services often prompts communities to opt for self-management, i.e., household garbage disposal. I use the same examples, in fact, the same building blocks to explain the self-organisation in waste collection and disposal. In both residential areas, community associations have taken the responsibility on themselves to dispose of household waste. The associations have hired several people to collect waste door-to-door daily, which costs around one US dollar per month. The communities take-up the responsibility and relinquish the city corporation from the responsibility of garbage collection. Similarly, the

Fig. 3a. Self-organized waste collection, Fig. 3b. Waste littering in vacant plots

community associations are responsible for solving interpersonal conflicts and for ensuring security by employing nightguards. Much too often, such community approaches are hailed as a success story of a responsible society (see, for example, BBC, 2019).

There are several drawbacks to such responsible communities and success stories. First, the waste collection is optional, and households may opt for self-management if they are not willing to pay. Many households dispose of waste directly to drains and empty lots located nearby in the absence of frequent owner oversight. Secondly, the community associations are not allowing the city corporation to put garbage tanks, which the city corporation empties every day. These waste collectors gather household waste, separate recyclable waste for their benefit, mostly non-electronics, shoes, old clothes and metallic objects, and throw away waste in public waste bins. Usually, the waste collection bins supplied by the city corporation are in the closeby impoverished communities, due to the Not-in-My-Backyard issue. Finally, and most importantly, such door-

to-door garbage collection is a compensatory mechanism for people's sheer unwillingness to dispose of garbage responsibly. Subsequently, the availability of cheap labour is a market mechanism behind such a market solution to public services in both the residential areas.

5.3 Other forms of Self-Organisation

Besides the public and private dichotomy, NGOs and donor agencies are catalysts of other forms of self-organisation in cities of developing countries. Especially in Khulna city, where more then half of the city population lives in poor settlements dominated by slums and squatters. Among these two, squatter settlements are without legal tenure and usually are located on public land. These are inhabited by city dwellers employed mostly in informal sectors and who resorted to squatter settlements due to their inadequate income level and social capital.

Generally, the squatters have to maintain informal relations with local elected leaders, musclemen, and law enforcement agencies, i.e., the police, KDA, and the city corporation. Many studies have highlighted this aspect of squatter existence. For example, Hackenbroch (2013) noted the informal relationships of street vendors with the local political leaders and the police to secure access to public spaces. Hossain (2016) noted how the slum and squatter settlers use their voting right as collateral to access basic public service. Many of the squatter leaders keep close cooperation with the present government's political wing, a way of ensuring their existence in urban geography. Sowgat (2012) showed that in Khulna city, slum dwellers support current political leaders so that they can continue living illegally and rely on the political leaders to solve the intra-community conflict.

Fig. 4a. Squatter door with NGO markings, Fig. 4b. Road by GIZ (Deutsche Gesellschaft für Internationale)

Figure 4a is the door of a squatter household with markings of different surveys done by NGOs, donor agencies, and public agencies. The planning agency (KDA) does not recognise the squatter settlements on the map as they are invisible in the Khulna master plan, even though their vote counts for national and city elections. The existence of these squatter settlements is political. Therefore, access to public services, i.e., water and sanitation, road connectivity, and electricity are given through a political process, as explained by Hossain (2016) and Sowgat (2012). The ward counsellors are the key to this political access to services. However, squatters are frequently evicted or displaced during eviction drives by the city corporation, and often their access to services is limited to election promises rather than actual delivery. Temporary stay and lack of tenure security are the two most prominent barriers to service provision by the city corporation. In

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this void, NGOs and donor agencies play a crucial role, especially for community and utility facility provision.

Figure 4b shows a road constructed by GIZ in Mitaly Colony, a squatter settlement in the central part of Khulna city. In the same area, Nobolok a local NGO has provided handpump tubewells and toilets. The United Nations Development Programme (UNDP), Bangladesh in collaboration with the city corporation has constructed toilets and drainages, and Japan Association of Drainage and Environment (JADE) has provided drinking water supply. Another two NGOs are providing micro-credits and training for livelihood improvement of the squatter settlers of Mitaly Colony. Connecting road, water supply, and sanitation facilities, drainage provision, and micro-credit distribution are all based on workshops with the community people, thus are examples of participatory self-organizstion by the community, NGOs, and donor agencies. Similar activities by NGOs and donor agencies are noticeable in Khulna and other major cities of Bangladesh. However, the Khulna master plan hardly recognises in planning their contribution for services and facilities to the poorest of the poor of the city.

6 PITFALLS OF SELF-ORGANISATION

Strategic planning is now an expired ideology and planning is considered a dead profession (Fuller, 1998). Under the influence of neo-liberal market-led development, essential components of urban planning like land and housing development, transportation network, and utility facilities are ever-changing, and age-old master planning and strategic planning can hardly comprehend the urban dynamics. Procedural and strategic planning hypothesises that participation is the key to the new urban dynamics and complexity. The hypothesis is based on peoples' participation and responsible citizenry. While participation is the consensual form of decision making (Davies, 2001), the level and nature of participation in urban decision making are yet to be explored (Swapan, 2014). Apart from the institutional form of participation, active participation requires motivation and capacity of the participant to generate consensus. Disappropriated citizens, i.e., slum and squatter settlements, have developed their informal circumventing mechanisms to access basic needs, and the city administration has at best tolerated them or shown a bit of mercy. Developing the culture of participation and weighing their voice equally cannot be achieved just by changing the planning system from master planning to procedural planning.

Secondly, participation does not ensure consensus. The community is not a homogeneous entity, and there are power relations and conflict of interests extending from political to personal, among the participants. The residential areas mentioned above – public (Nirala) and private (Nirjon) – have community elected committees. The committees consist of influential political leaders, police officers, and school teachers, and not everyone's voice is equally weighed. Similarly, the slum and squatters do vary in their nature, and dwellers, too, have varying personal capacity. Rupsha slum is the biggest in Khulna city with more than 10,000 voters, while Mitaly Colony has around 200 registered voters. Community leaders of Rupsha slum have the upper hand over Mitaly Colony leaders due to the difference in their voter numbers. City planners think twice before an eviction drive in Rupsha as their community mobilisation capacity and political influence is much higher than Mitaly Colony.

Finally, self-organisation does not necessarily ensure sustainability, i.e., health and safety in rapidly urbanising cities of developing countries like Bangladesh. Studies point to different hazards like water-logging, earthquake vulnerability, fire hazard, lack of community facilities, and traffic management (see, for example, Rahardjo, Hary and Morry 2020 and Ahmed, Nahiduzzaman and Hasan, 2018). These aspects are beyond the scope of this paper. Understandably, the role of the planner in twenty-first-century procedural planning is to strike a balance between top-down planning and self-organising fragments of cities.

7 CONCLUSION

The change from master planning to procedural planning or structure planning is a significant step towards devolution of power from the professional planner to consensus based planning by the stakeholders. However, such devolution of power is often restricted to tokenism as the authoritative planning continues to prevail. Naming the Khulna master plan a structure plan signifies that the age-old master planning remains behind the scene of all forms of planning. Both master planning and procedural planning are copied from the British planning system and applied irrespective of local contexts. Mass rejection of the planning process and codes leaves much of the urban geography illegal, which is often termed as 'informal' because the public

administration continues to tolerate such informality. The informal urban geography in most of the developing countries is self-organised without any direct intervention from the planning authority.

The case studies discussed in this paper show how planning codes are incapable of comprehending local dynamics, change in technology, and cultural context. Additionally, it shows how the self-organised waste collection, which is often hailed as community success stories in cities, fail to ensure environmental responsibility as they create a disparity between the rich and poor communities. Besides the public-private dichotomy, this paper also discusses the NGO and donor agency planning for half of the urban community, especially the slum and squatter settlements, who are left to fend for themselves. Even after the shift from master planning to consensus-oriented participatory planning, the Khulna master plan does not acknowledge the self-planning for half of the urban dwellers. Finally, participation does not ensure consensus. The capacity of the participant and equal opportunity leading to the equal voice of participants remain crucial as the community is not a homogenous entity. For Khulna city, where more than half of the city dwellers live in poor settlements, city planning cannot be possible without empowering them. In line with this argument, a comment from Christine Platt, President, Commonwealth Association of Planners (CAP) is notable: "we have ten, maybe fifteen years, to get on to a new track. After that the slum problem, environmental damage and urban insecurity will become so entrenched that they will dominate international relations for the rest of the century" (The Daily Star, 2020).

In conclusion, the big question is: what can the planner do in self-organising cities? Planner intervention can be and must be equity-based. Secondly, as mentioned earlier, the existence of much of the poor settlements in urban geography is political/informal rather than legal/formal. Therefore, planners must acknowledge the squatters in urban space in maps of city plans, a step towards future permanence and legality. Thirdly, planners must change the planning system, which can lead to new patterns of space governance. The devolution of planning power to ward level (or lowest level elected entity) to create political space for planning is one way of doing so. Finally, traditional planning as a profession has been declared dead. Thus instead of planning, planners must be the catalyst for wide-range dialogue among the great variety of urban stakeholders just to keep the profession alive.

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Public Perception of Environmental Change in Rapidly Growing Cities: the Case of Cairo, Egypt

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1 ABSTRACT

Cities, especially in the global south, have expanded exponentially over the recent time. However, the pace of the required public acceptance of environmental change and the progression (invasion) into new ecosystems is not yet fully taking place at the same speed of the socio-cultural and natural identity changes and environmental awareness. Accordingly, scholars nowadays are calling for the pressing necessity of dealing with cities as socio-ecological realms, where social and ecological issues should be tackled and solved in an integrated manner.

Future extensions of Cairo are promoted by the Egyptian government and the private sector promises unrealistic images of landscape futures through unsustainable landscape practices influencing the socio-cultural meanings and values of nature while disregarding the environmental context of the proposed new city extensions. Lush and vast open green spaces are being marketed on an everyday basis through billboards on main roads across the capital, TV advertisements, and newspapers. These aspirational landscape images are promoted in a desert climate, which manipulates the public expectations and masks the environmental change that is facing the new urban extensions.

This paper argues that these acts affect the public attitudes and aspirations towards nature/landscapes of the future and hinder the required shift and awareness of environmental change as per the new ecosystem inputs. Environmentalism and pro- environmental behaviour require knowledge, awareness and most importantly frequent experiences of nature as advocated by scholars from different ecological and psychological disciplines. In this regard, the research paper shall investigate these propositions in the case of Cairo and its new administrative capital as an urban extension. The research deploys various methodological strands including visual data and sources to shed a light on the different daily images and messages of landscapes. The findings offer insights about the accompanying messages of landscape production dynamics as a main step towards understanding landscape futures and balancing between quality of life, environmentalism and economic prosperity in the new developments.

Keywords: Enviornmental Change, Cairo, Public perception, Landscape messages, Visual rhetoric

2 PUBLIC PERCEPTION OF ENVIRONMENTAL CHANGE

Environmental change was dealt with for a long time as a purely scientific problem led by natural scientists, till a more comprehensive understanding of the environmental problems began to prevail (Heise, 2016). According to Kari Norgaard and Dale Jamieson, the detailed attention to the political, social, cultural and rhetorical forms by which the climate problem is framed in different communities is the only way forward (Heise, 2016). UNESCO has adopted environmental perception by individuals and communities as a diagnostic tool since the 1960s (Roeschel, et al., 2016), when studying environmental perception became a fundamental tool for the management of places and landscapes (Roeschel, et al., 2016). An unaware public of the realities and risks associated with climate change poses a huge threat to society and the planet (Petersen, et al., 2019).

Public perceptions of climate change causes and consequences affect the ways in which individuals and societies respond to climate change (Capstick, et al., 2015). Public perceptions of climate change are very divergent in the different countries and even within some local contexts (Capstick, et al., 2015; Rajapaksa, et al., 2018). Changes in public perceptions are not well understood and are complex, as aspects of the surrounding physical and social contexts are crucial, including cultural values, political context, the nature of media coverage, in addition to the level of direct risk exposure (Capstick, et al., 2015). It is noteworthy to mention that knowledge about the causes of climate change is strongly related to public percpetions of climate change risks compared to physical knowledge which is not always positively influential or related

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(Rajapaksa, et al., 2018). Hence emphasis on the causes of climate change is crucial for effective awareness campaigns and communication strategies (Rajapaksa, et al., 2018). In addition making climate change locally relevant is crucial, by connecting it to salient local issues and co-benefits (Nash, et al., 2019; Upham, et al., 2009; Pidcock, 2018). This is an important step towards bridging the gap between wider global awareness and local relevance (Nash, et al., 2019). Perception of climate change is argued to be the foundation of climate change related policies, where the ways that climate change perceptions motivate individual pro-enviornmental actions is of great significance for the government to implements these policies (Yu, et al., 2013).

It is noteworthy to mention that there are a number of factors that affect the willingness of communities to engage in proactive adaptation to future climate change impacts: optimism bias (Taylor, et al., 2014), psychological distance (Taylor, et al., 2014; Rajapaksa, et al., 2018) and experience of risks (Rajapaksa, et al., 2018) are among the most discussed factors. The psychological distance refers to the spatial distance or the physical vulnerability of people's living places while the experience considers the impact of past events with regard to people's current perception and behaviour (Rajapaksa, et al., 2018). Insufficient understanding of the impact of people's actions on environmental sustainability and climate change may hinder environmentally-friendly actions (Rajapaksa, et al., 2018). Communities are affected by what they experience and what they perceive. Therefore, when the projected climate change impacts are more immediate, familiar and salient, the willingness of users to adopt protection measures proactively increase independently of climate change beliefs (Taylor, et al., 2014; Rajapaksa, et al., 2018). Environmental respresentations are interpreted through social and cultural layers of understanding which shape environmental issues (Nash, et al., 2019). Accordingly, my studies confirm the influential role of pro-enviornmental values, cultural worldview, and political affiliation in shaping beliefs and concerns about climate change (Taylor, et al., 2014).

3 THE ROLE OF VISUALS IN ENVIRONMENTAL CHANGE DISCOURSE

Despite the importance of public perceptions of environmental change, there is an ignorance about the ways that public understanding has developed as a result of the imbalance of studies of public perceptions between developed nations and other countries (Capstick, et al., 2015). The climate change issue is not always the main concern of the public compared with economic circumstances, which in turn affects its coverage intensity by media outlets (Capstick, et al., 2015; Scruggs & Benegal, 2012). The same premise works the other way around where the lack of climate change media coverage affects public perceptions and concerns for this issue compared to other widely covered issues by the media that are more salient and immediate.

There are various explanations for the challenges of public engagement on climate change as the uncertainities of the climate science act as a stumbling block for communication with the public where climate change discourses might seem abstract and intangible to the public (Pidcock, 2018). In addition, the political atmosphere is also influential for this topic. In some nations, the political polarisation of climate change is a major issue while in others the absence of public and political dicourse is the problem (Pidcock, 2018). If the issue of climate change is to be perceived as genuine and of serious risk, the trust and credibility of the communicator is of crucial central influence on climate change perception, to the extent that the general perceptions of the communicator are as important as the message itself (Upham, et al., 2009). Thus the public distrust of government as a source of information about climate change, will have implications on the government's efforts for raising awareness and changing behaviours through information campaigns (Upham, et al., 2009). In addition, public engagement aiming at attitude and behaviour change has jeopradised success where powerful contextual factors are operating against this change (Upham, et al., 2009). Also institutional trust is influential regarding opinions towards environmental change, whether the change is directly engineered or managed (Upham, et al., 2009). Thus the perception of and trust in the stakeholders involved in managing landscapes is crucial in defining the public's environmental values, and place attachement (Upham, et al., 2009).

In accordance, connection with the audience should be based on shared values to build trust between the communicator and the audience (Pidcock, 2018). Media coverage has a crucial role in shaping public perceptions where people gain most of the political, economic news from the media, and scientific stories are no exception (Boykoff & Rajan, 2007). The power of media is being recognised by scientists now, whereas political, economic interests had always attempted to influence media coverage of specific topics to affect

the public's understanding and perception (Boykoff & Rajan, 2007). In addition, the state control over the public sphere coupled with high illiteracy rates and tenchnological limitations have always been a factor acting against equal coverage of topics (Boykoff & Rajan, 2007). The intersection of mass media, science and policy is a dynamic arena of communication in which all sides have their stakes and agendas (Boykoff & Rajan, 2007). Journalism and public concerns have shaped decisions in climate policy and science, but also climate science and policy have shaped media coverage and public understanding (Boykoff & Rajan, 2007). The media landscape is changing nowadays, where digital media platforms are providing an alternative outlet. Hence the ways of picturing climate change are divergent and have different tones and voices with potential implications for engagement (Wang, et al., 2018). Eco-media has a great impact on real-world interactions with the natural environment and offers a great potential for audiences to change the ways they think about and interact with nature (Wallace, 2019).

3.1 The role of visuals in environmental change communication

The current environmental issues require strong public support and a huge shift in public awareness (Altinay, 2015). Hence the communication techniques should adjust to changing conditions through deeper levels of engagement for communicating sustainability that would foster social learning, and appeal to the values and beliefs of the audience (Altinay, 2015; Sheppard, 2006). Environmental literacy is crucial so that individuals can evaluate and construct an understanding of human-nature relationships through environmental learning (Altinay, 2015). Human awareness of the surroundings is limited and knowledge about the environment is not always obvious through observation (Altinay, 2015). In this regard, visualisations are being relied on as a tool to evoke environmental issues in a meaningful and personal way in everyday discourse (Altinay, 2015; Sheppard, 2006; DiFrancesco & Young, 2010), and is argued to lead to behavioural change (Sheppard, 2006). Visual communication is critical as a contributor to the cultural and social life of environmental issues, yet under-estimated (DiFrancesco & Young, 2010). Hence, visuals are considered a crucial part of the interface between science and the public (Brönnimann, 2002). Work on climate imagery is important in terms of psychological distance that is argued to be one of the main hindrances against perception of environmental change (Wang, et al., 2018; Rajapaksa, et al., 2018; Taylor, et al., 2014).

Images are powerful for their ability to blend facts and emotions and have great engagement potentials where they engage viewers as witnesses rather than detached receptors of information and claims (DiFrancesco & Young, 2010). It is crucial to highlight that visuals that carry emotive content and are relatable to the individual's daily life are more effective in triggering pro-environmental behaviour than cognition alone (Altinay, 2015). Despite the great importance of visual images, our understanding of the ways they relate to public perceptions of climate change is still limited and less developed (Wang, et al., 2018). Hence there have been lots of studies concerned with the characteristics of these engaging visuals which encompassed realism, personal salience, immediacy, human element, and demonstrating future consequences (Altinay, 2015). In this regard, landscape visualisation is one of the unique beneficial visual imagery for bringing consequqences of environmental change home to people through its unique characteristics (Sheppard, 2006).

4 SOCIAL CONSTRUCTION OF PUBLIC PERCEPTIONS OF ENVIRONMENTAL CHANGE

People relate to the proximate and visible causes of climate change in the absence of wider understanding, as the perspectives of global climate change may be limited due to being beyond human perceptual capacity (Nash, et al., 2019). In addition, people sometimes interpret climate change events through the culturally available narratives that construct these issues, as the physical climate change is observable only over long time periods (Nash, et al., 2019). Hence perceptions of environmental conditions are fundamental to informing behaviour (Nash, et al., 2019). The social, economic, political and technological context of individuals shapes and constrains attitudes and behavioural responses to environmental change (Upham, et al., 2009). In addition, attitudes are conjectured constructs that refer to an individual's evaluation of an idea (Upham, et al., 2009). Accordingly, attitudes are dynamic contextual, and influenced by multiple factors (Upham, et al., 2009). Hence considering the wider context of the individuals is crucial while formulating and enforcing policies supportive of pro-enviornmental attitudes towards enviornmenal change in addition to cognition, affect and behaviour (Upham, et al., 2009). Furthermore, risk perception is a product of psychological processes and the broader social, institutional and cultural factors and the local context (Upham, et al., 2009). Hence there is a need for effective communication to facilitate sustainable relationship

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between people and the rapidly changing socio-ecological systems they inhabit and influence (Thomsen, 2015).

Landscape is the sphere where societies and nature interact and affect each other (Bürgi, et al., 2004). On the other hand, dynamism is an inherent feature of societies and nature which leads to 'change' as being an inevitable characteristic of landscapes (Bürgi, et al., 2004; Antrop, 2005; Wood & Handley, 2001). Drivers of landscape changes are argued to be socioeconomic, political, technological, natural and cultural driving forces (Bürgi, et al., 2004). Where the socioeconomic and political driving forces are strongly interlinked the socioeconomic needs are usually expressed or tackled in the political programmes, laws and policies (Bürgi, et al., 2004). Thus, the political identity dominates other factors in predicting climate change beliefs for individuals (Hamilton, et al., 2015). This is also concluded by Upham, et al.,(2009), where they confirm that political and environmental beliefs strongly influence attitudes and responses to climate change (Upham, et al., 2009). Technology has impacted the landscapes a great deal as well lately, as in the case of the impact of autombiles on settlment patterns. Culture is an important driver of landscape change (Bürgi, et al., 2004; Nassauer, 1997; Rockwell, 1994). Proctor (1998) and Bürgi, et al. (2004) argue that culture is a means of making sense of reality. Culture and nature are closely tied together which can lead to devastating consequences to nature as culture sometimes ignores or erases the autonomy of the natural world (Wallace, 2019; Nassauer, 1997). Yet there is a severe lack of approaches of 'Culture' integration into the studies of landscape changes (Bürgi, et al., 2004).

5 RESEARCH PROBLEM

Climate change is investigated and addressed by natural scientists, but it is also crucial to consider the social and cultural life of the climate change issue which is influenced by competing claims, values, priorities, and narratives (DiFrancesco & Young, 2010). Hence communication and media theories, and environmental sociology would be helpful in understanding how climate change issues are packaged by visuals that are consumed by the public which is not usually well acquainted with climate science (DiFrancesco & Young, 2010). As concluded by DiFrancesco & Young (2010, the lack of clear imagery about climate change makes it difficult for the public to visualise potential impacts and consequences and to link the scientific claims to everyday life (DiFrancesco & Young, 2010). Images are considered the 'co-constructors' of enviornmental messages, due to their communicative and engaging powers (DiFrancesco & Young, 2010). Risk perception is also impacted by social psychological proccessess such as media framing, perceptions of communicators, denial…etc. (Upham, et al., 2009).

The power of images originates from their influence to be manipulated and could propagate multiple forms and purposes, in addition to constructing and expressing social imaginaries of modernity (Kapferer, 2012). The diversity of available images nowadays is another factor (Kapferer, 2012). Hence the construction of images and mythologies of power is crucial in analysing the continously changing social assemblages of the modern world and in discovering and inventing new ways of recasting new realities (Kapferer, 2012). Advertisments for example have multi-faceted influences and effects. On the individual level, advertising media can shape and sometimes change a person's behaviour, opinions, and attitudes (Dyer, 1982). While on the community level , it propagates general ideas and beliefs (Dyer, 1982). It is also argued that the utopian imagery of advertisments encourages passivity and makes the public unaware of the imposition of consumerism ideologies (Dyer, 1982). There is evidence that asserts that advertising plays a role in defining 'reality', through the projection of goals and values that are consistent with and conducive to the consumer economy and convinces the public that they can buy a way of life and goods (Dyer, 1982).

In this regard, the power of images and the advertising effects are posing devestating impacts on the Egyptian landscape, socially, economically and environmentally. The real estate advertising campaigns that is taking over the capital specifically is shaping a utopian reality that is disconnected from the true identity of the Egyptians, imposing a westernised green utopia, and it is promoting consumerism lifestyles of living in gated communities. In addition to the devastating social impacts on the community and the solidarity of the urban form of the new cities, this new lifestyle and promoted green utopia is masking the consequences on environmental change that the public will be facing when it moves to the new desert extensions. This constructed reality is profit driven and environmentally unconscious. This research looks into the prospected impacts of these acts on the public perception of environmental change.

6 RESEARCH METHODOLOGY

In accordance with the great importance of images in the field of public perceptions and issues of environmental change, this research is employing a visual research method. Visual research methods are now adopted in numerous fields of inquiry, as a result of the rapid development of information technology that facilitated the creation and editing of digital and visual data (Knoblauch, et al., 2008). Visual data is becoming the subject matter and the methodology of social scientific inquiry where the ways of approaching visual data in a scientific, analytic or theoretical manner is gaining increasing influence (Knoblauch, et al., 2008). Visual methods can change the voice of the research and they also enable the researcher and the audience to widen their experience, understanding and representations of the issue of interest (Frith, et al., 2005).

Visual data and analysis are usuallay characterised as qualitative where they address the cultural meaning of visual data and relate to the different ways in which actors interpret this data (Knoblauch, et al., 2008). Visual data includes photography, video and graphic representations, but photography requires more interpretation (Knoblauch, et al., 2008). Photography is a visual system of representation where it produces certain realities through certain visibilities i.e. an object's visibitiy is produced that might not be present (Christmann, 2008). The intentional and subjective representation of photography offers multi-layered meanings, where recepients may see and understand them in different ways (Christmann, 2008). However if producers and recipients share common socio-cultural practices it reduces the divided understanding of the picture (Christmann, 2008). Pictures for social sciences provide personal insights and personal record of spatial and social relationships (Knoblauch, et al., 2008). The objects included in images, and the ways they are included (Dyer, 1982; Frith, et al., 2005), in addition to what is excluded are all important factors in the construction of the particular reality and the meaning-making that enables it (Frith, et al., 2005). The pictures' context of production and publication and the ways they will be perceived is of crucial importance as well (Christmann, 2008). Thus researchers should move beyond the simple level of analysing the items in the picture to perceive links and relationships to other elements and layers within the picture (Dyer, 1982). Images are socially constructed and always reflect the identity of their creator (Frith, et al., 2005). What is absent and not included in the image is as important as what is included (Frith, et al., 2005). Hence researchers are interested in what is being represented, ways of translating these representations and the process of producing the images (Frith, et al., 2005). Visual methods can be used to examine different ways of meaning-making (Frith, et al., 2005).

The research utilises visual inquiry to examine the real estate advertisments promoted in the new extensions of Cairo by the state and the private sector in order to untangle the underlining landscape messages beyond the images.

7 CASE STUDY BACKGROUND

Cairo is one of the oldest settlements in the world and is still inhabited and massively growing over time. The main attraction for the city was being on the Nile valley, which created a major natural spine through the city. The Nile is considered the green lung, providing greenery and waterscape which are both an economic and leisure asset for the community. Faced by the continuous population booming and rural urban migrations to Cairo, since the 1970s, the capacity of the city to accommodate the needs of its residents was questioned and jeopradised (Fahmi & Sutton, 2008). Hence the government considered the creation of new cities around Cairo as the way to provide better quality of life for the residents and to release the pressures on the inner core of the city. By the early 1990s, the neo-liberal economic paradigm was on the horizon towards economic globalisation which affected Cairo's cityscape a great deal. This entailed economic restructuring, the redefinition of the role of the state in national development and an increased dependence on the private sector (de Koning, 2005). The state handed over the management of some of the new towns to private promoters and speculators who depended on villa complexes, gated communities and enclosed elite compounds (Fahmi & Sutton, 2008; Schechla, 2015). This created new elements to Cairo's landscape that was not there before and affected socio economic and socio-cultural transformations accordingly and sometimes led to social and economic polarisation within the city and even within the districts (de Koning, 2005). In addition to the newly socio-cultural and socio-economic character that these real estate patterns introduced to the Egyptian and specifically to Cairo's landscape, the natural context and enviornmental impact of these practices were not deliberately considered. These new developments depend widely on

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advertisments to attract the consumers to purchase new dwellings in these new gated communities. Billboards are spread all over Cairo, promoting a type of green nature that neither resembles the green nature of the valley nor is it the desert landscape where these projects are being erected (Abotera & Ashoub, 2017). The main green elements that these projects depend on are open grass fields, golf courses and trees that belong to a totally different climate zone than where these projects are being established (Abotera & Ashoub, 2017). Despite the fact that the water and green nature elements can be argued to belong to the Nile valley, the elements themselves and the image frames of the advertisments and billboards are European and North American in style (Abotera & Ashoub, 2017).

8 LANDSCAPE MESSAGES & MEANINGS IN CAIRO

The surrounding physical and social contexts are important, encompassing the cultural values, political context and the nature of media coverage (Capstick, et al., 2015). The symbolic, cultural and expressive meanings of landscapes that develop through social interaction and embedded in social practices and institutions are crucial for environmental management (Williams & Patterson, 1999). Meanings are not inherent in the landscapes but created through everyday discourses and reflect the ways people define themselves within the environment (Greider & Garkovich, 1994). The socio-cultural perception learned through embodied practices and the large-scale imaginations held by society and culture are crucial elements of cognition of the natural environments in addition to the sensory interactions (Schilhab & Esbensen, 2019).

In this regard, Egypt is facing a major challenge. The socially constructed reality created through the messages sent are advancing distorted images of nature and also obscuring the climate change consequences that the city is facing, by creating a parallel strong discourse. The landscape messages can be based on two parallel discourses as illustrated in Figure 1: scientific based discourse that discusses the climate change consequences facing the city extentions in the desert, and discourse that promotes social learning about the changing natural identity of the Egyptian landscape. The scientific discourse is not expansively promoted among the public and it does not usually interact with the public on an everyday basis. In addition, it is not usually a localised discourseit and it does not rely on engaging visualisations, which of course adds to the psychological distancing from climate change. In addition, the media coverage of climate change is close to none, compared to economic and political issues.

Conversely, attractive and idyllic advertisments promote general meanings about what should be admired and desired through their vivid imagery, catch phrases and stereotyping (Dyer, 1982). These advertisments do not reflect social meanings and conditions, on the contrary they teach the recipients ways of thinking and feeling through fantasy and dreaming (Dyer, 1982). Advertisments impact people and societies through manipulation rather than informing, through distorting rather than reflecting the quality of life in the targeted society and are mainly the products of decisions taken by minor group of powerful businessmen (Dyer, 1982). This results in promoting fantasies for the public that results in spreading frustrations about people's daily lives through false utopias (Dyer, 1982). In accordance, the parallel discourse that interacts with the public on a daily basis, are the real estate development advertisments that have been taking place in Egypt recently. These projects are pioneered by the state and the private sector. The state anounced the erection of a new adminstrative capital from 2015. This mega national project as promoted by the state is expected to relieve the capital's congestion. Among the ambitious plans and projects within the new adminstrative capital,is the 'Green River' which is a huge scaled park double the size of central park New York. This park is planned to be the main natural spine of the new city. However the main hindrance is that, this new extenstion lies totally in the desert with no access to freshwater, not withstanding the major water crisis that Egypt has been facing lately. This adopted paradigm and vision by the state is propagating green images of the desert, as a clear manifestation of humans as masters of nature. It is argued that people's actions and attitudes towards their environments depend on the way they think about themselves in relation to their surroundings (Rockwell, 1994). Reflecting on that, it is clear that these messages would definitely affect the pro-environmental beliefs and such attitudes of the Egyptians.

In addition, the real estate development led by the private sector in this new extenstion, is all based on luxurious housing schemes that rely on vast open lush landscapes. These practices are not only ecologically draining in the desert, they do not even support biodiversity or add to the health of the ecosystem. The frequency of encounters of these constructed realities with the public are high, and are visually appealing

with striking and catching slogans and phrases, especially in contrast with the weak and impersonal media coverage of climate change consequences and risks.

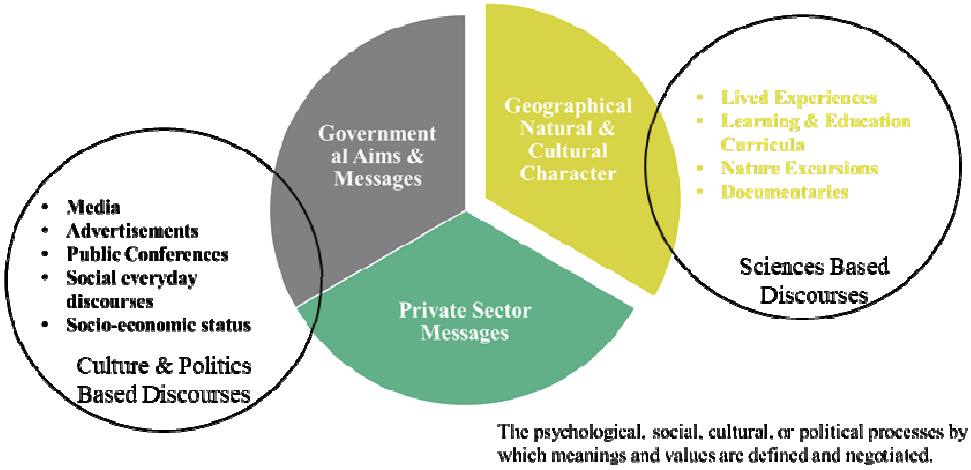

Fig. 1 illustrates the parallel discourses creating landscape messages among the public. Source: authors.

9 THE VISUAL RHETORIC AND ENVIRONMENTAL KNOWELDGE

The state and the higher income sectors are invading the desert by their optimisitic projects and luxorious housing patterns. But the billboards and the advertisments in mass media are as crucial as invading the mental image of the desert for the public and imposing a different foreign nature (Abotera & Ashoub, 2017). These new claimed utopias lead to the recreation of the mental image of the national territory and have critical implications on the spaces of representation of Egypt itself (Abotera & Ashoub, 2017).

On the other hand, the geographical natural identity and reality of the desert and its associated environmental change is not discussed or even noticed among these new created images. Hence the public perceptions of environmental change is jeopradised. The media communicate images of the satisfying life as one that is based on consumption and waste, which impacts people's values a great deal (Rockwell, 1994; Dyer, 1982) where the new levels of consumption entail and foster land use and land cover changes (Rockwell, 1994). In accordance, it is the culture of the elites that has direct independent effects on the environment, where land use and cover changes are one of them while the culture of the vast majority may affect the kind of leaders they would have which in return would have an impact on land use changes and the environment as well (Rockwell, 1994). These prepositions are true of projects in the case of Cairo. Seeing is based on learning and knowledge and previous knowledge has a role in knowing what we see (Dyer, 1982). Thus the Egyptians' prior experience and knowledge of the Nile greenery of the valley is more rooted in their brains and identities than the desert landscape. In accordance, they would relate more to seeing images of greenery than images of the yellow desert. This is the crucial danger of the current transformations taking place in Egypt. Transforming the current socio-cultural natural identity would require efforts for the public to perceive the environmental change as it is and get associated with it. But the current trends are not helping in this direction. Quite the reverse, they are still reinforcing the green natural identity of the Nile and, worse still, linking it to westernised images of consumption.

9.1 Governmental/state visual rhetorics

Understanding the change that is taking place, its reasons and the solutions is one way of identifying the drivers of change (Wood & Handley, 2001). Studying the connections between people and their environments is crucial for understanding the changing societal demands as a result of an altered natural environment (Bürgi, et al., 2004). It is argued that landscape changes are driven by numerous factors, with political and cultural forces being the strongest among them. The case of the New administrative capital in the desert surrounding Cairo is another proof of this preposition. The state's ambitions and visions regarding the new extension of Cairo is not consistent with the landscape character that is expected to accommodate these extensions. The political will and the strong connection of the socio-cultural identity of the green Nile are the main building blocks of the proposed transformation/landscape change that is taking place within this new ecosystem. In addition, dysfunction defined as the disruptions caused by the mismatch between the type

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or intensity of land use and the landscape character is one of the consequences of landscape change (Wood & Handley, 2001). It can be said that the dysfunction that the new administrative capital is facing, is the main landscape change driver, as illustrated in Figures 2 and Figures 3. Dysfunction destroys the character of landscape which is defined by the discinctiveness of landscape elements. This process can impose an inappropriate development pattern on the landscape through forces such as suburbanisation and intensive development (Wood & Handley, 2001). The distinctive elements of the desert landscape are being erased and substituted by the envisioned reality by the state that may be driven by the need of guaranteeing success and attracting the people from the centre to meet the main goals of this project. In this case the state is relying on the strong socio-cultural identity of the Egyptians and their desperate need of greenery in comparison to the great deprivation facing the congested centre of Cairo to accomplish the goal if this project.

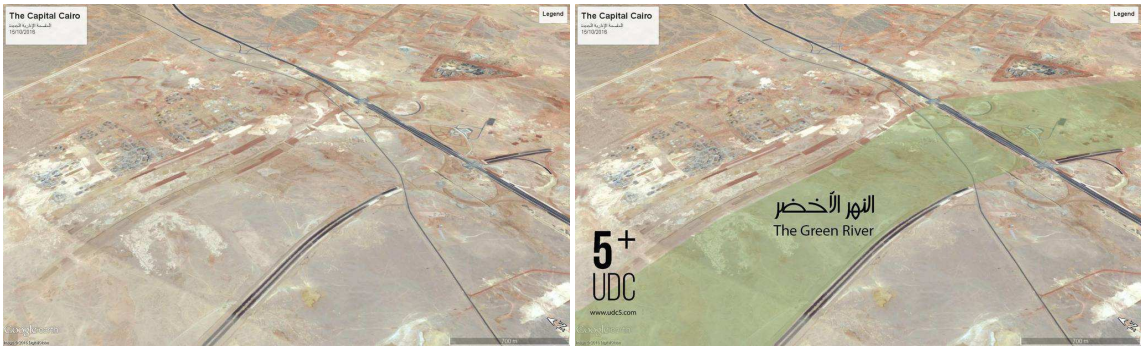

Fig. 2 illustrates the real situation (on the left) vs the schematic proposal of the green river in the new adminstrative capital (on the right). Source: https://www.skyscrapercity.com/showthread.php?t=2083125

Fig. 3 illustrate the variance between the real current situation of the ecosystem(on the left) and the proposed/envisioned green (on the right) and. Source: https://www.skyscrapercity.com/showthread.php?t=2083125

9.2 Private sector visual rhetorics

The private sector is not only causing landscape changes of the desert ecosystem, but it is also affecting the public's culture and aesthetics preferences for landscapes. Culture is the most influential driving force of society, but sometimes it can lead to a devastating consequences on the health of the ecosystems (Nassauer, 1997). In this regard, the private sector practices and projects are spreading a westernised landscape character that is based on golf courses and vast areas of green lush, as shown in Figure 4 which is not part of traditional Egyptian landscape and culture. Advertising has a powerful impact on people's beliefs and values, and it is argued that it is more or less like propaganda, as it stuns and demoralises the critical consciousness with strong and extreeme statements and pushes the seller's version of reality (Shudson, 1993). In Cairo's case the private sector is producing its own propaganda.

Furthermore, analysing the context of the images production is crucial to obtain a better insight into the hidden messages within them. Also the ways that these images are being perceived is crucial. Hence this research is arguing that the hidden messages of these lush green photos in the desert distort the relationship between people and the environment as thet assert the man's mastery over nature and his striking acts against the inputs and contexts of nature. In addition, the ways that people would perceive the proposed development in the desert would eliminate environmental change from the everyday discourse which would have serious implications on their environmental beliefs and attitudes. In addition the aesthetic appeal for greenery as transformed and associated with lush greenery propagated in these messages is not part of their cultural perception of nature. Aesthetics can be the path to sustainability (Meyer, 2008), but this is certainly not the

case here. The advertisments are sending deceiving and distorting messages of the new natural desert identity to the public, totally opposed to and distant from their Nile valley identity. Worse still, these images are linked to a westernised utopia. Hence these implications are not only enviornmentally destructive but they are also culturally and socially antagonistic.

Figure 4 illustrates the billboards spread all over the capital, advertising for golf courses and lush green based residences. Sourxe: https://insiteooh.com/article/2380-porto-group-launches-their-newest-project-in-mostakbal-city

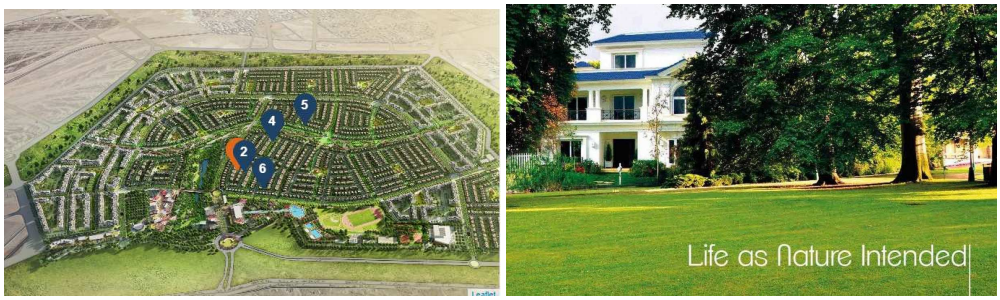

Figure 5 illustrate two examples of the imagined real estate to be erected in the new city extensions. Source: SODIC EAST, NEW HELIOPOLIS, EGYPT

10 DISCUSSION

It is argued that fast and sudden changes in the surroundings might result in a loss of sense of place and a downturn in people's identification with the landscape (Bürgi, et al., 2004). Identity has impacts on the cognition, affect, and behaviour as identity is fluid, multi-dimensional, and socially relevant (Devine-Wright & Clayton, 2010). 'Identity processes are embedded within wider dynamic cultural, political and economic forces' (Devine-Wright & Clayton, 2010). Thus identity is studied as both an effect and a cause where it can be examined as a dependent and independent variable (Devine-Wright & Clayton, 2010). Egyptians have always identified themselves as being from a green agricultural country and have the pride of the Nile river running in their veins through generations. In accordance, the new extensions are basing their success on the pride that the Egyptians hold for the Nile and is naming the huge park within the new capital as the 'Green river' replicating the image of the Nile river but in the desert. This practice is affecting the new desert identity where the state should have embraced the new ecosystem and promoted better acquaintance/adaptation with the new landscape character rather than erasing it. The state should have promoted the new identity of the Egyptians through media outlets employing local and engaging images, to help the public in reidentifing themselves with the new natural identity that is accommpanying the relocation to the desert rather than the narrow Nile Valley that has been part of their lives and identity since eternity.

When natural environments become more salient in public discourse, the relevance of the environment to identity will increase (Devine-Wright & Clayton, 2010). Sustainable practices, pro-environmental beliefs, and the changing/ different natural character identity of the new cities are not communicated sufficiently and not as engaging as the distorted landscape images of the new developments through advertisments. If the ecological standpoint was as widely communicated and as frequently discussed and encountered in everyday discourses, it would have helped in reshaping the identity of the Egyptians and prepare them to be more resilient in coping with the new ecosystem. On the contrary, the current atmosphere is not allowing the public to perceive the environmental change that is taking place in their surroundings.

This research is ringing the bell for the adverse effects of economically driven projects and their advertisments on the public perceptions of environmental change. Their impacts are not only ecologically

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insensitive but also socially, and culturally destructive. This is even more dangerous, as culture is an important driver of landscape change (Bürgi, et al., 2004; Nassauer, 1997; Rockwell, 1994), so when the culture of the whole community would be illusioned by these westernised utopias, it would certainly drive the landscape to change in a very dangerous trend. In addition, these practices are increasing the psychological distancing of the Egyptians from environmental and climate change consequences, making it more difficult for environmental awareness campaigns to induce behavioral change and so hindering the adoption of pro-environmental attitude.

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🏆 *reviewed paper*

Realexperimente als Treiber sozialer Innovationen? Umsetzungsimpulse für eine nachhaltige urbane Mobilität im Quartier

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1 ABSTRACT

Die sozial-ökologische Transformation urbaner Mobilität ist eine der wesentlichen Herausforderungen, denen sich die Mobilitäts- und Stadtplanung derzeit stellen muss. Oft scheitert die Realisierung geplanter Innovationen aus der Mobilitätsforschung allerdings am Transfer in die Praxis. Gleichzeitig deutet Vieles darauf hin, dass im Zuge der Entwicklung zur Wissensgesellschaft die Relevanz des Sozialen im Innovationsprozess weiter zunimmt. Auch bei der Planung urbaner Mobilität könnte die Synthese von Innovationen und sozialen Praktiken neue Umsetzungsperspektiven aufzeigen. Im Zentrum stehen dabei Interventionen respektive Realexperimente, in denen Gesellschaft und Raum zu einem Laboratorium des Wandels werden und Lösungsansätze für die von Unsicherheit geprägte urbane Transformation entstehen. Realexperimente machen Mobilität nicht nur im Sinne einer technologischen oder ökonomischen, sondern insbesondere einer gesellschaftlich-institutionellen Experimentierkultur sichtbar und erlebbar. Das Aufzeigen von Handlungsalternativen befördert dabei vielfältige Wirkungen - über Anregungen zum Diskurs bis zur Etablierung neuer Gewohnheiten. Als Instrumentarium sozialer Innovation im Dispositiv der Wissensgesellschaft bereits behandelt, werden im Rahmen dieser Arbeit Adaptionsmöglichkeiten im Bereich der Mobilitätsforschung aufgezeigt.

Die vorliegende Publikation legt dar, ob und wie Realexperimente Perspektiven für Innovationsprozesse urbaner Mobilität aufzeigen können. Zunächst skizziert sie dafür die Signifikanz sozialer Innovationen für eine Transformation urbaner Mobilität. In einem zweiten Schritt wird der verwendete Realexperiment-Ansatz in seiner Relevanz für soziale Innovationen definiert sowie literaturbasiert und anhand beispielhaft ausgewählter Best-Practices mobilitätsassoziierbarer Realexperimente in Beziehung zur urbanen Mobilität gesetzt. Hierauf aufbauend werden abschließend die Potenziale von Realexperimenten für soziale Innovationsparadigmen urbaner Mobilität formuliert.

Keywords: Mobilität, soziale Innovationen, Realexperimente, Transformationsforschung, Nachhaltigkeit

2 SOZIALE INNOVATIONEN UND DIE TRANSFORMATION URBANER MOBILITÄT

Bedingt durch starre Infrastrukturen, etablierte Verkehrsträger und einflussreiche Akteurinnen und Akteure, wie Automobilunternehmen, wird das Transport- und Mobilitätssystem derzeit durch ein hohes Maß an Pfadabhängigkeiten beeinflusst (Butzin/ Rabadjieva 2018: 9). Laut Wehrspaun/ Schack (2013) hat im Sinne eines Geflechtes von Wechselwirkungen die „kulturelle Dominanz des Automobils als mächtiger gesellschaftlicher Trend der letzten Jahrzehnte […] zu einer am motorisierten Inidivualverkehr ausgerichteten Verkehrsplanung und einem dementsprechend autozentrierten alltäglichen Verkehrsverhalten geführt.“ (2013: 19). Das Spektrum der negativen Externalitäten dieser Haltung, wie Lärm, Luftverschmutzung, mangelnde Aufenthaltsqualität und ein erhöhtes Unfallrisiko wirken sich wiederum mittel- und unmittelbar auf unser Gesellschaftssystem und die Lebensqualität in unseren Städten aus (vgl. ebd.). Dass ein Transformationsprozess vor diesem Hintergrund notwendig ist, gilt weitgehend als politischer Konsens und ist vielfach dokumentiert (vgl. Ruhrort 2019: 23ff.). Oftmals stehen Unsicherheiten und Unberechenbarkeiten respektive ein ‚Nichtwissen‘ politischer Entscheidungsträger im Umgang mit Innovationsdynamiken und Interessenkonflikten diesem Transformationsprozess allerdings im Weg. Institutionelle Gegebenheiten, etablierte Interessen und Allianzen (re)produzieren vielmehr mit bekannten (technischen) Problemlösungsansätzen den Status Quo.

Schon im Bericht des Club of Rome zur Lage der Menschheit heißt es allerdings: „Wir vertreten in der Tat die Ansicht, dass soziale Innovation nicht mehr länger hinter der technischen zurückbleiben darf“ (Meadows 1972: 173). Sowohl in der staatlichen Innovationspolitik als auch in der Forschungsförderung und -praxis herrscht bis dato allerdings nach wie vor ein anderes Bild. Innovation wird asymmetrisch gedacht. Die Betonung liegt auf der technischen Innovation. Die Gestaltung nachhaltiger Mobilität ist hingegen weit mehr: Zwar braucht es für die Veränderung urbaner Mobilitätsmuster in Richtung einer nachhaltigen urbanen

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Mobilität vielfältige allokative oder autoritative Ressourcen (vgl. Schneidewind/ Scheck 2013: 236 nach Giddens 1984), wie neue Verkehrsinfrastruktur für den Fuß- und Radverkehr, neue Technologien und Leitsysteme, Tempolimits oder Innenstadt-Einfahrverbote. Gleichzeitig gilt es im Zuge des Innovationsprozesses eine Vielzahl an Routinen und Normen sowie gesellschaftliche Warnehmung respektive Signifikationsmuster (Akzeptanz und Wahrnehmung der Mobilität) zu berücksichtigen. Die nachhaltigkeitspolitisch für die Transformation urbaner Mobilität relevante Bezugsgröße ist daher letztlich nicht die einzelne technische Innovation, sondern das sozio-technische System. Das Mobilitätssystem mit seiner Vielzahl an technischen Einzelaspekten und systemischen Strukturen, aber auch involvierten Sektoren, Entscheidungs- und Wirkungsebenen, die im Kontext der Transformation bedacht werden müssen (Lange 2010: 2015). Demnach können technische Potenziale in Richtung Nachhaltigkeit nur ausgeschöpft werden, wenn sich auch die sozialen Praktiken entsprechend verändern (Schwarz et al. 2010: 169). Das macht es für Wissenschaft und Praxis notwendig, auch im Kontext der Mobilitätstransformation, die Relevanz des Sozialen bereits im Innovationsprozess (vgl. Howaldt/ Jacobsen 2010: 9ff.) zu fokussieren. Soziale Innovationen, die an Kommunikationen, Interaktionen, Institutionen, Akzeptanzen und Funktionalitäten appelieren, können dabei „auch und gerade gegen den Widerstand von Gewohnheit, Unsicherheit und etablierte Interessen“ (vgl. Zapf 1994) neue Problemlösungsverfahren aufzeigen und ermöglichen (Aderhold 2010: 121).

2.1 Soziale Innovationen im Transformationsdiskurs

Im Kontext eines Übergangs von der Industrie- zur Wissens- bzw. Dienstleistungsgesellschaft vollzieht sich auch ein Paradigmenwechsel im Innovationssystem. Systemische, auf Netzwerkbeziehungen beruhende Innovationsmodelle, in denen Akteurinnen und Akteure in einem interaktiven Prozess im Sinne einer Experimentierkultur neue (soziale) Praktiken und Artefakte entwickeln, ersetzen lineare Innovationsmodelle. Die Innovationsmuster der Gegenwart werden dadurch komplexer. Sie sind von Rückkopplungsschleifen und nutzer-induzierten Innovationen geprägt und zeichnen sich nicht mehr in erster Linie durch die Wirkung von technologischen, sondern ebenso durch gesellschaftliche Entwicklungen aus (Joly/ Rip 2012: 218). Damit öffnet sich der Innovationsprozess hin zur Gesellschaft. "An die Stelle eines stark auf die Rolle der Wissenschaft als Impulsgeber und Innovationstreiber fokussierten Modells tritt ein Modell, in dessen Rahmen Nutzer, Anwender, Verbraucher verstärkt einbezogen und die Gesellschaft selbst zum Ort von Innovationen wird." Laut Howaldt/ Jacobsen (2010) schärfen teilweise erheblich zunehmende Problemlagen im Zusammenhang mit Veränderungsdynamiken in Wirtschaft, Gesellschaft, Kultur und Natur „das Bewusstsein eines nur eingeschränkten Problemlösungspotenzials technologischer Inovationen sowie etablierter Steuerungs- und Problemlösungsroutinen“ (2010: 11). Anstatt der als 'natural and technical science driven' klassifizierten Steuerungsmodelle, gewinnen 'social science driven'-Modelle, deren integrativer Bestandteil sektorenübergreifende Leitbilder, soziale Experimente und Lernprozesse darstellen, zunehmend an Relevanz (Schwarz/ Howaldt 2013).

Was genau ist gemeint, wenn hier von Innovationen die Rede ist? Nach Schumpeter (1947) und Rammert (2007) „sind Innovationen endogene, gesellschaftliche Prozesse des schöpferischen und abweichenden Experimentierens und (Re-) Kombinierens mit unsicherem Ausgang“ (Kropp 2013: 89). Harvey Brooks (1982) nimmt dabei folgende Klassifikation der unterschiedlichen Innovationstypen vor: Er unterscheidet zwischen nahezu ausschließlich technischen Innovationen (neue Materialien), sozio-technischen Innovationen (Infrastruktur für die private Motorisierung) und sozialen Innovationen (Aderhold 2010: 115f). Innovationen sind in diesem Verständnis keine gesellschaftsexternen Artefakte, sondern Prozesse in deren Kontext verschiedenste Akteurinnen und Akteure strukturelle (technologisch und soziale) Erneuerungsmöglichkeiten ausloten, sie so verknüpfen, dass die bestehende Routinen in Frage gestellt weden und im Erfolgsfall neue Routinen entstehen (vgl. ebd.). Innovierendes Forschen ist somit kein Privileg der Wissenschaft mehr; ebenso haben Bürgerinnen und Bürger an wissenschaftlichen Prozessen teil (Best 2018: 102). Im Sinne des Transformationsdiskurses vollzieht sich der nachhaltige Wandel sozio-technischer Systeme damit als Systeminnovation, ein erfolgsversprechender Ansatz der Kombination technologischer und sozialer Aspekte, mit dem Ziel integriertere und umfassendere Veränderungsprozesse zu generieren (Schneidewind/ Scheck 2013: 231). Denn, laut Schneidewind/ Scheck (2013) sind technologische Innovation für sich genommen anfällig für Problemverschiebungen und Rebound-Effekte (vgl. ebd.). Die Integration sozialer Innovationen hingegen, erhöht im Kontext der nachhaltigen Entwicklung die Wahrscheinlichkeit "richtungssicherer ökologischer Entlastungen" (ebd. 232).

Nach der verbreiteten Definition von Howaldt/ Schwarz (2010) sind soziale Innovationen „eine von bestimmten Akteuren bzw. Akteurskonstellationen ausgehende intentionale, zielgerichtete Neukonfiguration sozialer Praktiken in bestimmten Handlungsfeldern bzw. sozialen Kontexten, mit dem Ziel, Probleme oder Bedürfnisse besser zu lösen bzw. zu befriedigen, als dies auf der Grundlage etablierter Praktiken möglich ist“ (2010: 89). Als soziale Innovationen gelten u.a. neue Governance-Formen, neue Muster der Arbeits- und Unternehmensorganisation, neue Produkt- und Dienstleistungssysteme oder neue Konsummuster (Schneidewind/ Scheck 2013: 230). Das entscheidende Kriterium, wonach aus einer sozialen Invention eine soziale Innovation wird, ist ihre Institutionalisierung respektive ihre Transformation in eine Praktik, die geplant oder ungeplant in die Gesellschaft diffundiert. Nach Rogers (2003: 5) ist Diffusion der Prozess „in which an innovation is communicated through certain channels over time among the members of a social system“. Die Diffusion sozialer Innovation verläuft dabei nach im Sinne einer Adoptionskurve: Beginnend mit der Gruppe der experimentierfreudigen und risikoaffinen 'Innovatoren' über die für den innovationsbereiten Mainstream meinungsbildenden 'frühen Adopter' und die von diesen beeinflussten 'frühen und späten Mehrheiten' hin zur 'kritischen Masse' (2003: 343). Damit ist der Diffusionsprozess abgeschlossen und die Innovation durchgesetzt“ (Howaldt/ Schwarz 2010: 94). Im Laufe des Diffusionsprozesses wird jede Innovation also kontextspezifisch transformiert (Howaldt/ Schwarz 2010: 93). Anders als technologische Innovationen sind soziale Innovationen daher in weitaus stärkerem Maße von ihrer kontextuellen Einbettung abhängig. Nicht unbedingt gehen dabei die Transformationsimpulse von zivilgesellschaftlichen Akteurinnen und Akteuren selbst aus. Eine Neukonfiguration von Alltagspraktiken kann beispielsweise ebenso durch externe Schocks oder massive staatliche Intervention veranlasst und durchgesetzt werden (vgl. Stiess 2013: 36). „Wie bei jeder anderen Innovation bedeutet ‚neu‘ daher nicht per se ‚gut‘ beziehungsweise in einem umfassenden und normativen Sinne ‚sozial erwünscht‘“ (Schwarz/ Howaldt 2013: 56). Die ‚soziale Akzeptanz‘ die zur Verbreitung, Institutionalisierung und Adaptierung führt, ist nur möglich, wenn neue soziale Praktiken und ihre Wirkungen von unterschiedlichen Zielgruppen und in gesellschaftlichen Segmenten akzeptiert, positiv bewertet und schließlich zur Routine werden (Stiess 2013: 37).

Ausgehend von dieser Definition lassen sich manigfaltige neuartige Konsumpraktiken und kollektive Nutzungsformen, die im Verhältnis zu herkömmlichen Konsummustern auf eine veränderte (nachhaltige) Nutzung, Instandhaltung oder Beseitigung von Produkten und Dienstleistungen im sozio-technischen Versorgungssystem zielen, als soziale Innovationen klassifizieren (ebd.: 35f). Ebenso stellt aber auch die Etablierung neuartiger Akteurskonstellationen und Netzwerke eine soziale Innovation dar. Vor dem Hintergrund der vorangegangenenen Ausführungen verwundert es allerdings nicht, dass soziale Innovation nach wie vor weniger ein spezifisch definierter Fachbegriff mit einem eigenen und abgrenzbaren Gegenstandsbereich ist, sondern meist als eine Art deskriptive Metapher im Kontext von Phänomenen des sozialen Wandels verwendet wird (Hoffmann-Riem 2008: 589).

2.2 Soziale Innovationen in der Mobilität

Das Konzept der sozialen Innovation stellt für Transformationsprozesse der urbanen Mobilität in mehrfacher Hinsicht einen vielversprechenden konzeptionellen wie auch umsetzungsorientierten Ansatz dar. Zum einen geht es darum, Veränderungen kollektiver Verhaltensweisen jenseits technologischer oder marktförmiger Kontexte zu verstehen. Zum anderen verbindet sich mit diesem Verständnis auch die Erwartung, die Herausbildung, Verbreitung und Stabilisierung der alternativen Alltagspraktik respektive Potenziale einer nachhaltigen Mobilität befördern zu können (Stiess 2013: 34).

Wie Joly/ Rip (2012) anmerken, existiert gerade im Verkehrssektor ein „Regime der Ökonomie techno-wissenschaftlicher Versprechen“ (2012: 223). Zur Minimierung spezifischer Umweltauswirkungen werden insbesondere die Nutzung von Synergieeffekten und verbesserter, vernetzter Planung sowie technische Innovationen, wie Elektromobilität und intelligente Verkehrsleitsysteme als Lösungsstrategien berücksichtigt. Die Verbesserung respektive Optimierung einzelner Verkehrsträger stellt allerdings nur eine Strategie einer nachhaltigen Mobilitätstransformation dar. Sie sollte eigentlich erst dann in Kraft treten, wenn sich Verkehr weder vermeiden noch verlagern lässt. In diesen strategischen Bereichen (Vermeidung und Verlagerung) sind soziale Innovationen angesiedelt. Sie fossieren im Sinne der Verlagerung eine an den Bedürfnissen der Nutzenden orientierte Verknüpfung verschiedener Mobilitätsformen des Umweltverbundes und somit ein multimodales Mobilitätsverhalten als neue soziale Praxis. Im Kontext der Vermeidung treten

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zudem Strategien der Unternehmens- und Arbeitsorganisation (Homeoffice-Konzepte, E-Learning, E-Governance) und neue Konsummuster (Fahrgemeinschaften, Car-Sharing) in Kraft. An diesen Beispielen wird deutlich, dass Mobilität als soziale Praxis verstanden werden muss, die sowohl durch strukturelle als auch individuelle Einflussfaktoren konstruiert wird und sie wiederrum selbst rekonstruiert. „Begreift man zum Beispiel die heute dominante Praxis monomodaler Automobilität, macht der Begriff sozialer Praktiken deutlich, dass diese Praxis auf einem spezifischen Arrangement von gesellschaftlich geprägten Bedeutungszuschreibungen zu wünschenswerten und erstrebenswerten Vorstellungen von Flexibilität und ‚Individualität', zugleich aber auch auf mit extremem Aufwand geschaffenen materiellen Infrastrukturen basiert" (Ruhrort 2019: 62). Soziale Innovationen, die eine nicht-motorisierte Mobilität, wie Fahrrad fahren oder zu Fuß gehen fördern oder eine gleichzeitig finanzierbare, gesunde und umweltfreundliche Mobilität im Nahraum ermöglichen, können daher in Kombination mit technologischen Entwicklungen entscheidende Potenziale zur Transformation freilegen (Stiess 2013: 39).

Da sich die vorliegende Publikation an der Umsetzungsebene sozialer Innovationen orientiert, sollen im Folgenden kurz die Praxisfelder sozialer Innovationen, die relevanten Akteurinnen und Akteure sowie Treiber und Barrieren im Kontext urbaner Mobilität skizziert werden. Dabei lassen sich exemplarisch (vgl. Butzin/ Rabadjieva 2018) zunächst drei Cluster unterscheiden: Grüne Mobilität (Ko-Modalität, Nutzen statt Besitzen, Elektromobilität, Multi-Modalität), langsame Mobilität (Integrierte Maßnahmen zur Förderung des Fuß- und Radverkehrs mit stark lokalem Fokus) und Zugang/ Inklusive Mobilität (Verbesserung der Mobilität für Menschen mit Behinderung) (ebd.: 3). Die Akteurinnen und Akteure (Unternehmen, lokalen öffentlichen Akteure, NGOs, Nutzende), die sich in diesen Praxisfeldern betätigen, unterscheiden sich meist deutlich von denjenigen des klassischen Verkehrssystems (Automobilhersteller, Verbände, Mobilitätsdienstleister) (vgl. ebd. 1f).

Obwohl finanzielle Ressourcen für die Entwicklung sozialer Innovationen in der Mobilität nicht zwangsweise ein treibender Faktor sind, stellen sie – sofern nicht ausreichend vorhanden – mitunter die größte Entwicklungsbarriere dar (Butzin/ Rabadjieva 2018: 8). Die zentralste Barriere besteht allerdings im Diffusionsprozess sozialer Innovationen. Das liegt schon in der Natur der Sache: Wie bereits angemerkt, besteht die Grundidee sozialer Innovationen darin, der Komplexität der an Veränderungsprozessen beteiligten Akteurinnen und Akteure und ihrer wechselseitigen Dynamiken dadurch gerecht zu werden, dass man auf lineare Steuerungskonzepte verzichtet. Dabei geht es im Sinne einer ‚good governance' primär um die aktive und breite Einbindung gesellschaftlicher Akteurinnen und Akteure in die Entwicklung und Umsetzung politischer Veränderungskonzepte – zum Zweck der Mobilisierung (Lange 2010: 206). Oftmals sind soziale Innovationen dementsprechend auch im Handlungsfeld der Mobilität stark in lokale Kontexte wie Quartiersentwicklungsprozesse eingebunden, angepasst und vom örtlichen bürgerschaftlichen Engagement abhängig. „Diese tiefe räumliche Verwobenheit und die damit ebenfalls zusammenhängende sozio-kulturelle Einbettung erschweren die Diffusion/Verbreitung der dahinterstehenden Kernidee, durch die sie auch in anderen Städten/Regionen Anwendung finden würde" (Butzin et al. 2013: 8). Im Sinne eines Barriereabbaus im Diffusionsprozess werden Netzwerkbeziehungen zum entscheidenden Treiber (Howaldt/ Schwarz 2010: 94). Horizontale Akteursnetzwerke sind dabei erfolgreicher, wenn sie sich auf die Unterstützung von Schlüsselpersonen und -institutionen aus dem politisch-administrativen System berufen können, die den erforderlichen Wandel deutlich und andauernd priorisieren, legitimieren und kommunizieren (Butzin/ Rabadjieva 2018: 7). Dazu gehört auch die politischen (Förder-) Maßnahmen stärker integrativ-synergistisch und explorativ-partizipativ auszurichten, günstige Rahmenbedingungen für soziale Innovationen zu schaffen und sie mithilfe einer adäquaten Umwelt- und Nachhaltigkeitskommunikation zu verbreiten (Wehrspaun/ Schack 2013: 29). Das bedeutet, mit dem Wandel der politischen Entscheidungskultur einer ‚good governance' im Zuge der Demokratisierung des Innovationsprozesses (vgl. Blättel-Mink 2013: 156), nimmt das Gewicht der staatlichen Institutionen nicht etwa ab, sondern zu. Auch die Akteurinnen und Akteure der Wissenschaft, nehmen sie denn ihre Rolle als aktive (Mit)Gestalterinnen und (Mit)Gestalter sozialer Innovation an, sind im Zuge dessen als Treiber zu berücksichtigen. Insbesondere deswegen, da es bei sozialen Innovationen auch immer darum geht, „das gesellschaftliche Wissen, das zu Problemdefinition, Problemlösung wie Kommunikation der Veränderungsansätze (Co-Design, Co-Communication, Co-Production) beiträgt, in strukturierter Form mit der Wissenschaft in den Austausch [zu] bringen" (Howaldt et al. 2010: 362).

3 EXPERIMENTELLE ANSÄTZE IN DER MOBILITÄTSPLANUNG: REALEXPERIMENTE ALS TREIBER SOZIALER INNOVATIONEN

Soziale Innovationen im Sinne eines Treibers des sozialen Wandels erweisen sich den vorangegangenen Ausführungen zufolge meist als Produkt eines Systemgrenzen überschreitenden Mechanismus des „kollektiven Experimentierens“ in der Gesellschaft (Kropp 2013: 94). Sie richten den Fokus auf die experimentelle Gestaltung sozialer Praktiken und über Nachahmung auch auf alternative Formen der Verbreitung und Institutionalisierung des Wandels (Howaldt et al. 2018: 367). Die ‚Krise der Mobilität‘ selbst löst einen gesellschaftsweiten experimentellen Aushandlungs- und Verarbeitungsprozess aus, dem es auf der (lokalen) Ebene der Realwelt zu begegnen gilt. Um den Prozess der Mobilitätstransformation durch die Gestaltung sozialer Innovationen aktiv anzustoßen, benötigt es ein Zusammenspiel unterschiedlicher disziplinärer Wissensbestände, eingebettet in einen transdisziplinären Kontext, in dem Akteurswissen gleichberechtigt mit einfließen kann (Schneidewind/ Scheck 2013: 233). Auf der Suche nach alternativen Problemlösungsansätzen und Treibern sozialer Innovationen fällt daher der Blick auf Realexperimente. Experimente außerhalb des Labors, in denen alltagspraktische Unberechenbarkeiten eine konstruktive Methodik zur Generierung neuer Erkenntnisse darstellen. Das Soziale selbst wird zum gesellschaftlich-institutionellen Lernprozess; durch das Ausprobieren kultureller Praktiken, partizipativer Stadtentwicklung, neuer gesellschaftlicher Organisation und alternativer Lebensstile. Dabei ist von großer Relevanz, dass Strategien anerkannten, theoriebasierten Wissens mit der Erzeugung neuen, praxisrelevanten Wissens im Kontext von gesellschaftlichen Problemstellungen reflexiv kombiniert werden (ebd.). In diesem Sinne besteht eine wesentliche Herausforderung der Mobilitätsplanung sowie der sie unterstützenden Wissenschaftsbereiche darin, analog zur Transition von 'natural and technical science driven' zu 'social science driven'- Innovationsmodellen (vgl. Kapitel 2.1), die klassische Auffassung des Begriffes des ‚Experimentes‘ als kontrollierte Labor- und Experimentsituation zu überwinden und zu Realexperimenten weiterzuentwickeln (Schneidewind/ Scheck 2013: 229). Der Gedanke an sich ist nicht neu: Schon die Sozialwissenschaften des frühen 20. Jahrhunderts (Chicago School) nutzen die Idee der ‚Stadt als Labor‘, um die alltägliche soziale Praxis von Anwohnerinnen und Anwohnern in ihren Quartieren selbst als Prozess des Experimentierens, der letztendlich zu sozialem Wandel führt, zu untersuchen. Im Unterschied zur experimentellen Soziologie der Chicago School beziehen sich aktuelle Transformationsdiskurse hingegen auf ein vollkommen verändertes Bild von Gesellschaft. Der Wissensgesellschaft in der (wissenschaftliches) Wissen eine enorme gesellschaftliche Rolle spielt. In dieser bilden neue Formen der Wissensproduktion die Basis und das Instrumentarium einer disziplinen- und sektorübergreifenden Reflektion, um mit der Durchsetzung von innovativen sozialen Praktiken, Transformation aktiv zu gestalten (Schwarz/ Howaldt 2013: 66). Der Hypothese, dass ein Wissenstransfer, der einer 'Einbahnstraße' gleichend die Forschungsergebnisse der Wissenschaft in die Praxis überträgt, eine gegenseitige Beeinflussung von Wissensgenerierung oder -anwendung nicht zulässt und darüber gesellschaftliche Transformation blockiert (vgl. Ober 2018: 386), werden dementsprechend neue Konzepte der Aushandlung und Verarbeitung von Wissen entgegengebracht. Anstatt reiner Grundlagen- und Begleitforschung treten sektorenübergreifende und transdisziplinäre Ansätze, die Transformation über die Entwicklung sozialer Innovationen unterstützen, als Realexperimente auf die Forschungsagenda (Howaldt et al. 2018: 364). „Ziel urbaner Realexperimente ist es, Wissen zu generieren, dass sowohl an die wissenschaftliche Debatte anschlussfähig ist als auch praxisrelevante Impulse für das Handeln diverser Akteurinnen und Akteure anbieten kann“ (Schneidewind/ Scheck 2013: 245).

3.1 Realexperimente als rekursive Lernprozesse

Unter dem Begriff Realexperiment verstehen Groß et al. (2005) eine Form des Experimentierens „außerhalb des naturwissenschaftlichen Labors“ (2005: 11). Als Teil komplexer und dynamischer gesellschaftlicher Prozesse ist es nicht von seiner (sozialen, kulturellen oder natürlichen) Umwelt trennbar. Laut Schneidewind/ Scheck (2013) bezeichnen Realexperimente im Gegensatz zu Laborexperimenten, Experimente in der Gesellschaft selbst. Es handelt sich um selektive Interventionen, die zum Ziel haben einen Veränderungsprozess anzustoßen (Schneidewind/ Scheck 2013: 240). Laut Groß (2014) bilden diese Interventionen die (lokalen) Anknüpfungspunkte für die (globalen) gesellschaftlichen Herausforderungen, denen mit neuartigen kulturellen Praktiken, partizipativer Stadtentwicklung, alternativen Lebensstilen oder neuen, innovativen Technologien begegnet werden soll (2014: 12). Dennoch, bis dato existiert noch kein einheitlicher Theoriezugang zu Realexperimenten als Beschreibungs- und Analysekatgorie der

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transformativen Forschung. So konstatiert Best (2018), dass die Verwendung des Begriffs des Realexperimentes im Kontext einer Experimentalrhetorik noch offenlässt, welche Kernelemente wie zu konstituieren sind (2018: 116).

Laut Groß et al. (2005) lassen sich dennoch zentrale Schlüsseleinsichten hervorheben (2005: 76ff.): Erstens besteht eine bedeutende Charakterisierung in der Annahme, dass Wissensanwendung eines bereits erprobten Wissensbestandes in neuen Umgebungen immer auch mit einer erneuten Wissenserzeugung einhergeht (Groß et al. 2005: 15). Dieser iterative Prozess der Verknüpfung von Wissenserzeugung und -anwendung wird im folgenden als rekursives Lernen bezeichnet. Der Techniksoziologe Wolfgang Krohn (2007) beschreibt rekursives Lernen „als einen Prozess einer allmählichen Beherrschung einer komplexen Handlungssituation, bei dem jeder wissensbasierte Lernschritt in praktisches Können übersetzt wird“ (Best 2018: 110). Zweitens, konzentrieren sich Realexperimente auf die Implementation von Interventionen in realen gesellschaftlichen Kontexten, dienen also einem gesellschaftswissenschaftlichen Erkenntnisinteresse und rangieren jenseits des klassisch-modernen Abgrenzbarkeit von Wissenschaft und Gesellschaft (vgl. Best 2018: 10; Schmidt 2017: 48).[1] Damit geht ein nur eingeschränkter Grad der Kontrollier- bzw. Reproduzierbarkeit der Rahmenbedingungen einher, in denen sich Realexperimente bewegen. Das hat zur Folge, dass sie nicht auf die gleiche Weise kontrollierbar, reproduzierbar und reversibel sind wie bspw. Laborexperimente (Best 2018: 109).

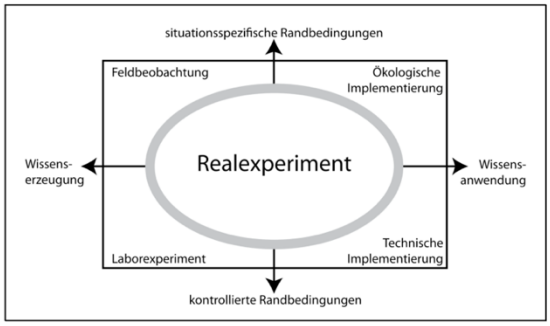

Abbildung 1: Einordnung von Realexperimenten in die Typologie des Experimentierens (Groß et al. 2005: 19).

Anhand dieser Grundannahmen lassen sich Realexperimente in eine ‚Typologie des Experimentierens‘ (vgl. Groß et al. 2005: 16ff) einordnen. Dernach können vier verschiedene Idealtypen des Experimentierens ausgemacht werden, die sich über ihren Grad der oben gennanten Dimensionen Wissensanwendung und -erzeugung (rekursives Lernen) sowie dem Grad der Kontrollierbarkeit von Randbedingungen (vgl. Abbildung 1) definieren. Realexperimente verbinden den vorangegangenen Ausführungen entsprechend, nach Groß et al. (2005) die Merkmale der vier Idealtypen der ökologischen und technischen Implementierung, des Laborexperimentes und der Feldbeobachtung (ebd.: 19).

Aus diesem Umstand resultieren die bereits zuvor angedeuteten veränderten Anforderungen an die Wissenschaft. Wenn davon ausgegangen wird, dass „Wissensproduktion nicht mehr als exklusives Terrain der Wissenschaft betrachtet werden kann, sondern Interdisziplinarität, Transdisziplinarität und Partizipation zum Normalfall werden, dann wird Forschung zu einem offeneren, öffentlicheren und vor allem heterogeneren Unterfangen“ (Bogusz 2018: 348). Wissenschaft und Praxis können daher im Rahmen von Realexperimenten zum einen durch neue Formen rekursiven Lernens und zum anderen bedingt durch ein neues Innovationsparadigma in Wechselwirkung treten und neue Problemlösungsansätze in Gestalt von sozialen Innovationen hervorbringen (Howaldt et al. 2018: 371). Realexperimente bieten dabei die Räume und Ressourcen zur Schaffung eines ‚Innovationsmilieus‘ (vgl. ebd.). Um die Neukonfiguration sozialer Praktiken im Rahmen von Realexperimenten von anderen Prozessen der Wissensproduktion abzugrenzen, betonen Howaldt et al. (2018) insbesondere den Aspekt der intentionalen Gestaltung: Die Transformation sozialer Praktiken verliert ihren formlosen Charakter. Sie wird zum Gegenstand eines Realexperiments, im

[1] Abzugrenzen ist es daher auch vom Konzept des Reallabors: Obwohl die Grenzen zwischen Realexperimenten und Reallaboren im Sinne einer Institutionalisierung von Experimental-Settings in der realen Welt nicht vollkommen eindeutig sind, liegt ein signifikanter Unterschied in ihrer Konzeption. Während Realexperimente „als Konzept zur Beschreibung und Analyse von Experimentalsituationen eingebracht wurden, [sind] Reallabore ein Vorschlag für die aktive Institutionalisierung von partizipatorischen Methoden der Nachhaltigkeitswissenschaften“ (Best 2018: 103).

Zuge dessen sie unter kontrollierten Bedingungen entwickelt, erprobt und evaluiert wird (ebd.: 367). Realexperimente sind daher als der Rahmen zu verstehen, in dem Wissenschaft und Gesellschaft sich aktiv und reflexiv mit der Neukonfiguration sozialer Praktiken auseinandersetzen, um darüber soziale Innovationen zu gestalten (ebd.).

3.2 Realexperimente in der Mobilität: Potenziale urbaner Experimentierräume für soziale Innovationen

Um diesen Rahmen zu generieren, wächst im Kontext der Frage nach den Potenzialen sozialer Innovationen in der Mobilität die Bedeutung urbaner Räume: Mobilität selbst zeichnet sich durch ein hohes Maß an raumbezogenheit aus. Im Kontext sozialer Innovationen wiederum kann laut Aderhold et al. (2015) die Stadt als Experimentierraum auf dem Weg zur Nachhaltigkeitstransformation einen besonderen Stellenwert einnehmen. Als Träger sozio-technischer Systeme ist sie sowohl Ort gesellschaftlichen Lebens, als auch Ausgangspunkt für Veränderungsprozesse und damit per se Experimentierraum (Schneidewind/ Scheck 2018: 242). Diesem Verständnis folgend sind Städte die ‚Boundary Objects' von Realexperimenten im Kontext urbaner Mobilität; das heißt Bezugsobjekte, die es unterschiedlichen Akteurinnen und Akteure und Disziplinen ermöglichen, ihre Wissensbestände auf einen gemeinsamen Punkt zu beziehen und im Sinne rekursiven Lernens ebenso zu generieren. Realexperimente brauchen demzufolge zunächst Räume, um die Etablierung neuer Signifikationsmuster, wie eine veränderte gesellschaftliche Wahrnehmung oder die Ausbildung neuer Routinen respektive die Etablierung neuer Mobilitätspraktiken zu ermöglichen. Als (lokaler) Anknüpfungspunkt für die (globalen) gesellschaftlichen Herausforderungen (vgl. Groß 2014: 12) wird daher die Raumeinheit ‚Quartier' (vgl. Schnur 2014) relevant. Das Quartier als Ort der Alltagspraxis einer urbanen Mobilität und als Raum, in dem sich Verkehrssysteme in Form von Mobilitätsdienstleistungen, -angeboten und -restriktionen, wie Parkplätzen, ÖPNV-Verbindungen oder der Gestaltung des öffentlichen Raums manifestieren und darüber die Verkehrsmittelwahl beeinflussen.

In diesen Experimentierräumen setzt in vielen europäischen und internationalen (Groß-)Städten die Stadtplanungspraxis mithilfe von Realexperimenten an, deren erklärtes Ziel es ist, Innovationen und Systemänderungen durch temporäre Umorganisationen des Verkehrs oder Neuverteilung und Umgestaltung des öffentlichen Raums zu fördern. Etablierte Verhaltensweisen sollen dabei hinterfragt und in einem gesellschaftlichen Aushandlungsprozess neue Praktiken zu erprobt werden (Reallabor für nachhaltige Mobilitätskultur 2017: 26). Die „Destabilisierung nicht-nachhaltiger Strukturen" (Newig 2013: 138) im Sinne einer Krisensituation öffnet dabei Gelegenheitsfenster für innovative Ansätze. Dieses Prinzip nutzend, können Realexperimente über die Schaffung externer Veränderungsanlässe zu einer (zumindest partiellen) Reflexion von Mobilitätspraktiken und weiterführend zu Routinebrüchen führen, da sie von den Akteurinnen und Akteuren eine konkrete Auseinandersetzung mit einer bestehenden Praxis in ihrem Alltag erfordern (John 2013: 128).

Ein Beispiel für ein solches Realexperiment ist der Tag des Guten Lebens. Seit 2013 werden im Rahmen einer experimentellen Intervention durch eine zivilgesellschaftliche Allianz rund um die Agora Köln unterschiedliche Stadtviertel für einen Tag zu urbanen Räumen ohne ruhenden oder fahrenden Verkehr. An einem autofreien Tag werden Straßen und Plätze für den motorisierten Verkehr gesperrt und der Raum so umfunktioniert, dass er in unkommerzieller Form durch die Stadtgesellschaft bespielt werden kann (vgl. Brocchi 2016: 88). Dabei soll der Verzicht auf Automobilität und Anonymität aufzeigen, „welche gesellschaftlichen Potenziale ein autofreies Leben in Stadt hat und dass der Verzicht auf ein Fahrzeug keinen Verlust darstellt im Kontext dessen, dass alle verzichten" (Best 2018: 111). Auch die Stadt Wien bedient sich dieser temporären Öffnung von Straßen für aktive Mobilität, um durch experimentelle Vorwegnahme eine gesteigerte Aufenthaltsqualität erlebbar zu machen und dahingehend konkrete langfristige planerische Gestaltungsprojekte zu testen. So heißt es im Fachkonzept Mobilität: „Wichtig für die Akzeptanz ist eine anfängliche, impulsgebende Belebung durch Aktionen im öffentlichen Raum, damit die neue Qualität des Raumes spürbar wird. Längerfristig sollen temporäre Fußgängerinnen- und Fußgängerzonen ohne die Bespielung durch die Stadt Wien auskommen." (MA 18 2015: 51) Über das Ziel, kostengünstig und schnell neuartige Konsumpraktiken und kollektive Nutzungsformen im urbanen Raum sichtbar- und erlebbar zu machen hinaus, sind diese Experimente insbesondere Treiber einer Etablierung neuartiger Akteurskonstellationen und Netzwerke, die in sich selbst eine soziale Innovation darstellen. So ist der Tag des guten Lebens ein Experimentierraum für neue Praktiken der (politischen) Partizipation (Brocchi 2016:

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93). Aus einem temporären Aktionstag ist so mittlerweile eine dauerhafte politische Initiative entstanden, die sich im Rat der Stadt etabliert hat und für eine alternative Verkehrspolitik einsetzt (Best 2018: 111). Der Tag des guten Lebens ist daher ein Beispiel dafür, wie mit Realexperimenten Wirkungen in anderen Politik- und Planungsbereichen erzielt werden können und begegnet darüber einer Diffusionsproblematik sozialer Innovation. Da es sich bei dieser Form des Experimentes nicht um ein wissenschaftliches Forschungsprojekt handelt, sondern um ein durch die Zivilgesellschaft initiiertes Realexperiment, trägt es zusätzlich der Tatsache Rechnung, dass innovierendes Forschen kein Privileg der Wissenschaft mehr ist; gleichzeitig stellt es nach Meinung der Autorin im Kontext der mit Mobilität assoziierbaren Realexperimente bislang eher die Ausnahme dar.

Rekursive Lernprozesse erfolgen bis dato eher zwischen Wissenschaft und Praxis. In diesem Sinne erarbeitete und erprobte das Reallabor für nachhaltige Mobilitätskultur, von 2015 bis 2017 neue „Lösungen für eine Mobilitätskultur, die Ressourcen schont, Gesundheit und körperliche Bewegung unterstützt, sozialen Austausch fördert und neue Lebens- und Aufenthaltsqualitäten schafft“ (Reallabor für nachhaltige Mobilitätskultur 2017: 27). Eines dieser Realexperimente (Die Stäffele-Galerie) befasst sich mit dem Potenzial wenig genutzter Mobilitätskorridore im öffentlichen Raum. Die für Stuttgart stadtbildprägenden Stäffele wurden dabei im Rahmen verschiedener Veranstaltungsformate zu Begegnungsorten. Über die Attraktivierung wenig genutzter urbaner Räume mithilfe der Förderung sozialer Praktiken (Verantwortungsübernahme, Belebung, Gestaltung, kreativer Nutzung), sollen Nachbarschaften über neue Bewegungsräume verbunden werden und entstehen. Diese fördern wiederum neuartige soziale Praktiken, wie nachhaltige Konsummuster (gemeinschaftliche Nutzung von Gütern) und eine Identifikation mit dem Stadtraum (ebd.: 32f). Die wissenschaftliche Evaluation des Realexperimentes ergab dabei, dass durch den konkreten lokalen Bezug „auf diese Weise auch Menschen zur Teilnahme motiviert werden, welche bei herkömmlichen Beteiligungsformaten normalerweise nicht anzutreffen sind“ (ebd.).

Dieses Realexperiment-Design adressiert damit zwei signifikante Dilemmas sozialer Innovationen (vgl. Kapitel 2.2): Zum einen geht es um Kommunikation und Planung urbaner Mobilität, die nicht nur eine Vielfalt der Nutzungen sondern auch eine Diversität der Nutzenden addressiert. Die Vermittlung nachhaltiger Mobilität in Form von Beratung und Bildung, aber vor allem auch Planung erfolgt oftmals ohne jede Differenzierung bezüglich Geschlecht, Lebensform und -stil oder verschiedenen soziokulturellen Milieus. Dabei bestimmen insbesondere diese Faktoren Mobilitätsansprüche und -verhalten (MA 18 2013: 73). Eine Kontextualisierung nachhaltiger Mobilität nicht nur in räumliche, sondern auch in gesellschaftliche Strukturen ist insbesondere deswegen relevant, da laut Stiess die Verbreitung, Übernahme und Adaptierung sozialer Innovationen nur dann möglich ist, wenn neue soziale Praktiken und ihre Wirkungen von unterschiedlichen Zielgruppen akzeptiert und positiv bewertet werden (2013: 37). Realexperimente bieten die Möglichkeit diese Kontextualisierung vorzunehmen.

Zum anderen können durch Realexperimente nicht nur Planungen an bestehende Bedarfe angepasst, sondern aktiv ein Miteinander im Verkehr erarbeiten und umgesetzt werden. Wie Ober (2018) bemerkt, ist dieser Prozess in der besonders heterogenen und nicht widerspruchsfreien Wissensgesellschaft eine sehr aufwendige Aufgabe, die nur mit den Zielgruppen gemeinsam erarbeitet werden kann (2018: 385). Das bedeutet allerdings nicht, dass eine generelle Einbindung der Öffentlichkeit erfolgen muss. Vielmehr gilt es im Rahmen von Realexperimenten das selektive Engagement von Gruppen zu stärken. Was bei der Beteiligung in zivilgesellschaftlicher Expertise in anderen Forschungsformaten oftmals nicht die Regel ist – allein die Wissenschaftlerinnen und Wissenschaftler formulieren die Forschungsfragen und -ziele, während die Akteurinnen und Akteure der Zivilgesellschaft erst später in den Prozess aufgenommen werden (vgl. Ober 2018: 386) – ist in Realexerimenten ausdrücklich erwünscht. Die Akteurinnen und Akteure der Zivilgesellschaft bringen im Rahmen der Entwicklung und Durchführung von Realexperimenten (Co-Creation, Co-Design) andere Wissensbestände mit in Innovationsprozesse ein. So können nicht nur neue Umsetzungsimpulse entstehen, sondern ebenso eine Shared Ownership für ein Projekt und gesellschaftliche Transformation (vgl. ebd.).

Lösungsansätze für ebendiese Problematik der Kommunikation, Erarbeitung und Umsetzung neuer und bestehender Potenziale zu generieren, ist Gegenstand des jüngst mit dem Deutschen Nachhaltigkeitspreis ausgezeichneten Forschungsprojektes Reallabor GO Karlsruhe. Ein Projekt der Hochschule Karlsruhe – Technik und Wirtschaft, das im Rahmen von Realexperimenten neue soziale Praktiken im Sinne von dynamischen Partizipationsmöglichkeiten rund um das Thema Zu Fuß gehen erforscht (vgl. Häußler/

Blaszczyk 2019). Im Forschungsprojekt wurden zwei übergeordnete Ziele miteinander verknüpft: Zu Fuß Gehende sollten mithilfe neuartiger, niederschwelliger Beteiligungsformate und digitaler Partizipationsinstrumente eingebunden und darüber der Fußverkehr gefördert werden. Dabei erfolgte schon die Auswahl der Experimentierräume über die digitalen Partizipationswege im Straßenraum oder auf klassischen Beteiligungsformen wie Bürgerveranstaltungen (ebd.: 4). Die insgesamt sechs Realexperimente selbst, wurden dahingehend im Stil eines tactical urbanism[2] Ansatzes mit geringer finanzieller Belastung durchgeführt und griffen die von den Zu Fuß Gehenden selbst evaluierten Probleme im Fußverkehr auf (ebd. 5). Mit diesem Vorgehen bezieht sich das Projekt auf eine Innovationsparadigma, dass die Umsetzung mobilitätsrelevanter Realexperimente gleichermaßen als Treiber sozialer und technischer Innovationen begreift. Entsprechend der in Kapitel 2.1 vorgenommenen Definition von Systeminnovationen, stellt dieses Vorgehen einen erfolgsversprechenden Ansatz dar, um integriertere Umsetzungsimpulse für die Stadtplanungspraxis zu generieren.

4 REALEXPERIMENTE ALS TREIBER SOZIALER INNOVATIONEN?

Ziel der vorliegenden Publikation war es, ausgehend von der These, dass eine Transformation urbaner Mobilität Innovation benötigt, theoriebasiert den Blick für nicht-technologische Innovationsaspekte zu schärfen und Impulse der Umsetzung aufzuzeigen. Die vorangegangenen Ausführungen stellen literaturbasiert dar, dass soziale Innovationen, wie neue Governance-Formen, Muster der Arbeits- und Unternehmensorganisation, neue Produkt- und Dienstleistungssysteme oder Konsummuster aber auch die Etablierung neuartiger Akteurskonstellationen und Netzwerke, auch im Kontext der urbanen Mobilität immer relevanter werden. Denn, Mobilität muss als soziale Praxis verstanden werden, die sowohl durch gesellschaftliche als auch durch infrastrukturelle und technologische Einflussfaktoren konstruiert wird und sie wiederrum selbst rekonstruiert. Soziale Innovationen können in Kombination mit technologischen Entwicklungen dementsprechend entscheidende Potenziale zur Transformation urbaner Mobilität freilegen und etablieren. Dabei müssen sie sich auch einigen Herausforderungen, wie Diffusionsbarrieren, die Ansprache und Aktivierung von heterogenen Zielgruppen oder ausreichender Finanzierung stellen. Wie die in Kapitel 3.2 dargestellten Best-Practice-Beispiele zeigen, können Realexperimente im Kontext urbaner Mobilität diesen Herausforderungen begegnen, wenn sie es schaffen in diversen gesellschaftlichen Segmenten akzeptiert, positiv bewertet und schließlich zur Routine zu werden. Den vorangegangenen Ausführungen zufolge können Realexperimente dementsprechend nur dann als Treiber sozialer Innovationen fungieren, wenn Akteurinnen und Akteure aktiv in die Gestaltung eingebunden werden. Wissenschaft nimmt in diesem Prozess eine Brückenfunktion zwischen Zivilgesellschaft und Politik ein. Indem sie die Neukonfiguration sozialer Praktiken durch Realexperimente in der Gesellschaft selbst fördert und in die wissenschaftliche Politikberatung einfließen lässt (Ober 2018: 387). Realexperimente stellen dabei Räume und Ressourcen zur Schaffung des passenden ‚Innovationsmilieus' dar. Wissenschaft und Praxis können, zum einen durch neue Formen rekursiven Lernens und zum anderen bedingt durch ein neues Innovationsparadigma, in diesen Räumen in Wechselwirkung treten und neue Problemlösungsansätze in Gestalt von sozialen Innovationen hervorbringen. Realexperimente können daher im Kontext der Diffusionsproblematiken insofern Potenziale generieren, als das ihre wissenschaftliche Evaluierung Möglichkeiten nachahmbarer Narrativen gesellschaftlichen Wandels aufzeigt. Wie das Reallabor Go Karlsruhe zeigt, können aufbauend auf den Erfahrungen gut dokumentierter Experimente kostenaufwändigere, fest installierte Maßnahmen und Formate geplant werden. Die wissenschaftliche Evaluierung ist aber auch deswegen von Bedeutung, da wie in Kapitel 3 dargestellt in der Wissensgesellschaft neue Formen der Wissensproduktion praxisrelevante Impulse für das Handeln diverser Akteurinnen und Akteure liefern. Die Sichtbarmachung der Potenziale könnte daher wiederum einen Prozess des ‚up-scalings' einleiten, indem risikoaffine 'Innovatoren', wie in der klassischen technologischen Innovationsförderung längst gängige Praxis, dazu verleitet werden, finanzielle Hilfen, maßgeschneiderte Beratungsangebote und Gründungsunterstützung zur Verfügung zu stellen (vgl. Butzin et al. 2013). Ebenso kann auch ohne eine vorgenommene Evaluierung die sichtbare Unterstützung von Schlüsselpersonen und -institutionen aus der Wissenschaft, die in ihre Rolle als aktive (Mit)Gestalterinnen und (Mit)Gestalter soziale Innovation fördern und kommunizieren, oder, wie am Beispiel des Tag des Guten Lebens sichtbar wird, die kommunale Unterstützung eines Realexperimentes, Treiber sozialer Innovation sein. Weiterhin gilt es

[2] vgl. Lydon/Garcia, 2015.

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dennoch, den eingeschränkten Grad der Kontrollier- bzw. Reproduzierbarkeit der Rahmenbedingungen zu bedenken, in denen sich Realexperimente bewegen. Die Offenheit für einen Ansatz des Experimentierens der nahelegt, dass Realexperimente auch Scheitern dürfen, würde daher den Umgang mit politischen Entscheidungsträgern wie auch eine (wissenschaftliche) Förderlandschaft durchaus bereichern.

Dabei ist es relevant, dass Realexperimente, die auf eine langfristige Neukonfiguration sozialer Praktiken und damit einer Veränderung der Mobilitätsroutinen hinwirken, keine einmaligen Ereignisse darstellen. Denn, laut John ergibt sich erst dann ein Anlass zur Veränderung, wenn sich Routinen wiederholt als ungeeignet erweisen (2013: 110). Da kulturelle Wandlungsprozesse zusätzlich mitunter langfristig und träge seien können, enfalten Realexperimente ihre Wirkungen eventuell auch erst lange nach ihrem Abschluss. Solche Wirkungen sind daher nur schwer evaluierbar (Reallabor für nachhaltige Mobilitätskultur 2017: 26).

Zusammenfassend lässt sich festhalten, dass das veränderte Verständnis von Wissenschaft im Kontext von Fortschrittsprozessen einen Prozess des "kollektiven Experimentierens" zugleich möglich und notwendig macht: Statt sich mit der Entwicklung exogener Lösungen über die Realwelt zu stellen, werden in Realexperimenten im Sinne eines Gedankens der Gleichwertigkeit in sozio-technischen Systemen, kooperative Prozesse zwischen Wissenschaft, Wirtschaft, Zivilgesellschaft, Politik und Plannung angestrebt. Gleichzeitig braucht es dazu noch einiges an definitiorischer Arbeit. Bislang sind sowohl Realexperimente als auch soziale Innovationen eher deskriptive Metaphern im Kontext von Phänomenen des Wandels, als planerische Instrumente. Ohne eine weitere Fundierung, bleibt das Konzept der sozialen Innovationen nur ein Anhängsel technischer Innovationen. Im Sinne rekursiven Wissens gilt es, Prozesse zu evaluieren und selbst Realexperimente auf den Weg zu bringen, um daraus zu lernen. Für das Erreichen struktureller wie auch institutioneller Veränderungen auf der Ebene lokaler Mobilitätspolitik könnten so die Blaupausen geschaffen werden, an denen es bis dato mangelt. Letztendlich soll abschließend auf den wichtigen Umstand hingewiesen werden, dass der Ansatz des Experimentierens die Haltung nahelegt, dass Realexperimente auch Scheitern dürfen. Die hier dargestellten Fallbeispiele sollen sich daher weniger ein ‚Best-Practice-Euphorie' anschließen. Der Gegenstand des Scheiterns und die Faktoren die es bedingen, lassen ebenfalls eine systematische Auseinandersetzung und somit Rückschlüsse auf die Stabilisierung von Strukturen, den Aufbau neuer Routinen, die Neukonfiguration sozialer Praktiken und letztendlich sozialen zu. Allerdings ist bis dato in Bezug auf Realexperimente in der Literatur wenig Wissen über die tatsächlichen Relationen von Versuch und Irrtum zu finden.

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🏆 *reviewed paper*

Reshaping the Urban Experience: Prospects for Digital Streetscape towards better Livability in Public Spaces

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1 ABSTRACT

As addressed through the literature on urban planning and design, urban livability concepts generally focus on the issue of "quality of life". Streetscape design is a good tool that can be used to create a sense of place and improve the urban quality. Thus, streetscape design and urban livability are strongly interconnected. But this connection needs desirable and attractive urban spaces that could interpret and reflect its richness. However, urban spaces are now exclusive domain managed almost entirely for traffic flow which makes them lose their distinctive character as places for people. Furthermore, with the continuous growth of internet usage, people's needs of public spaces have differed. These needs have to be specified. New possibilities of use and new atmospheres should be also created to cope with their new needs. Therefore, cities around the world are progressively working on developing new strategies to face the 21st century's challenges.

In this context, the paper raises the question of how urban spaces can be enhanced, depending on streetscape's improvements, to promote livability for its users. Based on the fundamental idea that streets are places for people more than just being arteries for traffic, the paper proposes the "Digital Streetscape" concept as a hybrid model that correlates the advantages of three techniques to meet the contemporary needs of people as well as to rejuvenate cities. On a broader level, the paper aims to conclude a set of guidelines and recommendations to improve the main elements of streetscape design that are derived from the theoretical study. This is carried out to identify the most suitable design concepts and options that can be adopted in the design of future urban spaces to produce new generation of livable communities.

Keywords: Livable Streetscape Design, Alexandria Livable City, Hybrid Approach, Digital Streetscape, Place-Making Concept

2 INTRODUCTION

High tech and high quality of life are the main pillars of any city aspiring to meet the challenges of the 21st century and restore its livability. In order to develop this idea, the paper follows the "Place-Making" concept as being relevant to understand livability (PPS, 2007). This concept considers livability as a coin that has two faces. People contemporary needs are one of them. Quality of places that have potential to meet their people's needs is the other. To be livable, cities must put both sides of the coin together.

Pedestrian-friendly streets are the city's most fundamental assets. The pedestrian movement is always considered as the most favorable type of human interaction with the urban environment (Blaga, 2013), but it takes more than just a good paving to produce an excellent pedestrian landscape. It is the whole environment arround the person that has to be understood.

Based on the pioneering study by professor Jan Gehl, a set of quality criteria for the design of the pedestrian landscape has been developed. It offers a way of looking at the environment based primarily on people and their human senses. These criteria are known as "The Twelve Quality Criteria" and are divided into three main groups: (1) Protection, (2) Comfort, and (3) Enjoyment. (Gehl & Svarre, 2013)

Nowadays with the continuous evolution of digital technologies, this set of quality criteria have been augmented. Thus, the paper proposes a hybrid approach that combines the highest urban design qualities with the latest digital technology. It focuses more on people who use the space, their needs, and pattern of use. This approach contributes to formulate a framework that correlates the advantages of three contemporary techniques: the Smart; the Eco-Oriented; and the Tactical Urbanism. Defining their concepts and dimensions as well as analyzing their interrelation with the concept of livability will help creating a new model of streetscape that has the potential to thrive in the 21st century. This model will be referred to as "Digital Streetscape". Implementing Digital Streetscape guidelines will reactivate spaces by creating

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sustainable environments that react and interact with the passers-by which will help increase awareness for their movements in public spaces and thus foster their sense of place and provide better livability in cities.

3 LIVABLE STREETS

Starting in the 1960s, it was a turning point. Public life and the interaction with public space were pinpointed as a field to be more carefully studied. Leaders like Jane Jacobs, William H. Whyte and Jan Gehl began questioning vehicle dominance and its impact on individual life and the amount of social relationships developed. Donald Appleyard and other successors in the field started afterwards to link between the people oriented approach and the street livability (ARUP, 2016). Copenhagen has been the living laboratory for applying this approach from 1968 up to today. Its redesign was based on careful observations of people and their needs (Gehl & Svarre, 2013).

Taking copenhagen as an exemplary, many cities around the world recently started to wisely design streets as valuable civic spaces more than just car corridors because of the important role they play in forming the visual image and increasing the city livability. Improving these public spaces is the simplest way to improve the quality of life for all citizens as professor Allan Jacobs cited that "If we can develop and design streets so that they are wonderful, fulfilling places to be – community-building places, attractive for all people – then we will have successfully designed one-third of the city directly and will have had an immense impact on the rest." (PPS, 2008)

3.1 Streets as Public Places

Based on the UK's Manual for Streets, streets must be a destination in its own right to be called as "Places"; they must prioritize people's activities and give them a reason to go there several times. While streets in which the priority is for people's movement only, are just "links" that do not contribute to livability (PPS, 2016).

The image of the city and its attractiveness to visitors depends on its street life. A street with vibrant street life provides ample opportunity for social interaction. Successful places are where people not only feel safe and comfortable, but also experience a sense of ownership and community (Hill, 2012). The street life can be achieved when applying the transportation policy and design approach of "Complete Streets" used in the United States and Canada. Complete Streets approach inspires residents to view their streets as public spaces. It acknowledges the role they play in not only enabling circulation and making connection between important destinations, but also in encouraging and defining a vibrant community for all users of all ages and abilities, including people who walk, cycle, drive, or transit riders (IBI, 2013; SGA, 2018).

Then, Complete Streets become Livable Streets because both share same concepts, summarized in (Figure 1), that seek better integration of the pedestrians' needs into the roadway's design. This will enhance the pedestrian character of the street and provide a balance between all different modes encouraging a better quality of life and a greater range of community and street activity. Following the "Place-Making" concept and in order to strengthen the connection between people and the places they share, an effective Streets as Places process, that contributes to livable street environment and prioritizes people's health, happiness, and well being, needs to be planned and designed appropriately using four essential guidelines (PPS, 2018):

(1) Streets as Places promote sociability; they are welcoming and encourage the street life for diverse users groups of different gender, age, abilities, and income level ensure that no one group dominates the space and makes others feel out of place and unwelcomed.

(2) Streets as Places are comfortable and attractive; they create a positive image by keeping the place clean and well maintained as well as fostering a sense of identity. They must be protected against traffic and accidents, crime and violence, and unpleasant sensory experiences. They must also offer opportunities to a wide range of activities and interactions that elevate the behavior of users and their sense of place.

(3) Streets as Places promote vitality. They provide amenities to support a variety of activities; they give people the choice to do whatever they want to support their different needs whether they are alone or in groups and during different times of day, week, and year.

(4) Streets as Places are walkable and accessible; they are easy to get to and get through. They are shared streets where no one mode of transportation dominates and preclude the comfort of other modes. They also

encourage slowing speeds with a number of design tools including changes in widths, curvature, and intersection.

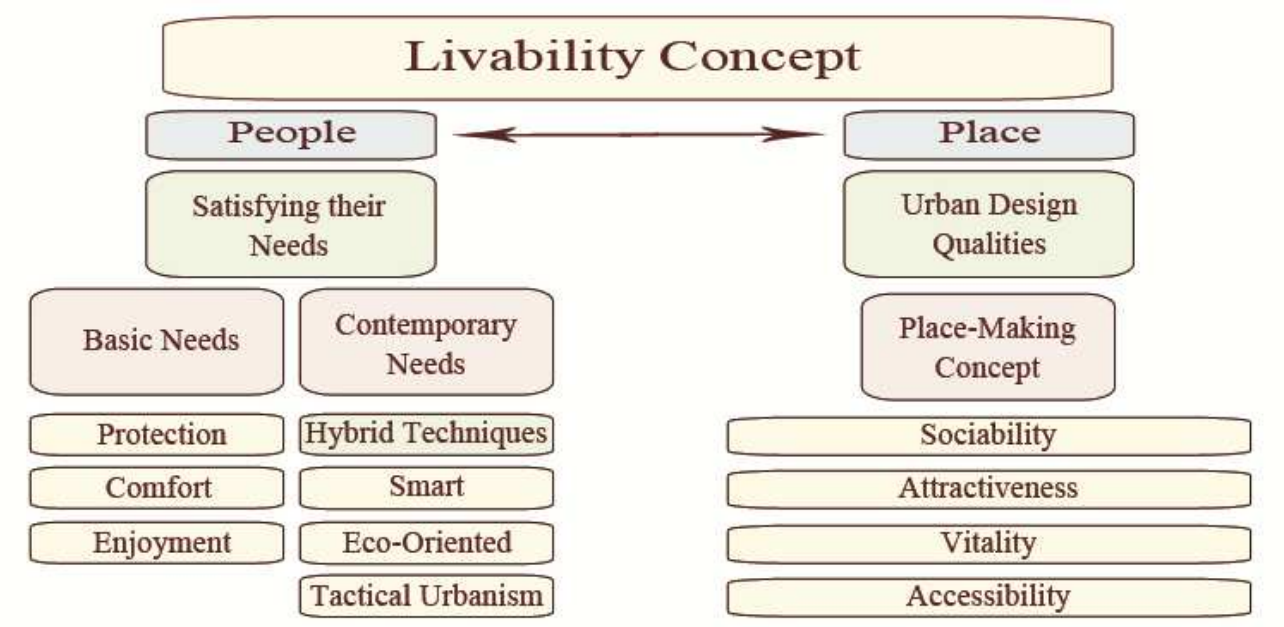

Figure 1: Flowchart summarizes the above concepts (The Researcher)

3.2 Streetscape Design Elements

The streetscape is the visual elements of a street that combine to form the street's character. It is one of the most important factors which helps in city success and tourist attractions by its strategic role in directing the movement of people and stimulating business and employment. Improving the streetscape can make the local environment more inviting, healthy, enjoyable, safe, and interesting and can create more livable communities (White, 2015). A successful streetscape design must take into account four basic principles, (1) legibility, (2) comfort and safety, (3) attractiveness, and (4) liveliness. The design of each streetscape element must ensure and enhance the legibility of the city and it must be functional and responsive to the needs and expectations of all its users. It must also be aesthetically pleasing and attractive, and to be designed to create lively spaces where people can meet and interact (Streetscape Management Section, 2007). Elements of streetscape are main components of a street's urban design. This paper will focus on three main elements as follows (Rockville Town Center, 2001; City of Cheyenne, 2007; Better Streets San Francisco, 2010):

3.2.1 Sidewalks

Sidewalks have a vital role in city life as they are an essential component of any pedestrian-friendly street system where pedestrians can experience safe, comfortable, legible, and attractive environment. Well designed sidewalks function as outdoor rooms and gathering places that can activate streets socially and economically, enhance connectivity and help define community character. This can be done through providing well designed and coordinated tree planting, lighting, street furnishings and paving materials.

3.2.2 Trees and Landscape Strips

Planters –either moveble or raised– help define and separate spaces and act as an effective treatment between sidewalks and streets that create a buffer from moving vehicles and street noise. They greatly enhance the pedestrian environment by softening the hardscape, providing shade and shelter, and fostering a vital connection to the natural world. When placed on a walkway, they should not create congestion or block pedestrian traffic, also their placement on street corners, crossing, and other critical areas should not obstruct drivers' view.

3.2.3 Street Furnishing

Street furniture is the most significant and influential component of streets' urban design. Benches, lighting fixtures, bus shelters, vendors' kiosks, signages, bollards, water elements, trash receptacles, bike racks, and public art considerably shape the nature of streets, public squares and entire cities. The placement and design

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of these elements should be consistent and coordinated in design, materials, colors and styles to avoid visual clutter and define spaces' identity and character.

4 "DIGITAL STREETSCAPE" CONCEPT

Based on the above concepts and classifications, the paper proposes an approach focusing on and prioritizing people and their quality of life. This approach aims to enhance the overall urban quality based on the contemporary needs of people. Streetscape elements are found to be the effective tool that can be used to achieve this aim. Taking into account the four basic principles of successful streetscape design, Streetscape elements will be augmented by a new layer that merge the three contemporary techniques: the Smart; the Eco-Oriented; and the Tactical Urbanism. This merging will create a new model of streetscape that has the potential to thrive in the 21st century and will be referred to as "Digital Streetscape".

4.1 The Smart Technique

This technique aims to transform urban landscape into a network of intelligent, hyper-connected, responsive, and virtual streetscape. Adding a digital subsystem to streetscape elements is the key of this technique. By using sensors, digital screens, Wi-Fi spots, and smart phones' applications, streetscape elements can be modified to better serve people's needs.

Debates surrounding the impact of technology on the usage and act of communication within public spaces raise the question of whether ICTs elements will promote livability in physical urban spaces or will they threatening it. One of the neglected public spaces in Alexandria City has been subject to an earlier study where the smart technique was applied as a tool to verify the application potential and added benefits of installing some ICTs elements in the physical urban space (Abdel-Aziz, et al., 2016). These elements are classified into four categories: (1) Wi-Fi spots, (2) digital interactive media façades, (3) interactive public displays, and (4) smart phones' applications. A conceptual 3D model for the redesign of the space is proposed based on analyzing the space and on people's opinions and suggestions derived from an On-Site Questionnaire to test the implementation viability of these elements and their influence on transforming the space into more active, vital, and interactive place with users.

For better results, the model is displayed into the Virtual Reality Cave (VR CAVE) where people enter wearing 3D glasses and can experience the 3D graphic concept, walk around, and get a proper view of what it would look like in reality. They were then asked to answer an evaluation survey to collect their opinions.

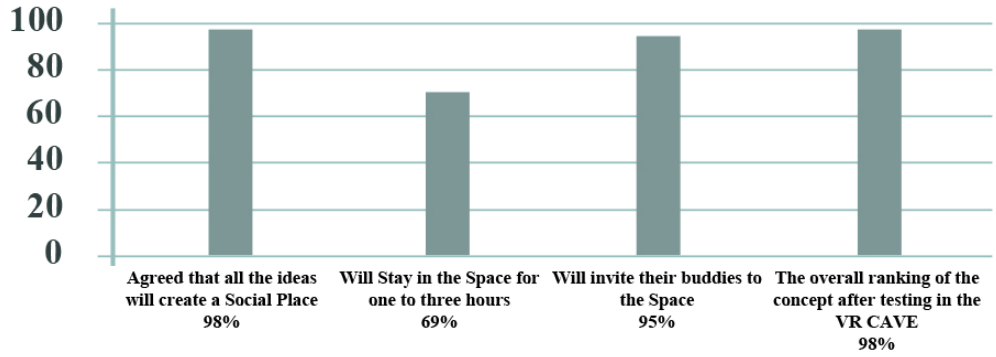

Figure 2: Graph shows the results of the earlier studies' evaluation, answered by 100 participants (The Researcher)

Taking into consideration the multiplicity of needs and pattern of use associated with diverse types of users, the survey's results in (Figure 2) prove that the use of ICTs elements in physical public spaces is so encouraged nowadays and that the digital technology has the ability to increase the attractiveness of the space and the interaction between people with each other as well as between people and the place around. Thus public spaces that take into consideration digital elements will foster the sense of place compared to those neglecting their implementation proving that the smart technique fosters the livability in urban spaces.

To create livable streets based on this Smart Technique, government interventions alone are not enough; it takes collaboration and partnerships between local businesses, institutions, and individuals. This could easily be done through a wide range of smart phones' applications that open lots of new options for participation

and citizens' engagement (Drohsel, et al., 2010). Thus, people will get more attached to their city because places will be designed according to their needs.

Some key design options and recommandations for installing the Smart Technique in physical urban spaces are illustrated in (Figure 3) and are provided as follows:

4.1.1 Sidewalks

The pavement can be improved using sensors that translate people's presence and movements into different forms of interaction. For example, a pavement that lightens when someone step on them or urban furniture that changes its color based on specific ways people use them, etc. Similarly, the well-known example of "the Piano Stairs" which is an interactive staircase that sounds like a huge piano when people step on it (CMUSE, 2014). Another interactive installation that uses light and sound to create a playful experience is the "Tangible Orchestra", exhibited at Royal Mile, Edinburgh. This installation encourages people interaction and playing within the space (Carvajal B., 2014). The "Sea Organ" in Zadar, Croatia is another attractive artistic installation which utilizes the power generated by the motion of sea to create beautiful sounds of music (villakatarina, 2018).

Digital projection on pavement can also be used to generate interactive spaces by changing the area's image, colors, dynamics, etc. Popular games like hockey can be transported into interactive digital games by projecting an interactive ball on the ground over a painted or projected game field (Reinhold, 2013).

4.1.2 Trees and Landscape Strips

Trees can be improved to be a source that generate art and culture in public spaces. Using string LED lighting or up-lighting fixtures, trees can be illuminated by different colors at night as a sort of public art which brings positive attention to streets and public spaces.

Digital projection can also be used on trees like what the french artist Clement Briend have done in Colombia showcasing godlike figures from the local religious culture (Reinhold, 2013).

4.1.3 Street Furnishing

Benches can be improved by offering outlets that allow users to simply plug-in their USB chargers to charge their gadgets at anytime of the day. The solar-powered rocking lounge chair "SOFT Rocker" created by Professor of Architecture at MIT, Sheila Kennedy, is a great example of this (Kennedy, 2011). Using sensors, benches also can be an interactive art in public spaces that raise awareness of art and create a place for playing and hanging out that brings together people of all ages. The canadian intervention by "Daily / Tous Les Jours", "21 Balançoires (21 swings)" is a great example of this (Cartiere, 2011).

Lighting Fixtures can be improved to be intelligent streetscape elements. Ron Harwood is the inventor of "Intellistreets", an LED street light system that goes way beyond simply lighting the streets by providing many options like WiFi connection, sensors that diminish its light in off-peak hours to save energy, and real-time environmental monitoring sensors to detect gas leaks, radiation, CO2, etc., (Harwood , 2012). Another invention is the Light-Fiedlity (Li-Fi) which is a label for wireless-communication systems using light as a carrier instead of traditional radio Frequencies. Li-Fi is the latest technology that can provide the fastest internet speed so that it can replace the Wi-Fi (Verma, et al., 2015).

Bus Shelters can be improved using touching digital screens that offer usres a variety of services like bus route guide, digital city map, destination search, and traffic broadcasting station. As well as offering displays showing a virtual store with (QR) code to purchase and order goods while on move (Hwang & Choe, 2013).

Signages and Advertising Boards can be improved using digital displays in either passive broadcast mode showing playlist of videos and animation or interactive mode by touching the screen or enable the pairing of the mobile phone using bluetooth, QR codes, and SMS (Schieck & Fan, 2012; Ylipulli, et al., 2014).

Water Elements can be improved by the creative sensors use. The "Digital Water Curtain (DWC)" is cited as the urban furniture of the 21st century. The DWC is a type of fountain of new nature adapted to nowadays urban landscaping requirements being at the same time a playful, refreshing, eco-oriented, and iconic landmark in the urban landscape (Wan, 2013).

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Trash Receptacles can be improved using sensors that monitor when the receptacles are filling up and alert the sanitation department to empty them before they are full. This tend to make collecting waste much more efficient which means less hours and money spent on sanitation (Haggin, 2019).

Bike Racks must be provided for safe and secure parking to encourage bicycles' use. Smart bike racks "bikeep" is a San Francisco-based start-up that can increase the safety and security of parking by synchronizing the rack with a smartphone application. The rack also send an alert to the phone if someone tries to move the bike without proper authorization through the app (Smart Cities Connect, 2017).

Others view bicycle racks as an eyesore. The sleek alternative prototype "Align" by Milou Bergs pops up only when needed, the front wheel of the bike sinks down, raising a bracket to hold and lock the back wheel. When the bike is removed, it disappears entirely, hidden flat inside the pavement (Urbanist, 2018).

Public Art can be improved using digital technolgies in different ways to take it beyond the decorative elements to the functional elements. As presented above, all streetscape elements are suitable for artistic expression and can promote art in physical spaces when augmented by any digital subsystem.

Street Furniture in general can be adapted to help disabled people making their journeys easier and safer. Designers Ross Atkin and Jonathan Scott create the Responsive Street Furniture prototype. Users need to register with their smartphones, specify their needs whatever their disability: brighter street lights, audio information or more time to cross the street. Based on smartphones' connectivity, responsive street furnitures are able to identify users when they walk-by and adapt to their preferences (Howarth, 2015).

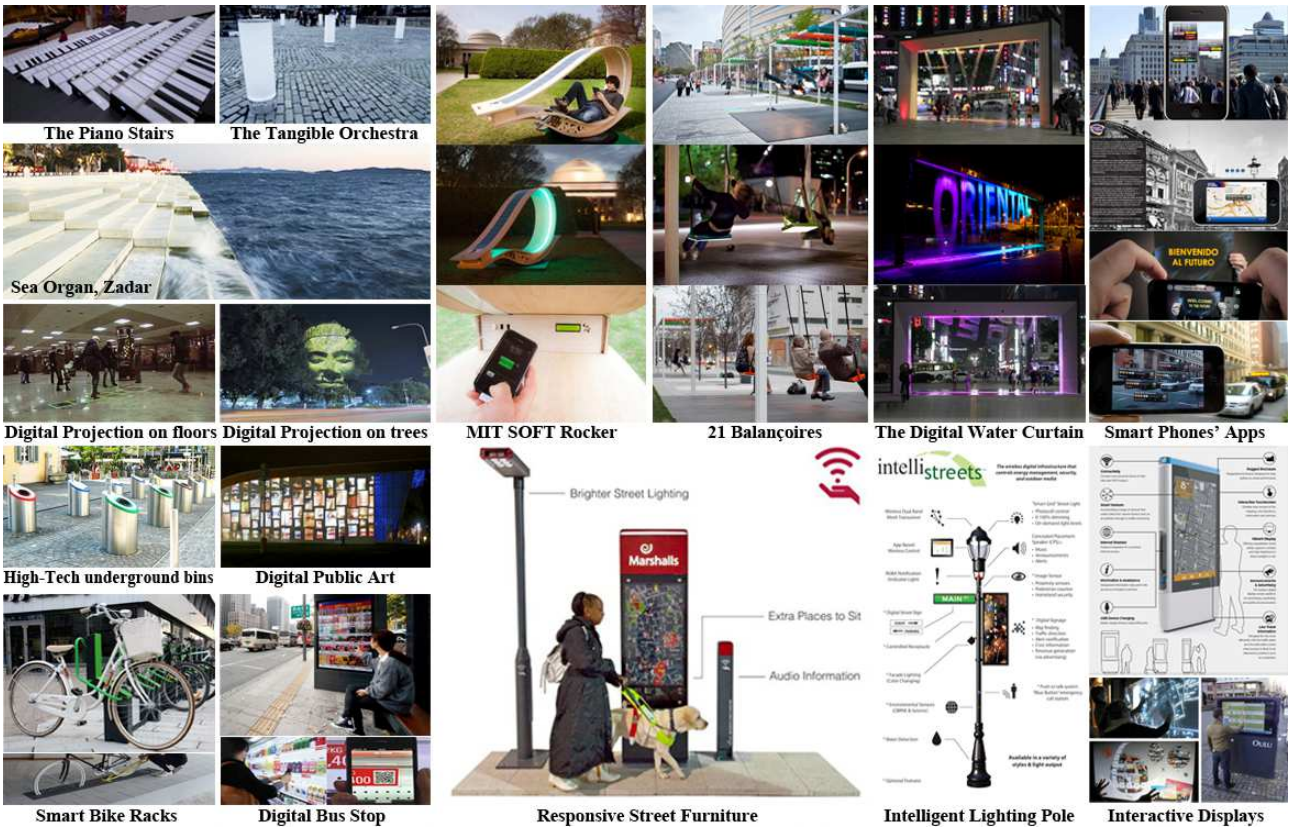

Figure 3: Illustrations demonstrate some options for installing the Smart Technique (Compiled by the Researcher, Sources are cited for each category respectively on pp. 5-6)

4.2 The Eco-Oriented Technique

The Eco-Oriented Technique mainly focus on the sustainable design options. Sustainable streets give priority to pedestrian, bicycle, and transit use, and also emphasize ecologically-friendly treatments. The treatments may include sidewalk widening, landscaping, traffic calming, sustainable materials, and other pedestrian-oriented features. In the U.S., a "National Streetscaping Week" is established to encourage the design of streetscapes that use sustainable design strategies to improve the environmental, economical, and social well-being of neighborhoods and communities (White, 2015).

Beside the four basic principles of successful streetscape design, and in order to achieve sustainability in streetscape, streetscape should consider the economical and environmental principles. Therefore, CH2M HILL COMPANY's Sustainable Street Design Options in the U.S. codified five main aspects to obtain sustainable street and then provided 161 options for design (Bevan, et al., 2007). These five main aspects are: (1) Reduce Energy Consumption, (2) Reduce Consumption of Material Resources, (3) Reduce Impacts to Environmental Ressources, (4) Support Healthy Urban Communities, and (5) Support Sustainability During Implementation. As the result of such aspects: the air quality, the water quality, and the energy efficiency are improved, meanwhile, the heat island effects, the light pollution, and the consumption of material resources are reduced.

Different cities around the world have applied sustainability on streetscape to create better places for present and future residents. Chapel Hill and Chicago in the USA both represent successful examples to apply many ways for achieving sustainabilty in streetscape, as: stormwater management, use of sustainable materials, lighting and dark skies, and landscaping and urban heat island (Rehan, 2013). These examples prove that the sustainable urban street design principles are considered as a pattern to adapt the livable street design.

Some key design options and recommandations for installing the Eco-Oriented Technique in physical urban spaces are illustrated in (Figure 4) and are provided as follows:

4.2.1 Sidewalks

Paving materials should be selected for sustainable manufacturing and permeability. Using locally sourced paving materials manufactured with sustainable practices will reduce life-cycle impacts on the environment.

Using durable materials will help to reduce maintenance costs as well as using cool pavements wherever possible will reduce the urban heat island effect. Paving materials should not pose tripping hazards for disabled people or cause excessive vibration for wheelchairs (City of Cheyenne, 2007). Materials and textures should reinforce distinctiveness and improve the appearance of the area as well as special paving treatments should be used in shared public ways (Better Streets San Francisco, 2010).

Paving can be improved by using solar cells that convert the sun's energy into electricity used to light up the entier space at night. The "Greeting to the Sun" in Zadar, Croatia is a unique example of an efficient and renewable energy source as well as an aesthetic enhacement (villakatarina, 2018).

4.2.2 Trees and Landscape Strips

Planters' locations should consider all other streetscape elements. Street trees should be large enough to provide shade for pedestrians and parked cars. They also should be hardy enough to withstand pollution, heat, glare and other urban conditions. Tree grates should be used wherever a tree is placed and should allow for tree growth and be made from recycled durable metal. Electrical outlets should be provided within the grate area to allow for lighting opportunities of greenery and flowers to be enjoyable at night. All landscape areas should be provided with adequate irrigation systems. Wherever possible, water runoff should be directed to landscaped areas for retention and percolation. These "Rain Gardens" could improve the esthetics of the sidewalks by including lush plantings with varying colors and textures (Rockville Town Center, 2001).

The Moss-covered City Tree bench designed by German startup "Green City Solutions" to combat urban pollution is the world's first intelligent biological air filter. Each bench is equipped with so-called "living wall", which is filled with a variety of moss types that naturally absorb pollution. The living structure also collects rainwater and automatically redistributes it using built-in irrigation system. Using Internet of Things technology, it is able to measure and maintain its own performance and the plants' requirements. The wall of irrigated mosses also generates a cooling effect helping to combat the urban heat island effect (Hitti, 2018).

4.2.3 Street Furnishing

All Streetscape Furnishing should be made of durable, environmental conditions resistant, non-abrasive materials that withstand cracking and require low maintenance. They should be crafted not sharp. They should be well illuminated to attract people at night. Energy saving LED light sources are preferred because they have a longer lifespan that minimize repeated replacement and reduce maintenance costs. As well as their design should add public art to the streetscape (Department of Transportation, 2013; IBI, 2013).

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Some Streetscape Furnishing elements can be integrating together to form a new furnishing element with more advantages. The modular bicycle parking "plant-covered bicycle parking pod" is a great example of this. It is a new design concept that integrate bike racks with benches, greenery, a small vending machine, and advertising board all incorporated into the form of the parking in an organized way. The idea creates a piece of modern sustainable city furniture that offers a place for cyclists to safely park their bike, while offering a relaxation area for pedestrians (Inhabitat Staff, 2013). Same can be done for bus shelters.

Streetscape Furnishing can be improved using some innovative solutions like the Swiss company "Villiger" solution to deal with trash by using a system of underground waste disposal. They use high-tech underground garbage containers to save space and keep streets clean. Trash containers are stored below ground level to get rid of the smell and keep the trash out of sight which help reduce air pollution. This idea does not only serve for cleaner cities but also for more aesthetic surroundings (startupselfie, 2018). Another innovative solution is the concept design of the "Turbine Light" in Incheon Metropolis. It is designed to light up during the night using energy from the wind generated by moving cars. This by capturing the air flowing around the car to turn the turbine and therefore gain some renewable energy (Tak, 2009).

Figure 4: Illustrations demonstrate some options for installing the Eco-Oriented Technique (Compiled by the Researcher, Sources are cited for each category respectively on pp. 7-8)

4.3 The Tactical Urbanism Technique

Because of the confrontations that face cities in the 21st century, quick, low cost, temporary, community based, scalable, and creative interventions are needed in attempts to improve the condition of cities, thus the concept of Tactical Urbanism has been shaped. This technique refers to the concept of "Short-term Action || Long-term Change". Cambridge dictionary defines tactical as "relating to tactics or done in order to achieve something". Merriam-Webster dictionary added "of or relating to small-scale actions serving a large purpose" or "adroit in planning or maneuvering to accomplish a purpose" (Lydon, 2015).

In the context of cities, the Tactical Urbanism is a bottom-up process starts with the initiative of public participation, not through following official protocol. Tactical Urbanism gives the chance to test new concepts before making large political or financial investments, encourage people to work together, inspire action, low risk with high rewards and draw attention to perceived shortcoming (AbdElrahman, 2016). Tactical Urbanism starts with temporary interventions that can lead to the development of more permanent interventions over time. For example, in New York city, the department of transportation collaborated with local organizations in order to transform underused asphalt into temporary plazas for pedestrians, some of which became recently permanent (Yassin, 2019). Previous researches show the Tactical Urbanism as a creative technique and a benificial tool in promoting livability due to its guaranteed outcomes and benefits. Also, it allows the public to participate and visualize the streets creatively based on their contemporary needs.

Some key design options and recommandations for installing the Tactical Urbanism Technique in physical urban spaces are illustrated in (Figure 5) and are provided as follows:

4.3.1 Sidewalks

Pavment can be enhanced to foster inviting streets by adopting a Place-Making strategy that emphasize pedestrian needs through: (1) using barrier elements or colored treatments that separate sidewalks and plazas

from the roadway for safety, (2) using traffic calming elements like speed humps, speed table, and speed cushion and install ramps at all intersections as well as (3) creating more than standard crosswalk striping where pedestrian traffic is anticipated and encouraged which make motorists more aware of pedestrian activity and ensure safe pedestrian circulation, (4) applying medians help making a streetscape more pedestrian-friendly as they serve to separate opposing traffic, offer more space for planting, and provide a refuge for pedestrians crossing the road, and (5) simplify street closure permits to encourage a wide range of ways in which a city's streets may be utilized (NACTO, 2013).

Temporary street closures restrict a street to pedestrians at specific time of day, specific days of the week or during the year for certain seasons. They can take multiple forms ranging from an emphasis on active recreation, biking, or exercise to business activity, food, or arts (Lydon, 2016).

4.3.2 Trees and Landscape Strips

Movable inexpensive plants, trees, and other landcape amenities go a long way in making the street an inviting space to linger and socialize. They may be used to develop the underused asphalt into social and cultural places (Lydon, 2016).

4.3.3 Street Furnishing

Tactical Urbanism help people activate their streets by allowing projects in the streets and encourage public input for street furnishings. Movable chairs and tables are preferable. Shade elements should also be added in sunny/hot climates. Times Square is a successful example of turning a crowded street into a pedestrian plaza (Lydon, 2015).

Converting car-zones into public spaces is another option to increase the vitality of street life. PARK(ing) Day is an annual event where on-street parking spaces are converted into park-like public spaces. The initiative is intended to draw attention to the sheer amount of space devoted to the storage of private automobile that can be used for pedestrians' benefits when non in use like on weekends' days for example. Parklets also are public seating platforms that convert curbside parking into vibrant community spaces (Lydon, 2015; NACTO, 2013)

Curb extensions beside their role in visually and physically narrowing the roadway and creating safer and shorter crossings for pedestrians, they can also be transformed into interim public plazas using low-cost materials, flexible outdoor seating, and movable planters. Interim public plazas can reconfigure and revitalize any underutilized area or intersection that might otherwise be unsafe (NACTO, 2013).

The initiative of Bates College students is an example of a temporary protected bike lanes project in Lewiston, ME. This temporary intervention have led to permanent changes. Cities across the US have begun using a stepped approach to major redesigns, where temporary materials are used in the short term to be replaced by permanent materials after the public has tested the design thoroughly (Lydon, 2016).

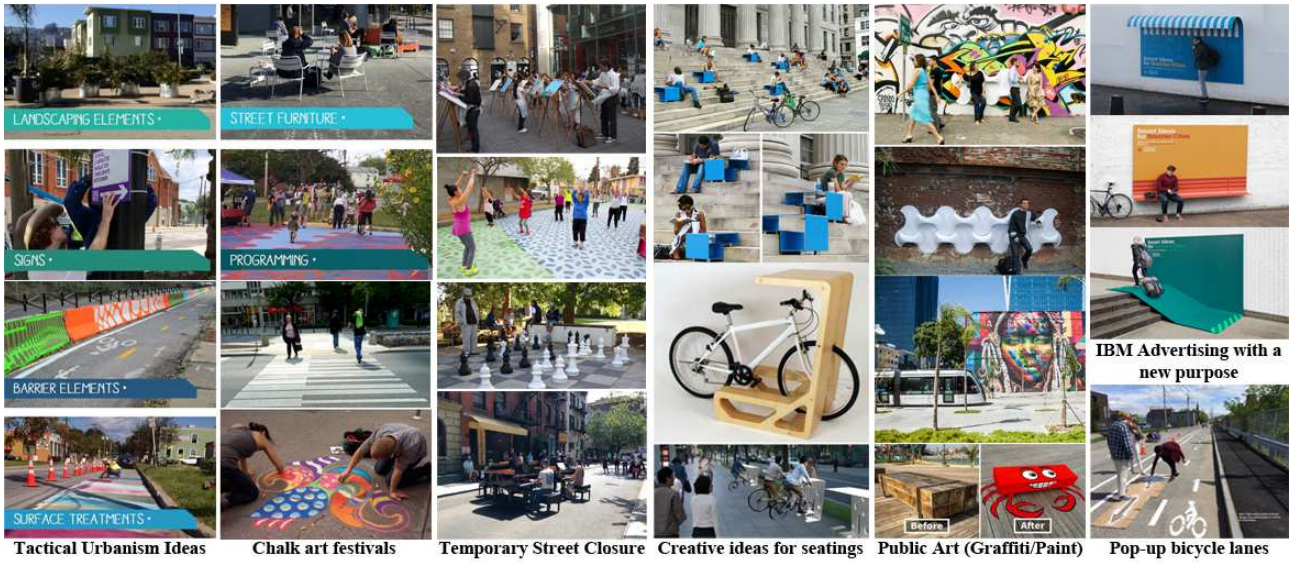

Figure 5: Illustrations demonstrate some options for installing the Tactical Urbanism Technique (Compiled by the Researcher, Sources are cited for each category respectively on pp. 8-9)

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5 FINDINGS AND CONCLUSION

Despite the breadth and complexity of Urban Livability Concept and also the conflict between cost matters and Eco-Oriented approaches however the paper was intended to focus on a limited set of issues which are connected and closely affect the quality of life and enhanced usability of public spaces from a qualitative perspective mainly. Moreover with the complex paradigms of Smart Cities and Tactical Urbanism, yet here makes an initial reference that they are increasingly being embedded in the notion of "needs" in a multiplicity of social context.

The following table, illustrated in (Figure 6), connects the Streetscape Elements with both the Basic Principles of Streetscape Design and the Principles of Urban Livability. This cross-relationship has provided sort of a matrix to evaluate the impact of each Digital Streetscape Element on improving Livability. The numirical value is based on observations carried out by the author. Where ticks appear they signifie a related/not related observation. The rating method is shown at the botton of the figure for clarity purposes and the rating points are calculated as basic numerical evaluation which are summed up together in horizontal order to reflect the extent of effect as a percentage.

Streetscape Elements	The "Digital Streetscape" Hybrid Model (Each Streetscape Element should provide the following guidelines)	Basic Principles of Streetscape Design: Urban and Social Principles: Legibility	Comfort & Safety	Attractiveness	Liveliness	The Livability Concept based on the Place-Making Approach: Satisfying People's Needs: Basic Needs: Protection	Comfort	Enjoyment	Contemporary Needs: Smart	Eco - Oriented	Tactical Urbanism	Urban Design Qualities of the Place: Sociability	Attractiveness	Vitality	Accessibility	Total Evaluation of Livability: Max. Points 55	%
Sidewalks	- Use Durable local materials, easy to maintain.	3	5	5	5	4	3	5		✓		5	5	5	5	50	90%
	- Use porous paving.									✓							
	- Use safe pavements' patterns and textures for disabled people.																
	- Separate Sidewalks and Plazas from the roadway.																
	- Use sensors for light/ sound effects.								✓								
	- Use Solar Cells wherever possible.								✓	✓							
	- Use Digital Projection whenever possible.								✓								
	- Allow Street Closures for (Games, Art, Music, and Exercises) events.										✓						
Trees and Landscape Strips	- Increase Green Areas.	3	3	4	4	4	4	5		✓		5	4	3	3	42	76%
	- Large Trees Canopies.									✓							
	- Rain Gardens.									✓							
	- Recycled water for irrigation system.								✓	✓							
	- Recycled and durable materials for tree grates.									✓							
	- Well lit the greenery.																
	- Digital Projection on trees.								✓								
	- Encourage Smart integration of benches and greenery.								✓	✓							
	- Encourage Public input for movable plants.										✓						
Street Furnishing	- Add Digital Subsystem to the Street Furnitures through - Smart Benches with Wi-Fi Connection, Sensors, Electrical Gadgets, Solar Panels, LED lighting.	4	5	5	5	4	5	5	✓	✓		5	5	5	5	53	96%
	- Intelligent Lighting Fixtures for both vehicles and pedestrians with cut-off Luminaire using LED Lighting system that enable Li-Fi Connection or using Solar Panels Lighting system.								✓	✓							
	- Highlight monuments and unique architectural details.																
	- Digital Bus Shelters with interactive Digital Screens, Virtual QR Store, and green shelters.								✓	✓							
	- Digital Advertising boards and signages.								✓	✓							
	- Interactive Public Displays that enable the pairing of Smart Phones.								✓	✓							
	- Digital Water Elements.								✓	✓							
	- High-tech underground Garabage Containers that include recycling waste separated containers and use sensors that monitor and alert when the receptacles are filling up.								✓	✓							
	- Synchronize Bike Racks with Smart Phone Applications for security.								✓								
	- Digital Public Art on media facades or Virtual Public Art using holography and Augmented Reality Applications.								✓								
	- Make all the Streetscape Furnishing Responsive to help disabled people.								✓								
	- Made all the Streetscape Furnishing with durable, locally sourced, high quality materials that require low maintenance.									✓							
	- Encourage Public input for "Movable Chairs, Tables, and Trash Bins."										✓						
	- Create Public Spaces at any underutilized area or intersection.										✓						
	- Support Graffiti Art on the street.										✓						
	- Encourage pop-up Bike Lanes.										✓						
Rating (Points)		POOR (2) GOOD (3) VERY GOOD (4) EXCELLENT (5)															

Figure 6: Table shows the impact of Digital Streetscape Hybrid Model on improving Livability (The Researcher)

This model provides a tentative platform to consider, observe, evaluate, redevelop and intervene in public open spaces in a flexible and case sensitive way. For various context, it allows a track for integrating place specific attributes with planning goals and intentions. This allows the formulation of more responsive and sound approaches. However, this attempt is conceived as a pilot study which remain open and possible to be amended and readjusted with more/less streetscape elements on one side and principles of streetscape design and urban livability on the other. The cross-relationship and approach towards improving urban experience remains the same. Yet, it could better respond to local conditions and particular contexts in diverse cases. Through the right application and insertion, the hybrid approach is achievable, and it will have the potential to provide a different sense of engagement with the social and physical surroundings.

The ideas and outcomes of this paper are part of an ongoing study regarding urban space quality of Alexandria's Waterfront. They will be further verified through empirical studies and surveys involving samples of the public and various actors in order to establish clearer definitions and relationships. This in turn helps to gain more insight into how Urban Spaces can be improved to better serve the Contemporary Needs of People in terms of Streetscape and Livability.

To conclude, a visual diagram could be provided to illustrate the main idea advocated by this research (Figure 7). It explains the rationale and key principles utilized together in this study to fulfill the Hybrid Approach sought to reshape the Urban Experience.

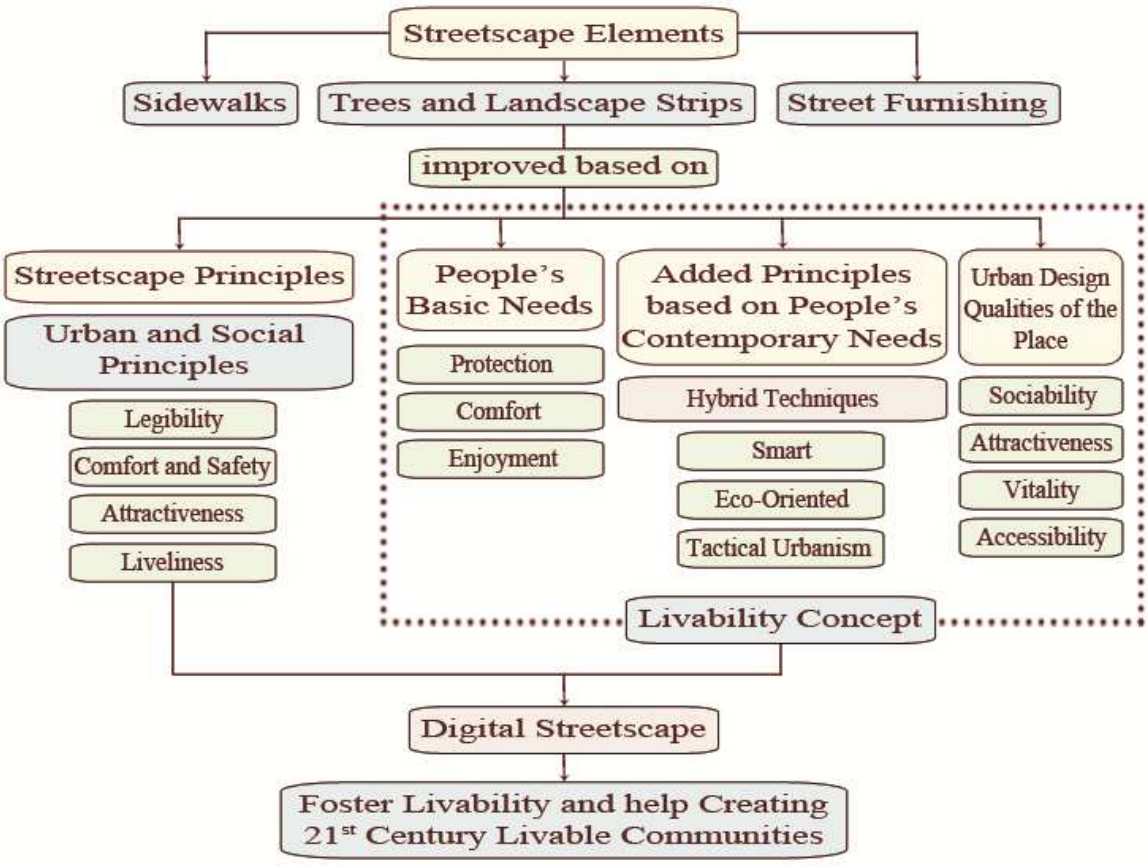

Figure 7: Flowchart summarizes the main idea of the paper (The Researcher)

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🏆 *reviewed paper*

Rethinking Mobility and Fixity in Developing Cities: a Case of South Africa

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1 ABSTRACT

Cities in the developing world are spaces of mobility and fixity. Globally access to mobility is often governed by social and economic constraints. Post 1994, South Africa metropolitan cities have seen numerous policies and legislative frameworks being developed to enhance urban mobility. Traditionally movement patterns in such developing cities is controlled by various transit services such as the level of accessibility, travel-time and number of alternative travel options. However in situations whereby there is no correlation between legislative instruments and daily operations of public transport systems. The objective of this paper was hence to access the rhythm of how commuters traverse in contemporary African cities. Using an explorative approach cognitive and spatial data was collected to develop a heat map to visualise variations of accessibility with the city. Preliminary finding reveal transportation hubs and areas of economic activities such as Park Station, Sandton and Rosebank have the highest levels of accessibility. Using the findings from the paper, city authorities can visualise movement patterns in the city and also forecast locations to improve transportation infrastructure.

Keywords: Urban mobility, Movement patterns, Cognitive data, Spatial data, South Africa.

2 INTRODUCTION

The concept of mobility vs fixity in the developing world has become a dominant theme in the discourse of city development practises. There is wide acceptance that transport planning and urban planning practices are ill aligned and are based on different philosophical principles. Citizens are entangled in system that either evokes movement or fixity (Hannam et al., 2006). Thus, there is need for research in the pursuit of achieving more transit oriented, compact and inclusive urban forms. Given how contemporary city authorities seek to become a part of the Fouth industrial Revolution (4iR) new developmental policies are being introduced. These polices promise to introduce 'hyper-mobility' which shall drive economic growth and improve the quality of life of citizens. The question however is, are contemporary developing cities ready, given how many cities are yet to have the infrastructure required to support these developmental projects.

Nonetheless, building on Harvey (1989) and Hannam et al (2006) sustainable urban mobility practises should address grassroot issues such as accessiblity and quality of life. In Asia and African countries, new forms of urban mobility have arisen namely tuk-tuks, rickshaws and pedicab. The proliferation of these mobility modes can be linked partly as an effect of studies on innovative mobility. Given the exponential growth of urban areas, public transportation providers are now required to emphasise on investing on elements that influence citizen's movement ability that is stillness and motion. Such research takes into account mobility trends. Sheller and Urry (2006) articulate how movement in urban areas, evokes different corporeal or sensory experiences for various citizens. For some the city can be described as a place of freedom were ideas, knowledge, money and places are easily accessible, whilst for others these remain unattainable.

Informed by Lefebvre's rhythm analysis, recent mobility developments are informed by internal and external rhythms (Butler, 2012). The technological developments in transportation planning seek to enhance connectivity at key points of interest in the city. The actual practice of movement through space and time is can be seen through the ability of harnessing information and manipulating it to inform city growth. Consequently such studies encompasses both the embodied practice of movement and the representations, ideologies and meanings attached to both movement and stillness.

Managing movement in an urban setting requires a 'spatial fix' based on an abling spatial infrastructure and policies that enable movement (Harvey, 1989). Looking at the public transportation in Gauteng, South Africa, interdependent transportation systems have been developed namely a high speed train and bus rapid transportation services these which are supported by traditional public transportation systems. The complex

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nature of balancing the innovative mobility systems and the traditional systems is a deanting task. Given how these systems have are targeted at different citizen groups, there is still a need to ensure overlapping between the systems is possible as they share the same spatial space. However there is no linear solution that can be used to ensure overlapping in these systems, as mobility is a reflection of the goemetries of everyday life (Massey, 1994).

3 LITERATURE REVIEW

Sustainable urban transport planning and provision remains a pipe dream for most developing countries (Vasconcellos 2014). The significance of integration for moving towards sustainable development has become intertwined with the smart cities movement. It has been noted that, the problem is unprecedented in metropliatain cities which have witnessed an exponential spatial growth. This has led to many policy changes, with transportation policy emphasising on the financial implications of the devolution of the transport function to local metropolitan municipalities. There are wide spread concerns regarding the ability of local governments to cover costs associated with operating and managing public transport systems in a sustainable manner.

The use of multi-mobility has received a special interest in the many urban areas. Commuters are encouraged to use two or three modes of mobility during their commuting trips to allow public transportion systems to share synergies. This in part has led to a growth of Bicycle sharing services. There are several reasons behind this trend such as the reduced burden of introducing a bus services for short trips and allocation for parking space. Diez et al (2017) have articulated the uptake of BSS by the public to incentives used to persuade the public such as the inclusion of small rewards (extra minutes, points etc). The joint efforts from city authorities and BSS providers have overtime led to development of various query systems on bicycle booking and availability at various stations, noteworthy examples include Bike Share Toronto in Canada, Citi BikeTM in New York and Bluegoo in China.

Within the South African context, much emphasis has been placed on the financial implications of the devolution of traditional transportation facilities. Due the nature of urban centres, De Beer & Valjarevic (2015) conducted a study to analyse factors influencing mobility in the city of Johannesburg, South Africa. Their results reveal topography, operational models, and infrastructure as the common factors for various age groups. These present a starting point for the introduction of multi-mobility. Other key issue to be addressed will be a need for integration of the urban space and improving connectivity levels amongst the various public transportation infrastructure. However, it is clear that there is much work that needs to be done in order to better understand how mobility in cities such as Johannesburg can become more sustainable and effective in providing improved levels of access and mobility to a wider spectrum of people.

One of the solutions used to regulate transportation is travel demand management (TDM). This with regards to public transporation provision seeks to reduce the amount of motorised travel (Del Mistro & Behrens, 2008), and this has been done in Gauteng through the implementation of the Rea viya; Metro rail and bus; Ari yang; Putsco; Gautrain and Gaubus. However, TDM has not been fully implemented as people still prefer to use the mini-bus taxis, as they argue that these carter more to their needs as they have more flexible operating hours and that they have successfully penetrated into various their points of interest. Thus they is still a need to make the formal forms of public transportation more attractive to the commuter. To address such issues, the National Government identified the use of Intelligent Transportation Systems (I.T.S), this which refers to the “application of data processing, data communications, and systems engineering methodologies with the purpose of improved management, safety and efficiency of the surface transportation network.” (Gauteng 25-year Integrated Transport Master Plan, 2013, p. 6). To fully implement I.T.S, real time and historical data needs to be collected and analysed, as a means of continuously making improvements in travel demand prediction, traffic modelling and O-D surveys. As the Gautrain Rapid Rail Link was initiated in 2010 (Johannesburg Metropolitan Municipality, 2008a), there is a need for innovative research techniques that can be used to guide the expansion and integration of the railway system into the urban environment.

Hensher and Wong (2011:1) have accentuated how the “public transportation is an indispensable service and ensuring its effective and efficient provision is a priority of many governments”. In South Africa, the National Land Transport Transition Act (No. 22 of 2000) has also outlined how public transport should be given precedence over private transport. Drawing from this the Gautrain has been identified as the backbone

of all public transportation in the Gauteng City Region (GCR) (Gautrain, 2009), this initiative was made as a means to move towards a more holistic provision of an integrated transport system to address the numerous socio-economic factors in Gauteng. Nevertheless, the realisation of an integrated transportation system is at early stages, as there is still a gap in the planning systems with regards to identifying the origins and destinations of commuters. As seen with the lack of integration of the current modes of public transportation.

Looking at the violent reverberations of colonialism in the processes of city living in Africa, cities have become places of intense fixity for many native communities. The contemporary Africa city although characterised by increased mobility due policy changes, this increased mobility is only enjoyed by the elite with many informal sector works being entangled in processes of city living, with many in contant battles with city authorities. A wide body of research on these protagonists, has been developed with many advocating for their right to the city.

The BRT system in South Africa has been well received by the public, however there is still a need to develop more similar systems as currently it has not yet penetrated to certain key areas of economic interest in the country as the only fully operational BRTs are in Cape Town, Johannesburg, Pretoria and the East Rand (Risimati & Gumbo, 2018). From the works of modern day scholars the integration of public transport systems will lead to improved service delivery, inter-connectivity of places of economic activity and improve quality of life (Filippi et al., 2013). Thus for metropoltian cities in South Africa to acme, there is a need for development of planning support systems which will guide the growth and integration of the existing and future public transport systems.

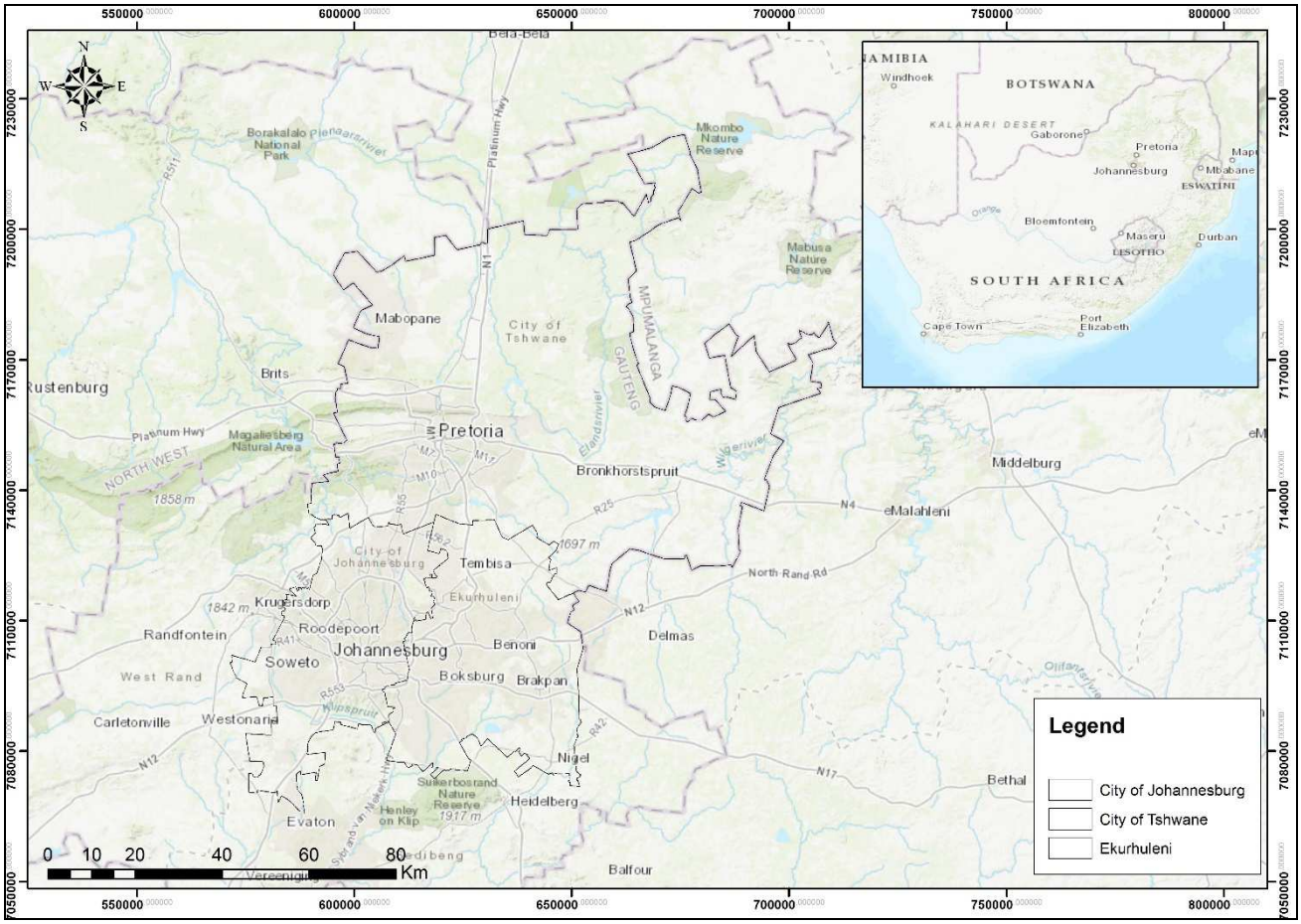

Figure 1: Study Area

4 STUDY AREA

The Gauteng province is South Africa was selected as a case study (Figure 1). The Gauteng economic hub is made up of three metropolitan cities namely Johannesburg, Tshwane and Ekurhuleni. Johannesburg is the commercial capital of South Africa with a population of 957 441 people and a surface area of 1,645km2 (Stats S.A, 2011). Pretoria is located to the north of Johannesburg as is known as the administrative capital of South Africa with a surface area of 687,5 km2 and a population of 741 651 people (Stats S.A, 2011).

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Ekurhuleni lies to the east of Johannesburg and is known as South Africa's manufacturing hub with a population nearly 3.2 million and a surface area of 1,975 km² (City of Ekurhuleni, 2013). All the four cities are run by an elected executive mayor from a political party.

5 METHODOLOGY

The study relied on a crowd-sourced data from social media posts. As a means of mining public opinions and also facilitate the research study, only social media (Web 2.0) posts relating public transportation for the year 2019 were collected. The execution of the public opinion data collection relied largely on the reliability of the information recorded that is all potential errors had to be minimised. Despite quality assurance being embedded in all the analytic processes, relating to social media collection and editing, errors may exist. To reduce errors accumulating the editing process was repeated until the researchers was satisfied that all the records used in the analysis reflected a true representation of the real world feeds (Figure 2).

Figure 2: Data collection and analysis framework

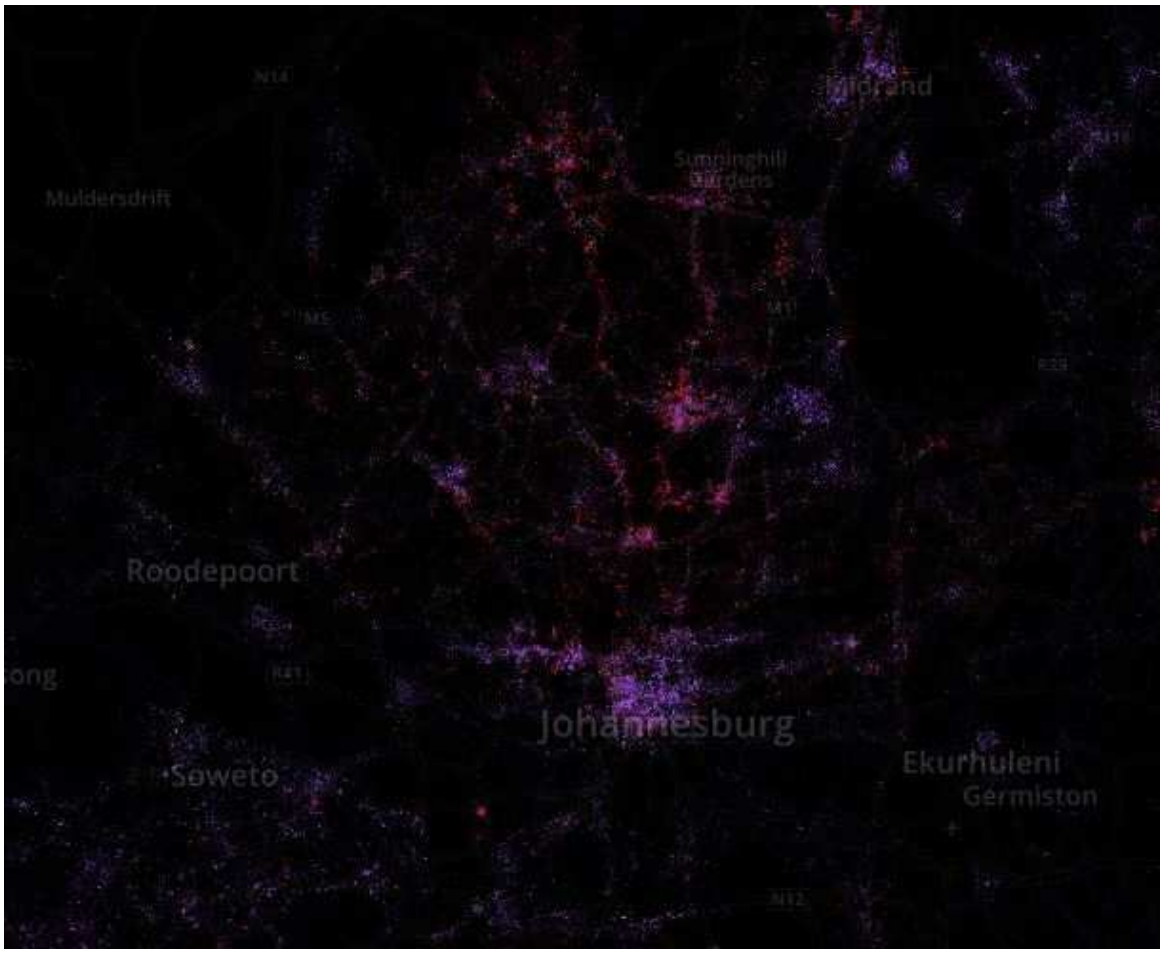

Figure 3: Mobility (purple) vs Fixity (black)

6 RESULTS AND DISCUSSION

Development of a public transportation system that promotes mobility in urban areas is a crucial and indispensable factor for the social and economic growth of any city. To a great extent public transportation providers within the City of Johannesburg have invested on mobility infrastruacture. Using geo-location data from the cognitive dataset, we visualise the points of interest of the users. Places of high mobility are represented in purple and places of fixity in black (see figure 3). The locations in purple can used to visualise

the spatial linkages between places of economic and social influence in the city. Zooming into the inner city of Johannesburg it becomes evident at locations such as Braamfontein, which is transit hub, which spatially promotes the use of multi-modal trips. Midrand, Rosebank and Sandton due the the high mobility rates have over time developed to become areas of economic importance as many companies, have set up their headquarters there. This has led to an increase of mobility in these regions. Other locations of high mobility include Sunninghill and Soweto.

Given the economic importance of such locations of high mobilty, many citizens traverse to these locations in search of greener pastures. This has led to the commercialisation of public space in these locations this which overtime become highly disreputable leading to a sprawl of illegal practise as the lower income groups and unemployed also seek to exercise their right to the city. This in part has given rise to a body of research documenting the continued battles between legality and illegality in cities. Nevertheless, although public transportation should be accessible to all, there are certain elements that hinder everyone equally enjoying the use of public transportation services. Factors such as income group, location and livelihood govern the social ranking of citizens, this inpart governs accessibility to services in the city. A notable example can be seen in Sandton, many citizens traverse daily to work in Sandton city, but not all can afford to utilise the Gautrain. Only the urban ellites can park their cars at the train station and utilise the high speed train. The low income earns have to wait in long queues in the dusk of dawn and board commuter-mini-buses and in the evening queue again to return home. For many ordinary citizens this has become an acceptable norm, with innovative public transportation systems being soley reserved for the urban ellite.

To unpack urban mobility one then has to explore the inter-relation with social norms. Looking at areas of spatial fixity (figure 4), such as parts of Rooderpoort to the west and locations in-between central Johannesburg and Soweto, we see the role of economic funtions to govern mobility. Locations with little economic functions generally have little to no movement. This has led to infrastructure in such locations to decay and negatively impacted the quality of life of citizens in these locations. Indeed, in such locations people's movement is limited, for many physical movement is as important as financial freedom. A deeper analysis between mobility and fixity, thus could be essential for unpacking the sociological approach to studying the urban setting (figure 3). Applying this approach to citizens perspectives, entails not only spatially mapping movement patterns but also assessing citizen views that drive cognitive decision making.

Figure 4: Factors influencing mobility vs fixity

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Urban mobility is consequently an essential element of citizen quality of life. The next question would be to assess the roles of city authorities and service providers to ensure equal access to mobility services, be it through developmental policies that establish and constantly reinforce the right of all citizens to access public services or re-thinking marketing strategies to ensure all have access to public transportation. In unpacking this relationship we illustrate the key terms associated with 'mobility and fixity'. From a commuter perspective, elements such as time, space, information and speed are the main congitive factors. Whilst for recreational trips elements such as access to information, opinions, connectivity and comfort are more essential. Where there is limited spatial integration and operational timetables most citizens have shown negative emotions to public transportation systems. Consequently in looking at the factors influencing movement, the relationship between being mobility and fixity is therefore dialectical and symbiotic in urban areas.

7 CONCLUSION

In this paper we have explored mobility and fixity in contemporary developing cities. Using the city of Johannesburg as a case study, we illustrate how certain locations in the city can be areas of hyper-mobility whilst also other areas in the city remain places of fixity. However space is never still, as is evident in South Africa as a whole, locations which were once reserved for a few pre-1994 are now accesible by all post 1994. However, it is clear that there is much work that needs to be done in order to better understand how public transportation in South Africa can become more sustainable and accesible by all whilst also providing improved levels of mobility to a wider spectrum of people. Furthermore explorative research is thus required around the opportunities for improved multi-modal integration both spatially and operationally.

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🏆 *reviewed paper*

Selbstermächtigung und Selbstorganisation als Schlüssel für nachhaltige Lern- und Transformationsprozesse in der Region Römerland Carnuntum

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1 ABSTRACT

The region Römerland Carnuntum (Lower Austria) is located between the metropolitan areas of Vienna and Bratislava and benefits from dynamic demographic and economic development. However, these processes of growth and rapid change are accompanied by specific challenges that are controversial and much-discussed within the region. The question comes up, how a high level of quality of life can be secured in the future and how a transformation towards sustainability can be initiated and established. Since traditional instruments of spatial planning, structural policy, and regional development increasingly show deficits in the face of such complex, multidimensional challenges, the region has set itself the goal of breaking new ground in cooperation, self-organisation, and self-empowerment, within the framework of which the actors in the region become self-organized, collaborative and long-term carriers of sustainable learning and transformation processes in the region. This article describes the structure of the project and highlights, in particular,challenges related to the committee 'Zukunftsrat Römerland Carnuntum', as a basis for self-empowerment, self-organisation and transformative learning as well as to the start-up phase of the transdisciplinary collaboration.First insights after almost one year of project runtime show, that the representative composition of the Zukunftsrat, and especially the random selection of citizens proved to be difficult. Nevertheless, the projekt benefits from outstanding commitment and a high willingness to participate on the part of the regional population.

Keywords: Transdisziplinarität, kollektive Lernprozesse, regionale Transformation, Selbstermächtigung, Selbstorganisation

2 EINLEITUNG

Das Römerland Carnuntum, zentral zwischen den beiden Metropolen Wien und Bratislava gelegen, ist mit einen Bevölkerungszuwachs von rund 17 % zwischen 2002-2018 (STATISTIK AUSTRIA, 2019)eine der wachstumsstärksten Region Österreichs. Eine Entwicklung, die sich auch in Zukunft mit dem erwartbaren Zuzug aus den beiden Großstädten fortsetzen wird. Die zentrale Lage ist für eine Vielzahl von Infrastrukturprojekten von überregionalem und internationalem Interesse von Bedeutung, wie dem Bau eines Eisenbahngüterterminals am Ende der ‚Neuen Seidenstraße', der 3. Piste Flughafen Wien Schwechat oder dem Ausbau der Ostautobahn (A4). Dieser massive Infrastrukturausbau und die Auswirkungen auf die Region sowie der demographische Wandel, verbunden mit intensivem Wohnbau und steigender Wohnnachfrage sind in der regionalen Bevölkerung und ihrer lokalen politischen Vertretung umstritten und viel diskutiert. Die Region stellt sich die Frage, wie unter diesen (teils extern gesteuerten) Rahmenbedingungen ein hohes Maß an Lebensqualität in Zukunft gesichert und eine Transformation zur Nachhaltigkeit eingeleitet und etabliert werden kann.

Das Römerland Carnuntum hat sich daher zum Ziel gesetzt, ein auf die Region abgestimmtes Zukunftsmodell, sowie Strategien und Strukturen zu dessen Umsetzung zu entwerfen. Da traditionelle Planungsinstrumente der Raumplanung, Strukturpolitik und Regionalentwicklung bei derart komplexen, multidimensionalen Herausforderungen, so genannten ‚wicked problems', zunehmend Steuerungs- und Innovationsdefizite aufweisen (Dentoni and Bitzer, 2015; Klein et al., 2001), sollen bewusst neue Formen der Zusammenarbeit und Prozesse der Selbstorganisation initiiert und institutionalisiert werden, um einen regionalen Transformationsprozess hin zu einer Modellregion für Lebensqualität und Nachhaltigkeit zu

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unterstützen. Dazu wurde ein transdisziplinäres, ergebnisoffenes Projekt mit einem Hauptaugenmerk auf die Aktivierung lokalen Wissens und lokaler Ressourcen sowie das Aushandeln von langfristigen Zielen und Veränderungen,als Grundlagen für sogenannte ‚Sustainablity Transitions'(Schäpke, 2018), entwickelt. Planung und Entwicklung sind dabei nicht begrenzt auf die Erstellung von Plänen oder das Treffen von Entscheidungen, sondern werden als kollektive, soziale Lernprozesse und Capacity Building (Selbstermächtigung) organisiert (Frantzeskaki and Tefrati, 2016; Lozano, 2007; Luederitz et al., 2017; Nevens et al., 2013)die zu 'Shared-Governance' (Zhang et al., 2019) ermächtigen sollen.

Der vorliegende Beitrag präsentiert den Forschungsansatz, den Aufbau und zentrale Herausforderungen des Forschungsprojekts „Selbstermächtigung, Selbstorganisation und regionale Transformation in der Region Römerland Carnuntum" (2019 – 2021). Ein besonderer Fokus liegt darauf, wie im Rahmen des Vorhabens produktive Lern- und Experimentierräume für lokale und regionale Akteurinnen und Akteure geschaffen werden können, um sie als Wissensträgerinnen und Wissensträger zu ermächtigen. Im Zentrum der Betrachtung stehen daher u.a. folgende Fragen: Welche Herausforderungen gehen mit der Etablierung regionaler, selbstorganisierter Strukturen, konkret eines regionalen „Zukunftsrates", einher? Welche Herausforderungen sind mit der Entwicklung und Umsetzung des transdisziplinären Forschungsvorhabens verbunden?

3 TRANSDISZIPLINÄRE FORSCHUNG ALS ARENA DER WISSENSINTEGRATION UND TRANSFORMATION

Transformationsprozesse in Richtung Nachhaltigkeit erfordern Zugänge, die durch die Integration verschiedenster Akteurinnen und Akteuren und Wissensformen neues „co-produziertes" Wissen hervorbringen und tiefere systemische Veränderungen im Wissenssystem selbst fördern (Marshall et al., 2018). Dazu braucht es Experimentier- und Entwicklunsgräume, in denen Stakeholder miteinander interagieren, eine neue, gemeinsame Wissensbasis und Handlungsweisen entwickeln und in denen transformatives Wissen entstehen kann (Marshall et al., 2018; Pohl, 2008). Für die Bearbeitung derart komplexer Fragestellungen der „realen Welt", die kreative Lösungsansätze (Dove and Jones, 2013; Lozano, 2014) und die Berücksichtigung verschiedener Wissensarten (Wissenschaft und Praxis, System-, Ziel- und Transformationswissen) erforderlich machen, gewinnen transdisziplinäre Forschungsansätze zunehmend an Bedeutung (Schneider et al., 2019). Den regionalen Akteurinnen und Akteuren als Trägerinnen und Trägern impliziten Wissens zu lokalen/regionalen Präferenzen, Prioritäten und Besonderheiten kommt dabei eine bedeutende Rolle zu (Hirsch Hadorn, 2008). Ihre Einbeziehung soll letztlich zu einer stärkeren Identifikation und einem ausgeprägten Verantwortungsgefühl für die Fragestellung und zu einer höheren Qualität, Legitimität und Akzeptanz der erarbeiteten Lösungswege beitragen (Lang et al., 2012). Forschung und Praxis der Regionalentwicklung zeigen, dass selbstorganisierte Plattformen für langfristiges, soziales Lernen und die Integration vielfältiger Akteurinnen und Akteure eine bedeutende Rolle für die Nachhaltigkeit von Entwicklungsprozessen spielen, Prozesse aber oftmals nicht die gewünschten Ergebnisse bringen (Turnhout et al., 2020).Vor diesem Hintergrund können transdisziplinäre Kooperationen eine Arena für umfassende Lernprozesse und Capacity Building schaffen und dadurch dazu beitragen, dass sich unterschiedliche Personen aus Forschung und Region produktiv in kommunikative, egalitäre Planungs-, Entwicklungs- und Entscheidungsprozesse einbringen können (Innes and Booher, 2004; Uitermark and Duyvendak, 2008). Dennoch führen auch transdisziplinäre Forschungskooperationen nicht immer zu den gewünschten Ergebnissen (Luthe, 2017; van Drooge and Spaapen, 2017; Zscheischler et al., 2017; Schauppenlehner-Kloyber and Penker, 2015;). Klassische „Stolpersteine" liegen dabei u.a. in folgenden Herausforderungen:

- Initialphasen, werden – nicht zuletzt aufgrund der gegenwärtigen wissenschaftlichen Förderlandschaft – seitens der wissenschaftlichen Partner vordefiniert, die Leistungen der Praxispartner werden oftmals nicht durch die Förderprogramme abgedeckt.
- Forschungspartner ziehen sich oftmals vor der Umsetzungsphase zurück, ohne Sicherung des Fortschrittes (Monitoring, Begleitung danach, etc.) und ohne Institutionalisierung der sozio-institutionellen Lernstrukturen für zukünftige selbstorganisierte Lern- und Veränderungsprozesse.
- Die Grundannahme, dass transdisziplinäre Gruppen bessere Lernerfolge und nachhaltigere Lösungen zu „Wicked Problems" vorweisen können ist zwar oftmals angeführt, doch nur mangelhaft empirisch belegt. Eine Wirkungsmessung aus größerer Distanz nach Projektabschluss bleibt i.d.R. aus.

Beim Design des nachfolgend präsentierten Forschungsvorhabens wurde ein besonderer Fokus auf den Umgang mit den genannten Herausforderungen gelegt.

4 SELBSTERMÄCHTIGUNG, SELBSTORGANISATION UND REGIONALE TRANSFORMATION IN DER REGION RÖMERLAND CARNUNTUM

4.1 Die Leader-Region Römerland Carnuntum

2018 lebten in den damals 28 Gemeinden der Römerland Carnuntum 82.032 Menschen (Statistik Austria, 2019). Eine wirtschaftlich prosperierende Region die im Gegensatz zu vielen Abwanderungsregionen Niederösterreichs eine stark positive Bevölkerungsentwicklung verzeichnet (2002-2018). Die höchsten Zuwächse verzeichneten Gramatneusiedl (+56 %) und Haslau-Maria Ellend (+53 %), mehrere Gemeinden befinden sich unter den zehn Gemeinden mit den größten relativen Zuwächsen in ganz Niederösterreich (Statistik Austria, 2019). Keine einzige Gemeinde verzeichnete über den Zeitraum einen Bevölkerungsverlust. Besondes stark wuchsen die Gemeinden im Nahbereich derhochrangigen Schienen- und Straßeninfrastrukturachsen zwischen Wien und Bratislava. Viele einkommensstärkere Personen aus der Slowakei ziehen in die östlichen Gemeinden der Region an der österreichisch-slowakischen Grenze. Dies ist hauptsächlich auf niedrigere Grundstücks¬preise und die gute Infrastruktur zurückzuführen. Die Bevölkerungsdichte liegt deutlich über dem niederösterreichischen Durchschnitt. Im Gegensatz zu dieser positiven Wachstumsdynamik gibt es aber auch räumliche Entwicklungen, die bei den künftigen Planungsvorhaben besondere Aufmerksamkeit verdienen. Die Region gehört beim Feinstaub, bei den Hitzetagen und dem CO2 Eintrag pro Fläche zu den am höchsten belastetsten Gebieten in ganz Österreich (Amt der niederösterreichischen Landesregierung, 2019; CCCA Data Centre, 2019). Diese Faktoren stehen in Widerspruch zur Funktion einer „grünen Mitte“ zwischen Wien und Bratislava (Magistrat der Stadt Wien, 2005). Das Römerland Carnuntum weist einen hohen Anteil unterschiedlichster klein- und großflächiger Schutzgebiete auf. Am prominentesten ist dabei der Nationalpark Donauauen und auch der Alpen-Karpaten-Korridor führt durch die Region. Darüber hinaus befinden sich ein Naturpark (Mannersdorf am Leithagebirge - Wüste), Natura2000 Gebiete (Feuchte Ebene-Leithaauen, Donau-Auen östlich von Wien, Hundsheimer Berge), Naturschutzgebiete, das Ramsarschutzgebiet Donau-March-Thaya-Auen und eine große Zahl erhaltenswerter Gebäude im Grünland in der Region.

4.2 Projekthintergrund und -ziele

Die Akteurinnen und Akteure der LEADER-Region Römerland Carnuntum kamen zu dem Schluss, dass alternative und innovative Wege der regionalen Entwicklung erforderlich sind, um einerseits eine Selbstermächtigung regionaler Strukturen und Akteurinnen und Akteure zu forcieren und andererseits die Abhängigkeit von Fördersrtrukturen und –vorgaben zu reduzieren. Auf Initiative des Regionalentwicklungsvereins wurde daher 2019 der „Club of Rome Carnuntum“ gegründet, der entsprechend den Zielen des Club of Rome ein Modell der geistigen und nachhaltig wirksamen europäischen Regionalentwicklung in der LEADER-Region Römerland Carnuntum verwirklichen möchte. Zu den zentralen Anliegen des „Club of Rome Carnuntum“ zählen u.a.

- der Wissenstransfer für regionale Innovation und Nachhaltigkeit (i.e. Forschung, Bildung und Dialog für eine lebenswerte und nachhaltige Zukunft)
- die Entwicklung neuer Instrumente und Methoden für eine Zusammenarbeit auf Augenhöhe von Politik und Gesellschaft
- die Erforschung von Visionen, Strategien und Maßnahmen für ein nachhaltig lebenswertes Römerland
- und die bewusste Gestaltung der Lebensräume.

Das vorliegende Projekt setzt sich mit diesen Herausforderungen in einem kollektiven Lernprozess in der Region auseinander, um innovative Lösungsansätze zu erarbeiten. Ziel ist es, regionale Strukturen und Prozesse der Selbstermächtigung, Selbstorganisation und Transformation zu entwickeln, systematisch zu testen und zu implementieren. Die Region Römerland Carnuntum möchte sich dadurch als Modell- und Lernregion positionieren und eine Vorreiterrolle für andere Regionen einnehmen. Es werden im Rahmen des Projektes verschiedene transdisziplinäre Prozesse und neue Strukturen der Selbstorganisation erprobt und

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systematisch hinsichtlich ihres transformativen Lernerfolgs untersucht, darüber hinaus werden die Übertragbarkeit und Transfer von Erfahrungen und Ergebnissen auf andere Regionen beleuchtet.

Abbildung 1 veranschaulicht den Ablauf und die Struktur des Forschungsvorhabens. Zentrales Element des Projektes ist die Etablierung und Institutionalisierung eines regionalen Zukunftsrates (siehe Kapitel 5.1), der als transdisziplinäres Reflexions- und Ko-Entscheidungsgremium eine bedeutende Rolle im Projekt einnimmt. Ausgangspunkt ist ein kollaborativer Visionsprozess zur Erarbeitung einer gemeinsamen Zukunfsagenda für das Römerland Carnuntum 2040 als Modellregion für Nachhaltigkeit und Transformation. Die unverbindlichen Ergebnisse des Strategieprozesses sollen in der Lokalen Entwicklungsstrategie für die LEADER-Förderperiode 2021-2027 ‚verfestigt' werden (Metzger and Schmitt, 2012). Der Zukunftsrat und zwei Regionsschmieden bieten Lern- und Experiemtierräume um erste Schritte in Richtung Umsetzung zu ermöglichen. Die angewandten Prozesse und Methoden sind dabei nicht als isolierte und „einmalige" Interventionen („On-Off-Prozesse") zu verstehen, sondern bilden die Basis für nachhaltige Lern- und Transformationsprozesse in der Region.

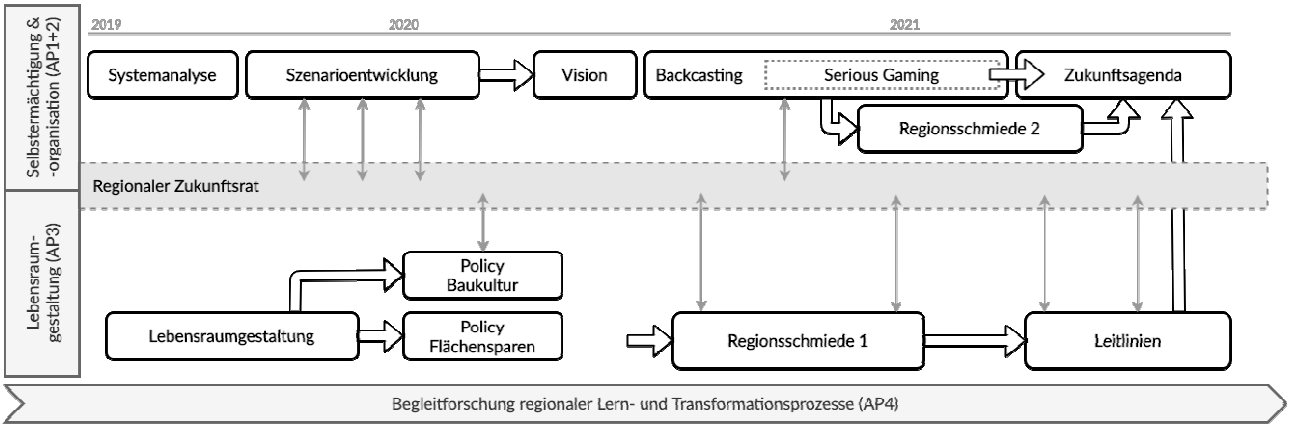

Abb. 1: Projektstruktur und -ablauf

4.3 Methodenvielfalt

Der innovative Charakter des Projekts liegt in der Kombination und systematischen Testung innovativer transdisziplinärer Methoden, die eine Aktivierung und Verknüpfung von expertinnen- und expertenbasiertem und lokalimplizitem Wissen fördern und konkrete Lern- und Experimentierräume zum spielerischen Testen neuer innovativer Lösungsansätze schaffen soll.

(a) Partizipativer Szenarioprozess zur Erarbeitung einer Vision Römerland Carnuntum 2040: wissenschaftsgeleitete und durch lokal implizites Wissen erweiterten Systemanalyse; Entwurf verschiedener plausibler und normativer (wünschenswerter) Zukunftsoptionen; öffentliche online-Bewertung der Szenarien; Entscheidung im Zukunftsrat über das favorisierte Zukunftsbild als Grundlage für die Vision Römerland Carnuntum 2040.

(b) Einsatz von Serious Games für das Backcastingzur Entwicklung einer Zukunftsagenda: spielerisches Entwerfen und Testen von Handlungsoptionen zur Erreichung der in der Vision gesteckten Ziele,Formulierung einer Zukunftsagenda; Input für LES 2021-2027.

(c) Zwei Regionsschmieden (Reallabore) zum Erproben regionaler Transformation. Konkrete Veränderungsprozesse, Maßnahmen, Aktionen – sogenannte „Transition Experiments" zu zwei unterschiedlichen Themen werden erarbeitet, ausprobiert und evaluiert (Luederitz et al., 2017).

Durch die transdisziplinären Methoden werden soziale Lernprozesse in Bezug auf das kognitive Systemwissen, das Zielwissen sowie Transformationswissen angeregt. Eine sozialwissenschaftliche Begleitforschung zielt neben einer laufenden Evaluierung des Projektes auf die Erhebung dieses bisher empirisch wenig betrachteten Lernerfolges trandisziplinärer Projekte ab. Dies beinhaltet einerseits zu erheben, ob und welches soziale Lernen in Zusammenhang mit bestehenden Normen, Annahmen, Zielen und Visionen stattfindet und andererseits worin der Beitrag dieser Lernprozesse zum regionalen Transformationsprozess besteht. Dabei wird auf unterschiedliche Methoden zurückgegriffen: Expertinnen- und Experten-Interviews, teilnehmende Beobachtung, quantitative Befragung der Mitglieder des

Zukunftrates sowie einer zufällig ausgewählten Kontrollgruppe in der Region (drei Mal im Projektverlauf) als auch eine Beforschung des Projetteams mittels q-Methode.

5 ERGEBNISSE UND DISKUSSION

Dieses Kapitel präsentiert einen Einblick in die zentralen Herausforderungen des ersten Projektjahres, mit Hauptaugenmerk auf der Etablierung des regionalen Zukunftsrates, dem im gesamten Projektverlauf eine zentrale Rolle zukommt. Die Erkenntnisse beruhen auf der Dokumentation und Nachbearbeitung der durchgeführten Sitzungen (im Team und im Zukunftsrat). Zusätzlich wurden explorative Interviews (n=9) und im Rahmen der Begleitforschung zwei quantitative Befragungen (im Zukunftsrat (n=81), in einer Vergleichsgruppe in der Region (n=161)) durchgeführt.

5.1 Etablierung eines regionalen Zukunftsrates zur Institutionalisierung zukunftsorientierter Lern- und Transformationsprozesse in der Region.

Dem Zukunftsrat kommt in Bezug auf ein offenes und flexibels Ko-Design des Forschungsprozesses und eine Institutionalisierung von Lern- und Transformationsprozessen über den Projektzeitraum hinaus eine entscheidende Bedeutung zu. Seine Etablierung erforderte im ersten Projektjahr auch deshalb sehr viel Aufmerksamkeit, da diesem Gremium darüber hinaus eine zentrale Rolle in der Einbettung des Projektes in der Region zugeschrieben wird. Im Fokus standen vor allem Fragen der Repräsentativität und Legitimation.

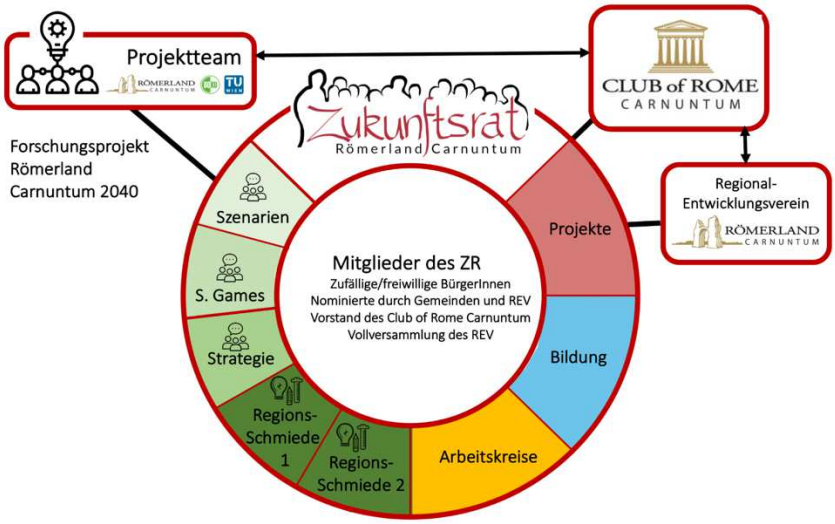

Abb. 2 : Der Zukunftsrat fungiert als zentrale Kommunikationsdrehscheibe im Projekt

(a) Zusammensetzung des Zukunftsrates

Räumlich umfasst der Zukunftsrat die 30 Gemeinden des Regionalentwicklungsvereins Römerland Carnuntum. Sowohl Entscheidungsträgerinnen und Entscheidungsträger und weitere Repräsentantinnen und Repräsentanten der Gemeinden, als auch Vertreterinnen und Vertreter der Regionalentwicklung sowie Bürgerinnen und Bürger, die sich an der Entwicklung der Region aktiv beteiligen wollen, sind darin vertreten. Konkret sollten als Mitglieder zur Teilnahme eingeladen werden (Summe rd. 200 Personen):

- die Vollversammlung des Regionalentwicklungsvereins Römerland Carnuntum (diese umfasst u.a. alle Bürgermeisterinnen und Bürgermeister der Region) – rd. 80 Personen, legitimiert durch Rolle/Funktion;
- aus jeder Gemeinde ein/e durch die Gemeindevertretung nominierte Person (mit oder ohne polit./administrative Funktion) – 30 Personen, ad personam ausgewählt;
- den Vorstand des Club of Rome Carnuntum – 9 Personen, legitimiert durch Rolle/Funktion;
- 30 durch den Regionalentwicklungsverein nominierte Personen – ad personam ausgewählt;
- 30 Bürgerinnenund Bürger: 1/Gemeinde – per Zufallsauswahl ad personam ausgewählt;

Die regionalen Vertreterinnen und Vertreter des Projektteams führten zu Projektbeginn umfangreiche persönliche Gespräche mit den Gemeinden und möglichen Mitgliedern des Zukunftsrates. Während das

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Projekt bei einzelnen Akteurinnen und Akteuren rasch eine hohe Zustimmung fand, konnten andere wiederum keinen Anknüpfungspunkt finden. So nehmen bis dato nicht alle Gemeinden die Möglichkeit wahr, sich im Zukunftsrat zu engagieren. Die Besetzung des Gremiums gestaltete sich schwieriger als zunächst erwartet, v.a. in Bezug auf die zufällige Auswahl von Bürgerinnen und Bürgern. Oftmals wurde das Argument des Datenschutzes genutzt, um keinen Zugang zu den Meldedaten zu gewähren. Es mussten daher gleich zu Beginn die vorab formulierten Regeln zur Besetzung des Zukunftsrates abgeändert werden und die Teilnahme für interessierte Bürgerinnen und Bürger geöffnet werden, um die Repräsentanz der Zivilgesellschaft zu forcieren. So wurden in einem weiteren Schritt Bürgerinnen und Bürger, die von sich aus Interesse an einer Mitarbeit bekundet hatten, eingeladen sowie weitere (v. a. Jugendliche und junge Erwachsene) persönlich, aber auch per Mail-Aussendungen, dazu motiviert, am Zukunftsrat teilzunehmen.

(b) Teilnahme und Motivation

Nach den ersten drei Sitzungen lässt sich folgender Einblick geben: An jeder Sitzung nahmen rund 75 Personen teil (es lässt sich keine Abnahme zur Motivation zur Teilnahme beobachten). 10 der 30 Gemeinden haben keinerlei Vertretung im Zukunftsrat (weder polit./admin. noch Bürgerin oder Bürger). Von den letztendlich 15 zufällig ausgewählten Bürgerinnen und Bürgern nahmen 11 an den Sitzungen teil, 13 weitere interessierte Bürgerinnen und Bürger traten dem Zukunftsrat bei. Von den Bürgermeisterinnen und Bürgermeistern der Region konnten bisher acht zu einer Teilnahme an den Sitzungen motiviert werden, wobei die Hälfte an mehr als nur einer Sitzung teilnahm. Rund 25 Personen nahmen an jedem der bisherigen Treffen teil, wobei es sich dabei rund zur Hällfte um Personen aus dem Umfeld der Regionalentwicklung (Vollversammlung, Club of Rome, Nominierte durch den Regionalentwicklungsverein) handelt. Grundsätzlich lässt sich zusammenfassen, dass Bürgerinnen und Bürger und jene Personen, die durch unmittelbare Nähe zum Regionalentwicklungsverein in den Zukunftsrat kamen, konsequenter im Zukunftsrat vertreten sind als politisch/administrative Vertreterinnen und Vertreter der Gemeinden. Ob eventuell die Vorbereitung auf die Gemeinderatswahl im Jänner 2020 eine Erklärung dafür sein kann, wird sich zeigen, sollten nach der Wahl mehr Entscheidungsträgerinnen und Entscheidungsträger am Zukunftsrat teilnehmen. In Bezug auf die Altersstruktur ist als bemerkenswert festzuhalten, dass bei allen Sitzungen eine sehr aktive Jugend präsent war.Eine detaillierte Auswertung der Teilnehmerinnen- und Teilnehmerlisten wird noch genauere Rückschlüsse zulassen.

Aus der ersten Befragung des Zukunftsrates in der Projektstartphase ging hervor, dass die Hauptmotivationen mitzuwirken wie folgt zusammengefasst werden können: a) der/die Teilnehmerin oder Teilnehmer hat bestimmte Themen, die ihm/ihr am Herzen liegen und für die sie/er sich einsetzen will, b) es besteht die Überzeugung, dass im ZR „Neues“ entstehen kann, und man Teil dieser Veränderung sein möchte sowie c) Bürgerinnen und Bürger leisten einen wertvollen Beitrag und sollten deshalb mitreden.

(c) Repräsentativität des Zukunftsrates

Im Zuge der Befragungen zeigt sich, dass die Themen, die im Zukunftsrat als wichtig erachtet wurden,zwar grundsätzlich weitgehend deckungsgleich mit den Themen der Befragten in der Region sind, ihnen jedoch eine zum Teil deutlich unterschiedliche Priorisierung zukommt. Dies bezieht sich einerseits auf jene Aspekte, die in der Region als wertvoll erachtet werden, als auch auf die Ziele, die die Region bis 2040 erreichen soll. Während innerhalb des Zukunftsrates die Aspekte „Natur und Lebensraum“, „Bildung“, „Wirtschaftsraum“ und „Lage zwischen Wien und Bratislava“ als besonders bedeutend hervorgehoben wurden, waren dies für die Befragten aus der Region insbesondere „Geschichte und kulturelles Erbe“, „Wein und Kulinarik“, „Natur und Landschaft“ sowie die „Lage“. Die Ziele, die die Region bis 2040 erreichen soll, unterscheiden sich dahingehend als der Zukunftsrat die Bereiche „Bildung“, „Lebensqualität“ und „Umwelt“ hervorhebt, während die Befragten aus der Region „Verkehr und Lebensqualität“, „Migration“ sowie „Natur und Landwirtschaft“ als jene Bereiche mit dem größten Handlungsbedarf identifizieren. Diese inhaltlichen Diskrepanzen zwischen dem Zukunftsrat und den Befragten aus der Region regen Überlegungen zur Repräsentativität der Teilnehmerinnen und Teilnehmer im Zukunftrat an, da sich diese in weiterer Folge auch auf den Szenario- und Visionsprozess sowie die Zukunftsagenda auswirken. Dem wird durch eine bewusste Öffnung des Projektes (z.B. Abstimmung über das gewünschte Szenario durch alle Einwohnerinnen und Einwohner der Region) sowie weitere Befragungen im Projektverlauf begegnet.

(d) Selbstorganisation und Selbstermächtigung

Aus der Forschung ist bekannt, dass die Möglichkeit von Kollektiven, ihre eigenenen Spielregeln auszuverhandeln und festzulegen ein zentraler Erfolgsfaktor für nachhaltige Prozesse der Selbstorgansiation ist. Daher wurde den Teilnehmerinnen und Teilnehmern der ersten Sitzung des Zukunftsrates die Möglichkeit engeräumt, eigene Spielregeln für die zukünftige Zusammenarbeit zu entwerfen. Dazu wurden Themenfelder und Bausteine (z.B. Grenzen der Mitgliedschaft, Selbstbestimmung, Monitoring und Anpassung, Konfliklösung) vorbereitet und von den Mitgliedern diskutiert. Darüber hinaus wurden grundlegende Werte als Basis der zukünftigen Zusammenarbeit erarbeitet. Es zeigte sich, dass vor allem die Themen der Verbindlichkeit (regelmäßige Teilnahme an den Sitzungen) hoch bewertet wurden, ebenso wie die wertschätzende Kommunikation auf Augenhöhe (z.B. auch ausgedrückt durch Du-Anrede zwischen allen Beteiligten). Außerdem wurde vor allem der Wunsch nach einem „Neuartigen", lockeren, anregenden, kreativen und innovativen Lern- und Arbeitssetting geäußert.

Der Gestaltung der Zukunftsratssitzungen kommt auch vor diesem Hintergrund eine besondere Bedeutung zu. Es wurde darauf geachtet, ansprechende Räume zu schaffen, um Prozesse der Selbstermächtigung zu fördern und Transformation in kreativ/spielerisch/anregender Weise zu erproben. Dazu wurden anschaulich-unterhaltsame Methoden der Wissensvermittlung wie z.B. ein interaktives Quizformat und alternative Visualisierungsmedien (Graphic Facilitation, dreidimensionale Aufsteller etc.) genutzt. Die regionalen Zukunftsvisionen wurden mittels Prototyping/Design Thinking, Rollenspielen und weiteren kreativitätsfördernden Methoden erarbeitet.

Noch unklar bleibt bis dato das tatsächliche „Gewicht" von Entscheidungen, die im Zukunftsrat gefällt werden. Während im Rahmen des Forschungsprojektes die Ergebnisse des Zukunftsrates als verbindlich gelten, gibt es (noch) kein Committement auf regionaler Ebene. Zwar sollen die Inhalte der Vision und Zukunftsagenda in die Erarbeitung der nächsten LEADER Strategie (2021-2027) einfließen, allerdings wurde kein Agreement darüber eingegangen, nach welchen Kriterien die Ergebnisse einfließen sollen, welche Inhalte Berücksichtigung finden und wie darüber entschieden wird. Ob und wie eine dauerhafte Implementierung des Zukunftstratesin der Region über die Projektlaufzeit erfolgt, wird sich erst im Projektverlauf weisen können.

5.2 Transdisziplinäres Set-Up des Forschungsvorhabens in der Antrags- und Startphase

Während die Projektdesigns trandsisziplinärer Forschungsvorhaben zumeist vorab von den wissenschaftlichen Partnerinnen und Partnern entwickelt und die lokalen Partnerinnen und Partner erst nach Problemdefinition und Zielsetzung in das Vorhaben integriert werden, ging im Falle des vorliegenden Forschungsvorhabens die Initiative von den regionalen Akteurinnen und Akteuren aus, und wissenschaftliche Partnerinnen und Partner für eine gemeinsame Umsetzung wurden gesucht. Damit gingen durchaus Herausforderungen in Punkto gemeinsamer Festlegung auf Projektdesign und -ziele einher. Rund ein Jahr wurde in einem intensiven Aushandlungsprozess an der Entwicklung des Forschungsvorhabens gefeilt (Ko-Design), wobei neben der Abstimmung im Team auch die Anpassung des Projektes an Möglichkeiten und Einschränkungen seitens des Fördergebers eine spezielle Herausforderung darstellte. So ist beispielsweise die Finanzierung der Leistungen regionaler Partnerinnen und Partner durch wissenschaftliche Förderschienen in der Regel – und so auch in diesem Fall – nicht vorgesehen, was das Schnittstellenmanagement zwischen Forschung und Praxispartnerinnen und Praxispartner erschwert. Gleichwohl ist die Integrationsleistung, die regionale Projektpartnerinnen und Projektpartner in der Region vornehmen durchaus von Relevanz für den Projekterfolg. Im Laufe der Projektvorbereitung, und auch laufend während der Startphase, mussten daher alternative Finanzierungen für einzelne Elemente des Projektes eingeworbenwerden.

Das Team umfasst 13 Mitglieder von BOKU, TU, Region und zwei prozess-unterstützende Moderatoren. In zumindest monatlich stattfindenden Teamsitzungen werden die zentralen Prozessschritte gemeinsam geplant und abgestimmt. Darüber hinaus finden nahezu wöchentlich Sub-Teamsitzungen zur Detailplanung statt. Dem transdisziplinären Selbstverständnis wird auch in der Projektdurchführung ein hoher Wert beigemessen (Ko-Produktion).Das bedeutet u.a., dass sämtliche Projektschritte der Startphase gemeinsam diskutiert und geplant wurden. Dies fordert die „Alltagsgewohnheiten" der Projektpartnerinnen und Projektpartner durchaus heraus, ein hohes Maß an Zeit für Abstimmung und Diskussion ist nötig, was mit einer hohen Dichte an Teamsitzungen einherging. Durch unterschiedliche Arbeitsweisen und -haltungen sowie verschiedene (Fach-)Sprachen in einem heterogenen Team mit verschiedenen beteiligten Disziplinen (und

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der Praxis), ergab sich immer wieder die Notwendigkeit, Planungen u.U. auch sehr kurzfristig (z.B. unmittelbar vor Sitzungen des Zukunftsrates) abzuändern, damit alle im Team die Vorgehensweisen mittragen konnten oder immer wieder an einem gemeinsamenVerständnis von Projektzielen, anstehenden Schritten etc. zu arbeiten. Zuweilen sind auch scheinbar gleiche Begrifflichkeiten von den unterschiedlichen Projektpartnerinnen und Projektpartnern mit unterschiedlichen Bedeutungen besetzt, was zusätzliche Kommunikations- und Verständnisschleifen nötig macht.

5.3 Anknüpfen an vorangeganene Vorhaben - LENA und Regionsschmiede1

Die Anknüpfung transdisziplinärer Forschungsvorhaben an bereits vorhandene Strukturen, Organisationen oder Projekte (in der Region) stellt einen zentralen Faktor für den Vernetzungs- und Umsetzungserfolg dar (Thompson et al., 2017). Im Falle des vorliegenden Projektes kann bereits auf mehrere Initiativen und Projekte aufgebaut werden. So knüpft die Regionsschmiede 1 (Durchführung ab Frühjahr 2020) an das Projekt „LENA- Unseren LEbensraum gemeinsam NAchhaltig planen & gestalten:Grundsätze und Leitlinien einer regionalen Planungskultur und nachhaltigen Lebensraumgestaltung“ an, in dessen Rahmen die vom Bundeskanzleramt 2017 publizierten baukulturellen Leitlinien auf die regionale Ebene umgelegt wurden. Ausgangspunkt war ein Diskussionsprozess mit regionalen Akteurinnen und Akteuren und externen Expertinnen und Experten zur Fragestellung, wie der Ablauf baulicher Aktivitäten zur Erhaltung und Förderung einer hohen Lebensqualität stattfinden soll(Dillinger et al., 2019). Als erstes Ergebnis entstand das Pactum Römerland Carnuntum, in dem sich 28 Gemeinden zur Achstamkeit in Planung und Durchführung baulicher Aktivitäten und zur regionalen Zusammenarbeit für zukunftsorientiertes Bauen bekennen.

Im Rahmen der ersten Regionsschmiede wird darauf aufbauend die Institutionalisierung eines Regionalen Planungs- und Gestaltungsbeirats (REGB) erprobt und getestet. Der Beirat soll Richtlinien und Kriterien für seine Entscheidungsfindung erstellen, Planungsvorhaben beurteilen und Gemeinden planerische Empfehlungen geben. Eine der zentralen Herausforderungen, welche in der Regionsschmiede erarbeitet werden, befasst sich mit der Festlegung der regionalen Relevanz sowie der Prüfwürdigkeit von Projekt- und Bauvorhaben, womit Rückschlüsse auf die Ermächtigungsstrukturen im Sinne der regionalen Selbstermächtigung, Selbstorganisation und Transformation gezogen werden können. Die Regionsschmiede soll dazu beitragen, die Stakeholder in der Region zu vernetzen, als Plattform für Erfahrungsaustausch eine fachliche Kooperations- und Diskussionsstruktur für eine koordinierte Regionalentwicklung zu etablieren und gemeinsam Werkzeuge für die künftige Entwicklung des Römerlands Carnuntum zu schmieden. Die Regions-Schmiede als kontinuierliches Informations- und Diskussionsforum, soll eine gemeinsame Planung und Begleitung der erarbeiteten Anliegen aus dem Projekt LENA sowie aus dem Zukunftsrat ermöglichen.

6 SCHLUSSFOLGERUNGEN

Im Laufe des ersten Projektjahres bestätigte sich, dass das Set-Up eines transdisziplinären Forschungsvorhabens, mit einem hohen Maß an Interaktion in der Region, allen Beteiligten einen großen persönlichen Einsatz abverlangt und auch die Grenzen des Aufwandes „traditioneller“ Formen der Zusammenarbeit zwischen Wissenschaft und Praxis übersteigt. Im Rahmen der Ausarbeitung der Projektziele und des Projektdesigns im Konsortium wurde auch in diesem Fall deutlich, dass Instrumente der Forschungsförderung in der Regel nicht auf die Förderung transdisziplinärer Vorhaben ausgerichtet sind, was sich z.B. durch Grenzen der Förderbarkeit der Beiträge regionaler Projektpartner wiederspiegelt, die jedoch für den Projekterfolg eines derartigen Vorhabens von zentraler Bedeutung sind, da letztlich auch der wissenschaftliche Erfolg von der Kooperationsbereitschaft, d.h. dem nicht-bezahlten (oder alternativ finanzierten) Einsatz der regionalen Akteure abhängig ist.

. Es bestätigte sich darüber hinaus, dass die Startphase der Projektzusammenarbeit im Rahmen eines transdisziplinären Konsortiums eines besonderen Augenmerks auf das Finden einer gemeinsamen Sprache, das „Einpendeln“ auf ein geeignetes und handelbares Maß an Abstimmung und Integration, sowie das gemeinsame Erarbeiten einer „Kooperationskultur“ bedarf.

In Bezug auf die Implementierung des Zukunfstrates in der Region zeigte sich, dass die Besetzung eines derartigen Gremiums mit einigen Herausforderungen verbunden ist. Vor allem die zufällige Auswahl von Bürgerinnen und Bürgern stellte sich als schwierig dar. Aufgrund der Unsicherheit, nicht zu wissen, welche Personen dadurch Mitglied im Zukunftsrat werden könnten, sowie aufgrund der Datenschutzgrundveordnung unterstützten einige Gemeinden diese Vorgehensweise nicht. Bisherige (positive) Erfahrungen mit der

Zufallsauswahl liegen vor allem aus kurzfristigen Projekten vor (z.B. Bürgerinnen- und Bürgerräte). Im Kontext „längerfristig" agierender Gremien gibt es noch weiteren Forschungsbedarf. Was die Zusammensetzung des Zukunftsrat betrifft, zeigte sich weiters, dass die signalisierte Diversität, die sich durch die Einbidung unterschiedlicher Organisationen, Interessensgruppen, Vereine und Gebietskörperschaften ergibt verschwimmt, wenn man eine Ebene tiefer – von der Organisationsebene auf die Personenebene – blickt: wie in andere Regionen zeigt sich eine starke Überlappung der Akteurinnen und Akteure, die in multiplen Rollen ‚unterschiedliche Hüte' aufsetzen und in der Region aktiv sind. Solche zentralen Akteursknoten können sich sowohl als ‚boundary-spanner' (vermittelnd zwischen dem Zukunftsrat als regionales Netzwerk und der Gemeinde, als fomal-administrative, lokale Ebene) als auch als ‚gatekeeper' des Netzwerks (durch z.B. Verhinderung möglicher Mitglieder) ausbilden. Spannungen bei zentralen Akteursknoten, führen Rauws und de Jong (2019) insbesondere auch auf ‚belonging tensions' zurück, die sich durch konkurrierende Identitäten (z.B. regionales informelles Netzwerk vs. offizieller Gemeindevertreter) und Werte herausbilden.

Die Möglichkeit der Anbindung an vorangegangene Projekte in der Region (insbesondere LENA sowie Aktivitäten des Regionalentwicklungsvereins in Zusammenhang mit dem Club of Rome) erweist sich als sehr unterstützend, v.a. in Hinblick auf die Nutzung bereits bestehender Akteursnetzwerke und die Motivation einzelner Personen, sich auch weiterhin zu engagieren und eine Weiterentwicklung von Ergebnissen/Erkenntnissen früherer Projekte zu unterstützen.

Trotz der im gegenständlichen Beitrag vorrangig behandelten Herausforderungen transdisziplinärer Projekte in der Startphase, soll nicht unerwähnt bleiben, dass dieses neue Verständnis von Regionalentwicklung, als auch der Kooperation von Wissenschaft und Praxis, auf ein herausragendes Engagement und hohe Teilnahmebereitschaft der regionalen Bevölkerung stoßen. Damit ist eine wichtige Voraussetzung erfüllt,damit sich der Zukunftsrat als selbstwirksames Gremium etablieren und damit den Fortbestand des Lern- und Transforamtionsprozesses über die Projektlaufzeit hinaus gewährleisten kann.

7 DANKSAGUNG

Dieser Artikel wurde im Rahmen des Projektes „Selbstermächtigung,Selbstorganisation undregionale Transformationen in der Modellregion Römerland Carnuntum" verfasst. Das Projekt wird gefördert von der Abteilung für Wissenschaft und Forschung des Amtes der niederösterreichischen Landesregierung.

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reviewed paper

Shaping Urban Changes for Child-Friendly Cities: How Participation and Co-Creation Processes are Transforming Car-Oriented Neighbourhoods in the Metamorphosis Project

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1 ABSTRACT

The focus on cars in urban planning has made cities increasingly child-unfriendly. The European research project Metamorphosis aims at introducing new ideas and suggestions for changing this by empowering active mobility and bottom-up human-scale design. In three years, from 2017 to 2020, three universities, three commercial parties and seven cities work together towards a common goal: the development and implementation of bottom-up measures to achieve lasting behavioural change to make neighbourhoods more inclusive, active, less car-dependent and thus child-friendlier. The exploration of new ways to involve primary school children in city planning proofed to be successful and granted bigger support for the project among children, parents, schools, neighbours and policy makers. Aim of this paper is to elaborate on the implemented measures, the participation and co-creation processes carried out, as well as on the evaluation approach used, the project results and lessons learnt.

Keywords: child-friendly neighbourhood, co-creation, active mobility, behavioural change, public space

2 INTRODUCTION

Metamorphosis, as the Greek word suggests, is about changes. It is an EU-funded project based on the initial premise that, when an urban neighbourhood has many children in its public spaces, this is a major indicator that it is well designed as a people-oriented and sustainable neighbourhood (Gehl, 2013).[1]

Metamorphosis includes implementations in seven European cities participating with in total 64 different neighbourhoods (Fig. 1), selected to have a wide variety in size, structure, density and diversity. The participating partner cities are: Alba Iulia (RO), Graz (AT), Meran (IT), Munich (DE), Southampton (UK), Tilburg (NL) and Zurich (CH). The research and consultancy partners involved in the project are FGM-AMOR (AT), Ökoinstitut Südtirol (IT), Technische Universität Dresden (DE), University of Southampton (UK), Breda University of Applied Sciences (NL) and Synergo (CH). This international approach was taken on purpose. Since bottom-up measures are all about the community, it is essential to explore this as a wide range of different contexts to try to understand why something would work in Southampton and not in Graz, or vice versa.

Fig. 1: Cities implementing the Metamorphosis measures

Main project objectives are:

[1] http://www.metamorphosis-project.eu/

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(1) Transform car-oriented neighbourhoods into children-friendly urban environments, achieve mobility behavioural changes and increase the quality of life;

(2) Build the vision needed for such transformations - involving end-users, including children, and stakeholders;

(3) Answer some basic research questions related to neighbourhood transformation regarding catalysts for integration, the connection between neighbourhoodness and engaging in neighbourhood activities and how to engage with difficult to reach target groups;

(4) Achieve creative breakthrough innovations – in development, in design, in governance and in planning procedures - for streets, squares and other public spaces in neighbourhoods and urban districts by involving end-users;

(5) Develop and implement children friendly mobility solutions (e.g. pedestrianisation, better and more equitable shared public spaces, street design elements, child-oriented 'Share Points');

(6) Evaluate take up, involvement, process and impacts using innovative evaluation methodologies;

(7) Develop and implement innovative transfer instruments to transfer Metamorphosis-innovations from city to city and country to country, also beyond the duration of the project.

3 THE INNOVATIVE METAMORPHOSIS APPROACH

3.1 Nature of the implemented measures

The measures the seven partner cities are implementing lead from temporary activities to permanent implementations and are classified in the following areas:

- Interventions in public space, including e.g. hybrid zones, living labs and other interventions as public breakfasts, the transformation of parking spaces and on-street leisure elements.
- Temporary closures/openings, including e.g. closure of streets or squares for cars and open them for people in the form of holiday streets, festivals and living labs, particularly around schools and kindergartens. They grant children the opportunity to play on the street and use them as meeting space, promoting neighbourhoodness and child-friendliness. Especially for immigrant parents, it's essential to build their network through their kids.
- Crystallisation points - locations where people and children can communicate. These could be share points (e.g. mobility points) or urban gardens.
- Educational innovation tools - awareness raising tools, tools to encourage change and involve children in a playful way. This also includes inputs to the curricula, for example with provision of material to educate teachers and pupils on how to conduct a local school 'environment scan'. For this, the consortium is working closely with educators.
- Empowerment of active mobility, in the form of workshops and trainings to increase cycling competence, bike repair courses, walking buses, etc.
- In addition, the improvement of planning procedures and integration of know-how and successful activities into the local SUMP are also expected in the project.

3.2 Participation and co-creation with children

Since a sustainable neighbourhood, in terms of generations, implicates the involvement of the next generation, the project has its main focus on primary school children. The unique and innovative approach of Metamorphosis is to make children, ranging mainly from six till thirteen, essential stakeholders in thinking about urban space and value their input during all the phases of the project (Fig. 2). In every phase, children were involved differently. In the co-creating workshops, they came up with the measures and they helped with the implementations. After the implementation, they helped with the collection and evaluation of data for specific indicators and results that they then disseminated among their families. This involvement granted the opportunity to analyse urban problems not only from a researcher's perspective but also through children´s eyes.

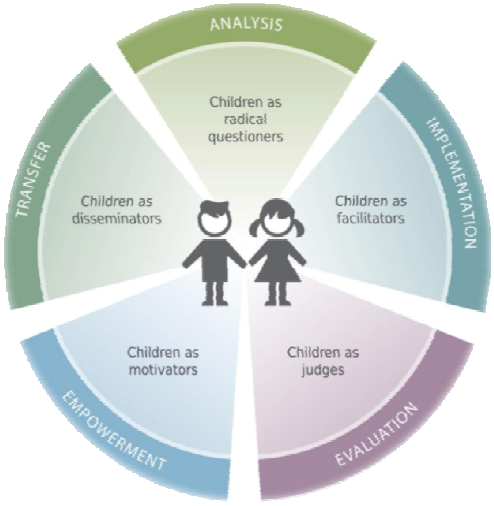

Fig. 2: Involvement of children (source: Grant Agreement Metamorphosis project)

This approach is essential to develop new and daring mobility solutions and create appropriate public spaces, especially for children, and increase the quality of life of all the inhabitants. Because when cities are designed for its most vulnerable group, all others thrive. In the evaluation process, children acted as critical and honest judges. Their ability to question everything, the well known “yes but why?”, helped to analyse their needs, habits and routines. And it all boils down to one simple thing: when people start using active modes at an early age, they are more likely to keep using those active modes in the future. This promotes active modes right from the start instead of trying to convince people to change their habits at a later age. Moreover, the success rate of implementing innovative or daring measures was higher when they reflected the wishes and desires of children since adults act more frequently on their children’s requests than on the request of experts telling them how to do so. Also, on a political level it is difficult to be against the wishes of children. Especially in combination with adults reminding them of the urgency for change. This philosophy granted an overall bigger approach for the project.

3.3 Practical example from Tilburg

But how does this work? In Tilburg, first stakeholders were consulted about what they need. The focus was around school environments. During several stakeholder workshops policymakers, parents and teachers were consulted about their needs. Since meeting formats were presumably less effective with children, they were asked in a school environment scan to point out things they liked and didn't like. A school environment scan is a walk with groups of children (around 4-8 per group) in which they were asked to rank their neighbourhood with green and red thumbs (Fig. 3). The locations that they rated are then noted on a map of the school environment with an explanation for the rating. The guardian/researcher is not allowed to steer the thoughts of the group in any direction and is just there to put down notes, answer questions and makes sure the group is safe. After the walk, the analysis of the group was compared with the analysis of the other groups to get a comprehensive idea of how kids look at the city. This is how kids contribute to the analysis of the school environment. In the next "dream workshop" children are asked to "sleep" and dream of their ultimate cityscape. After two minutes of "dreaming", the researcher asks them to draw it out. The researcher asks them to explain what they drew. Results range from Jurassic Park-like public spaces, dino's included, to very practical ideas on how to solve problems that they did encounter on their environment scan. This contributes to concepts for implementations. Then they are asked to present their findings in front of the class. In Tilburg, a city representative was present in most of the cases. This is how they transfer knowledge about how they perceive their city and what child-friendly is. By presenting it to a city official, their ideas get empowered. In a later event, the kids are asked to help with the implementation around their school zone. The type of implementation is based on the stakeholder workshops or the environment scan. Expectation management is very important at this stage.

Kids are easily disappointed and do not always see the bigger picture. After the implementation parents are asked to visit the implementation by the children. Now they transfer knowledge to their parents. This will most likely also reach the coffee tables of their grandparents, for instance – a good example of positive

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mouth to mouth marketing to inform people about the project and stimulate thinking about child-friendly cities. After the implementation, the impact is evaluated with the children and parents. Here it is not only important if the measure worked (counted impact) but also if they perceived it worked (perceived impact). Both are often not the same and insights in this helped the project in the process evaluation of the measures – children as judges.

Fig. 3: School enviroment scan in Tilburg (source: Metamorphosis)

3.4 Mixed evaluation approach

During the project, two different forms of evaluation were carried out: impact and process evaluation. Impact evaluation deals with the understanding of the practical/technical effects of measures, whereas process evaluation was concerned with understanding more clearly why measures have succeeded or failed (Crawford, & Bryce, 2003). Constant interaction of these two kinds of evaluation is necessary to achieve expected goals and targets and learn lessons to transfer. An in-depth analysis and understanding of the process, indeed, is essential to understand the data gathered and report the impacts of implementations.

3.4.1 Impact evaluation

The impact of the measures is assessed through the measurement (before and after the intervention) of specific indicators (European Platform on Sustainable Urban Mobility Plans, 2016; Flükiger, 2015) concerning the usage and safety of public spaces (e.g. people/ children in public spaces, traffic conflicts), the perception of public spaces (in terms of safety, greenery, attractiveness of the urban design, local identity, air and noise pollution) and mobility habits (e.g. modal split of the home-to-school trips). In addition, key Metamorphosis indicators, suitable for every measure (such as the satisfaction/ acceptance of the measure and the number of participants), have also been included in the data collection by all city partners.

Since children are constantly involved in the project, these indicators consider the feasibility of collecting the appropriate data (Litman, 2011; Balsas, 2004; Arup, 2017), the easiness to measure and communicate them. Methods most used are observations/ countings, interviews, questionnaire surveys, GPS trackings and mobility games.

Table 1 shows a detailed overview of the indicators and related methods the cities applied to for specific categories of measures.

Indicator	Data collection methods used in Metamorphosis	Measure*
Satisfaction with the measure	Questionnaire Hands-up survey	All measures
Number of participants/ users	Registrations Counting Hands-up survey	All measures
Number of affected people	Counting Extrapolate	All measures
Number of children in public space	Counting Observation	TSO, IPS
Average time spent in public space	Observation Questionnaire	TSO, IPS, WAM
Diversity or variety of activities / people's interactions	Observation Counting Questionnaire	TSO, IPS, TPS
Modal split	Questionnaire Gamified survey	WAM, TPS
Modal choice (school way, leisure car trip, daily goods shopping)	Travel Tracker Hands-up survey Questionnaire	TSO, TPS, WAM
Attractiveness of the school surrounding/ way to school	Questionnaire	TSO, IPS, WAM
Perception of safety, noise and air pollution	Questionnaire	TSO, IPS, WAM
Implemented ideas and tips from children	Questionnaire Observation	IPS, TPS
Opinion polls	Questionnaire	IPS
Area transformed (urban green and public space)	Measurement of area	TPS, IPS
Area dedicated for cars (street and parking)	Measurement of area Counting	TSO, IPS, TPS
Acceptance of the measure	Questionnaire Voting tool	IPS, TPS, WAM
Skills learned	Voting tool Questionnaire Observation	IPS,WAM
Awareness level	Questionnaire	IPS, WAM
Client-business relations	Questionnaire Counting	IPS, TPS
Number of utilisations	Counting Analysis of user sheets	IPS, TPS, WAM

Table 1: Indicators and methods used by the cities for specific measures. *TSO: Temporary street openings. IPS: Interventions in public space: temporary changes, such as public breakfasts or movable greenery. TPS: Transformation of public space: permanent changes creating crystallisation points, such as urban gardening or mobility share points. WAM: Workshops for active mobility: such as walking busses or repair workshops.

3.4.2 Process evaluation

Besides the impact evaluation, a process evaluation was conducted in order to monitor the single steps of the project and solve arising problems (Dziekan et al., 2013). Process evaluation involves the evaluation of the process of preparation and implementation of the measures, including the roles of information, communication and participation. It provides insights into organisational and administrative factors and looks at the phases of the process and not necessarily at the output. Process evaluation is more qualitative than quantitative and has the aim to extract lessons learnt from the cities that will be helpful for future activities and help to recognise similar obstacles before they become a problem. The results of the process evaluation are collected via biannual online questionnaires with questions focusing on the implementation

and operation phase respectively. Furthermore, workshops organised during project meetings and periodical telephone conferences help to identify further barriers and drivers.

4 RESULTS AND LESSONS LEARNT

At this stage of the project, the city partners already achieved most of the impacts expected, including:

- In total, about 140,000 people directly affected by the measures applied across the seven cities and over 30,000 citizens contributed actively to the process.
- Usage of public space by children and adults increased by over 40% after interventions, based on before and after survey counts in Graz.

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- In Munich over 80% of the surveyed parents and children (sample size = 146) that took part in the 'Walking Buses[2]' for home-to-school-trips stated that they did not use the car for pick-up and drop-off trips to school. 90% said they were satisfied with the change.
- A reduction by 56% of the number of students travelling by car after the introduction of a timed school street closure in Southampton, as well as an increase of the perception of safety and simplicity of street crossing by 68% and of the attractiveness of the street by 50% (sample size = 38).
- An average of 92% of adults and children participating in or affected by the measures said they were 'very' or generally satisfied with the child-friendly transformations through feedback questionnaires, interviews or 'hands-up' surveys.

The Metamorphosis consortium managed 60 different measures including a total of 785 implementations.[3] 36% of these implementations took part in the activity field Empowerment of Active Mobility, 33% in Interventions in Public Space, 17% in Educational Innovation Tools, 11% in Temporary Street Closures/Openings, 3% in Crystallisation points. The 785 implementations took place across Europe in three years. Many of the useful lessons learnt by the project partners have been reported in the process evaluation questionnaires designed to assist their efforts during the different phases. As regards the main findings from the last questionnaire, the city partners stated they were either 'very' or generally satisfied with 95% of the measures implemented. The appreciation was higher for measures that were organised in cooperation with local schools. This indicates that activities planned to be suitable for specific ages of children were in most of the cases perceived as more effective, creative and contributed to the success. In addition, based on the experience of Munich and Tilburg, the success of training workshops and other initiatives that empowered children and their families in active mobility is strongly dependent on the support provided by school directors, teachers and parents. Staff's time and resources necessary to plan and prepare an implementation as well as the ongoing commitment of the cooperating schools are essential factors that influenced the data collection for the impact evaluation of implementations.

However, some of the initiatives also met with local resistance. In Graz for example, the implementation of hybrid zones, livin' labs and new urban design interventions initially faced complaints from a few local inhabitants but also legal barriers due to the permissions required to the local authority to use the roads during the implementations. Effective counter measures were in these cases an intensive negotiation with the responsable departments in the city administration, in addition to the decision to first start testing small implementations aimed to become later longer or even permanent transformations, if they worked well as temporary.

Nonetheless, such events were generally welcomed by residents, when properly informed, and especially by parents of children directly involved, and gaining their support, e.g. via workshops, as well as that of local community organisations, was seen as a very important contributor to the success of the measures. Good feedback also came from Alba Iulia and Zurich, where children and adults taking part in the open 'public breakfasts' and transformations of parking lots into fun play spaces declared that they really enjoyed the activities and showed awareness of the need for change. The experiences of temporary street closures/openings in Southampton, Graz, Munich and Zurich also showed the need for strong political support. They required long lead times for the organisation, due to the complexities of the process, and good communication and cooperation with all the partners and stakeholders involved is essential. However, the latter was rated as the most relevant driver for 62% of the measures, followed by an efficient communication with the local neighbourhood as a key factor for success for 32% of the measures.

5 CONCLUSION

The implemented measures by Metamorphosis in the last three years showed profound behavioural changes in the affected neighbourhoods and a general increase of the liveability for the citizens. The Metamorphosis bottom-up activities contributed to a strengthening of the cooperation with stakeholders in the city, including children and the local community. Relevant lessons learnt on the engagement of children at school are that

[2] A Walking Bus is a group of pupils walking to school along a set route accompanied by a supervising adult. Among other things, it increases safety as well as physical activity during travel to and from school.
[3] Number of implementations as reported in March 2020

implementations where parents are involved as well proofed to be more successful in the long term since they often make the mobility choices for their children.

The experienced difficulties faced during the data collection highlighted the importance to analyse the process to understand the impacts and learn from it at future events.

Furthermore, the engagement of children requires different techniques to the traditional ones used with adults. Methods and ways to communicate need to be adapted to the situation and be suitable for the age of the target groups involved. This includes creativity and fun like games, concrete questions and some didactic skills.

Streets given back to children made them aware of what public space can be and that their voice can be heard to design or improve the quality of the city actively. Views and ideas have been collected in brainstormings after the exploration of the neighbourhoods. Those ideas were then officially proposed to the city administrations, that encouraged local policy makers to change their views on public space and make children's wishes concrete. Thus, the project provided good practices on how to integrate children's wishes in urban planning, and many of the interventions will concretely become part of the local sustainable urban mobility plans in the project cities. What was striking is that children want what most people want for their cities. Green, safe, active places with loads of opportunities for social contact. We should listen to them more often.

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🏆 *reviewed paper*

Smart Cities – a New Revitalisation Approach for Shrinking Cities?

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1 ABSTRACT

Smart City applications can be a new technological and sustainable approach to revitalize cities effected by structural economic changes and transform them into future oriented and livable places. By means of the case studies City of Bochum, Germany and the City of Cincinnati, Ohio, USA comparative planning approach presented.

Keywords: Urban revitalization, Substitute industries , Shrinking Cities, Smart Cities , Resilience

2 INTRODUCTION

As globalization causes ongoing local and regional structural economic transformation processes, big challenges arise for today's urban planning (Tverberg, 2013). Post-industrial transformations can lead to declining manufacturing industries and therefore to a decline of local jobs. This has among other causes effects on the urban landscape (Pallagst, 2007). The deindustrialisation and consequently out-migration of people has lead to the shrinkage of cities with visible changes such as declining and abandoned neighborhoods with derelict buildings (Hollander et.al., 2009).

As defined by the Shrinking Cities International Research Network (SCiRN) a shrinking city is an urban area of at least 10.000 inhabitants that has or is currently facing large population losses for at least two years. Additionally, the city is faced with structural economic transformations and its symptoms (Siedentop and Wiechmann, 2007).

Cities struggle with regenerating themselves based on new societal challenges (e.g. sustainability) and new substitute industries to stabilize the urban fabric and stop further shrinkage. Methods and new planning approaches have been applied in many old industrialized regions around the world. These measures often include substitute industries. This is defined as a primary creation of new/ other jobs as well as a strategy for the general revitalization or restructuring of the local economy. However, the term ‘substitute industries’ does not give any concrete pointers to a specific industry or sector (Pallagst 2017).

Due to the shifts in economic structure, cities are left with many old industrial and commercial brownfield sites in urban areas (Häußermann et al. 2005, p.12). Many programs, instruments and specially designed projects of the last decades have failed to provide the necessary results aimed at revitalizing these brownfield sites (Schackmar et al. 2018).

The role of technology is advancing, and – consequently - smart city developments aim towards technological solutions as job replacements and strategies for revitalization. Besides modifications of local governance and increased efficiency, they introduce technological applications to urban planning and cities (Schackmar et al. 2018).

The term ‘smart city’ is being used as a general leitmotiv for cities, as well as part of the discussion among urban and regional development models and planning in general (Vanolo, 2013). Smart cities are widely being discussed and defined in the literature, but their conceptualisation is still hard to grasp, as there are many different ways to include or exclude certain applications. Osborne and Rose have defined smart city as being framed as an efficient, green and socially inclusive and technologically advanced city (Osborne, T et al., 1999). A more recent attempt at defining what elements smart city could foster was published in the ISOCARP Review 2017, determining four pillars: sustainability, efficiency, people and security.

Since in shrinking cities many instruments and initiatives where applied in the past with more or less successful outcomes, new smart city related solutions could pave the way for revitalization. The research presented here argues that urban planning might play a role in bringing this technological framework forward, to cater to the needs of shrinking cities in a more efficient, social and sustainable way. By providing necessary frameworks and new urban laboratories, a new way to utilize the potential of smart city applications could shed light on issues unsolved today. In particular, applying these new technologies might reduce the use of city resources (e.g. municipal finance) as well as raise the quality of life for the inhabitants,

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or introduce new ways of mobility and services to the city (Gassmann et.al., 2018, p.18). This might create new substitute industries providing jobs in innovative economic fields.

This research aims is to analyze the strategy of introducing and applying smart city technology as a substitute industry in shrinking cities. In this context, the paper discusses introducing smart city strategies and technologies to reinvent shrinking cities.

The paper will present empirical results of an analysis based on case study examinations of the City of Bochum, Germany and the City of Cincinnati, Ohio, USA. The analysis of these cases might generate knowledge on the success and lessons that smart cities could provide for shrinking cities.

3 SHRINKING CITIES

3.1 Introduction to shrinking cities

The phenomenon of shrinking cities is not one limited to a country or a (global) region but rather an internationally observed process, set in motion by globalisation and structural transformations. Leading to long term demographic and economic changes, especially in old industrial regions or peripheral rural areas. Those causes and effects can have different triggers and turn out differently but the result for cities or urban areas is not that different. Changing demographics and declining birth rates in western Germany as well as the reunification effects on the eastern part of the country caused shrinkage (Pallagst, 2008).

The Shrinking Cities International Research Network (SCiRN) has characterized a shrinking city as an urban area of at least 10.000 inhabitants that has or is currently facing large population losses for at least two years. Additionally, the city is faced with structural economic transformations and its symptoms (Siedentop and Wiechmann, 2007).

3.2 Causes and consequences of shrinkage

The causes that can lead to a shrinking of the city include various aspects. These can occur individually or parallel and, depending on the location, depending on the individual case. The following four indicators are characteristic of the causes of urban shrinkage:

- The decline of a city-dominating economic area or several areas
- Emigration of the population (suburbanization and long-distance migration)
- Deindustrialization (in general)
- A particular concern in monostructured regions (Henckel, 2003; Liebmann and Kühn, 2010).

The above-described, mostly economic shrinking phenomena and the relocation of entire industries and the associated loss of jobs also include other causes: the old industrial regions and post-industrial regions of the mining and steel industry in western Germany, especially in the monostructured Ruhrregion (Ellrich and Neuhaus, 2012; Glock, 2007, p.1).

The natural population development in Germany is an important factor. Measured with the natural birth rate, this has been negative since 1972. However, demographic-related population losses cannot be as severe according to the latest developments. This means that Germany's population has only increased due to immigration for some decades or has remained relatively stable. Germany is currently experiencing positive population growth on average. This is based above all on immigration from economically weakened European countries and on refugee movements from the crisis regions of the Middle East and Africa since summer 2015 (Destatis, 2020; Breuer 2017).

There is also a shift in the average age due to falling birth rates and increasing life expectancy. By the middle of the century, the proportion of over-60-year-olds in Germany is expected to increase from one fifth of the population to around one third (Statista, 2020; Spiegel Wissenschaft Online, 2007).

In addition to this so-called aging population, there is selective emigration of mostly young, qualified and work-oriented citizens. This population development takes place especially in cities. It can therefore be concluded that the population is migrating if there is no prospect of a job on the job market and there is a lack of training or study opportunities (Deutsche Akademie für Städtebau und Landesplanung, 2002, S.7ff).

City shrinkage processes can thus be seen as a consequence of a structural change. The associated social change is another cause of the changes that have occurred due to structural change. However, short-term positive growth impulses due to immigration or increased birth rates do not take place in every region of Germany.

3.2.1 Consequences of shrinkage

Looking at the causes shows that urban shrinkage is a phenomenon that can have diverse and far-reaching reasons or origins. The shrinkage can be different locally and / or regionally. Nevertheless, it is based on the two indicators: the loss of inhabitants and the profound change in the economic structure. The following paragraphs are displaying the various effects of shrinkage:

3.2.2 Economy and job market

A weakened economic base (mostly in the mining or industrial sector) is the direct consequence of the decline of one or more local or regional economic sectors. The economic situation is characterized by a lower number of jobs and consequently also training opportunities. This weakened base can lead to increased emigration of young and well-educated people. This process can lead to a drastic labor shortage in the long run. In particular, medium-sized companies and the establishment or relocation of innovative companies can be negatively influenced (Institut für Landes- und Stadtentwicklungsforschung und Bauwesen des Landes Nordrhein-Westfalen (ILS NRW), 2003, S.A4).

Generally, it can be said that the so-called self-preservation cycle of the economy is disturbed. This means that if one or more important employers break away, this automatically has consequences for other branches of the economy. Here, for example, lower purchasing power (due to higher unemployment and moving away) has to be listed, which has a noticeable impact on the local economy. Visible effects are expected to result from vacancies in the inner-city retail sector (Bundesministerium für Verkehr, Bau und Stadtentwicklung, 2010; Winkel, 2002 S. 99ff).

This sets in motion a "downward spiral", which is made up of the following concise factors:

- Population decline (migration losses and low natural fertility rate)
- high unemployment (severe job losses)
- Loss of purchasing power and real tax
- declining financial strength of private and public budgets (due to falling tax revenues)
- Declining investments by private and public households (in companies and infrastructure)
- Image loss

The factors listed often lead to self-reinforcing urban shrinkage (Häussermann et al. 2005, p. 12).

3.2.3 Spatial consequences of structural change

The spatial consequences of structural change include inner-city vacancies and the urban sprawl and suburbanization of the urban fringe areas. This is mainly borne by families with higher incomes looking for a family home in the countryside (Glock, 2007).

A new aspect is the formation of location clusters. Many municipalities or regions have their own cluster concepts for this and try to locate and promote them in a targeted manner. The main focus here is on the new economy, i.e. companies in information and communication technologies. But developments in the logistics industry also play a major role. A dominant feature of the space here is, for example, the increase in logistics centers, both in terms of their number and in terms of their area (Henckel, 2003; Haas, 2017).

This development also includes the developments of large tertiary institutions (including service, research and education centers) on the outskirts. As a result of the rapidly changing economy and the migration or bankruptcy of companies, wastelands are emerging on many previously used commercial or traffic areas. As a so-called no man's land, they usually wait years for revitalization, i.e. a commercial or general structural connection use or renaturation. This release of space can be seen as a space-defining element of structural change (Henckel, 2003).

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3.2.4 Infrastructure and traffic

Due to the spatial impact of shrinkage, the mobility behavior of citizens is also changing. Due to the urban sprawl and suburbanization of the peripheral urban areas, access by public transport is only possible to a limited extent. Due to the poor accessibility and frequency in these areas and less comfort than in private cars, public transport is unpopular. As a result, more citizen commute and car traffic and car density increases in the inner cities. Likewise, the noise and pollutant emissions, which have an overall negative impact on the attractiveness of the municipality (Institut für Landes- und Stadtentwicklungsforschung und Bauwesen des Landes Nordrhein-Westfalen (ILS NRW) 2003,, S.A4-A5).

A city's infrastructure does not only include services of general interest, but also the technical, social and cultural infrastructure. This includes traffic routes such as roads, public transport, schools and sports fields, swimming pools, facilities such as kindergartens or hospitals, but also theaters. It is only possible to a limited extent to quickly adapt the infrastructure to changing needs as the population decreases. Here, supply and demand are not linearly related. As demand falls, the city has to adjust the offer, but this happens only slowly. As a result, fewer taxpayers will have to bear the same or rising costs for the oversized supply. The municipal financial crisis is getting worse (see next section: Municipal Finances; Institut für Landes- und Stadtentwicklungsforschung und Bauwesen des Landes Nordrhein-Westfalen (ILS NRW) 2003, S.A4-A5).

While the existing infrastructure in the inner cities is getting under increasing cost pressure, in many places in the peripheral urban areas a new infrastructure is being built due to the development pressure on these spaces. A paradox that poses a major challenge for local politics. This infrastructure is built for a thinner settlement density than in the cities. It therefore costs more to the individual because it is used by fewer people. At the same time, existing infrastructure or entire neighborhoods are being dismantled in shrinking cities (Ellrich and Neuhaus 2012).

The infrastructure can no longer be maintained at the usual level due to a lack of funds or less funds. A downward trend sets in, with savings being made on modernization first, then general maintenance can no longer be financed and finally, the complete dismantling or decay is due. This is also known as aging or investment backlog. There is a risk that the city will shrink even further if the public infrastructure is in a bad state since emigration can increase due to an unattractive appearance (Institut für Landes- und Stadtentwicklungsforschung und Bauwesen des Landes Nordrhein-Westfalen (ILS NRW) 2003, S.A4).

3.2.5 Municipal finance

Due to the emigration of the young and work-oriented population class, a monostructured social, age and nationality structure is emerging in the inner cities of shrinking cities. This factor, on the one hand, and the general income and expenditure policy of the municipal budgets, on the other hand, result in a structural loss of income for the municipality concerned. Above all, the directly falling and missing municipal income through wage and income tax should be mentioned. Trade tax is another important direct source of income for municipalities. The loss of large companies in an economically monostructured community can quickly lead to precarious financial conditions. Missing indirect income such as contributions and fees as well as key allocations by the state and the federal government also contribute to a constantly negative budget situation (Winkel 2002; Milbert and Gatzweiler 2009, Institut für Landes- und Stadtentwicklungsforschung und Bauwesen des Landes Nordrhein-Westfalen (ILS NRW) 2003, S. A7-A8).

3.2.6 Social consequences and housing

Further consequences and effects of structural change are due to the persistently high unemployment rates and the emigration of certain social or age groups in cities that are characterized by shrinkage. Those who are too poor, too unqualified or too old to migrate concentrate in the city centers. This development becomes clear based on a massive structural vacancy rate. With the loss of the financially stronger classes, the development of the housing market is one of the obvious signs of social change and its effects. With the concentration of vacant buildings and financially weak owners, there is a visible downward trend in the structural condition of the buildings and the public space. Entire neighborhoods, streets and neighborhoods can deteriorate (Glock 2007; Ellrich and Neuhaus 2012; Spellerberg et al. 2008, pp. 39-40).

The social decline due to unemployment and living in a district affected by the decline is causing stigmatization of the inhabitants (Glock 2007).

Concluding this chapter, city shrinkage is therefore a multi-dimensional process. These consequences and effects of the city shrinkage, which are shown above, depicting the breadth of the tasks with which an affected municipality has to deal with. It has emerged that with job losses, a spiral of self-accelerating decline can begin. The resulting, sometimes existential consequences (for the municipalities) reveal the question: Can shrinkage of a city be stoped, mitigated or prevented if enough alternative, new jobs are created or other measures of revitalization have been applied?

Creating or relocating new and alternative jobs for workers who have lost their jobs due to structural change is a lengthy and complex task (Peuling, 2017). The key to success seems to be the creation of a so-called substitute industry for the community or generate other beneficial ways to attract jobs.

3.3 Revitalization approaches

Having identified the need for reviatlisation approaches to cope with shrinkage and its effects many cities identified the need to diversify their economic basis. Thus, various policies and strategies have been developed. Most dominating is the approach to introduce new innovative industries to the cities economy, in order to revitalise the economic basis of the city.

The replacement of an industry (entire branch within a municipality or region) in the form of a new one, which generates work and added value on a similar scale, is generally regarded among shrinking municipalities as the so-called "key solution" for the stability of the city. This should enable the city and its population to continue to exist and prevent further shrinkage (Peuling, 2017).

The term "substitute industries" is been used to describe the primary replacement of jobs and the strategies for the general revitalization of the local economy. The term "substitute industries" does not provide any specific information about a specific economic branch or sector. In the USA in particular, this term has been reflected in the respective literature. Since manufacturing and mining companies have migrated or gone bankrupt, there has been no city in the United States, especially in the rust belt, that has made no effort to locate "substitute industries" (Pallagst, 2017).

Many cities in old industrialised areas have tried to revitalise and attract substitute industries. These industries run along the lines of culture, education and medicine, high-tech and IT, green infrastructure and last but not least the festivalization of cities. These are some (among other) prominent examples of often tried and applied sustitute industries. Overall lies the goal of becoming more sustainable and resilient as a whole.

In terms of technological advances, one topic of focus must be mentioned in more detail:

3.3.1 Hightech and IT

The further mechanization or rather computerization of society, research, administration and the production of goods and services will continue unabated in the coming decades. The developments in the high-tech industry and IT sector are global or in every economic sector and are characterized by a great dynamic of innovations. Therefore, the promotion and settlement of companies and institutes in this area is particularly future-proof, or is very popular with local authorities. The federal government very deliberately and on a large scale supports projects in the areas of digital economy and society, sustainable management and energy, innovative work environment, intelligent mobility, healthy living and civil security (Bundesministerium für Bildung und Forschung, 2017).

The anchor point of the high-tech and IT industry is the regional or local, national and international networking of science and business. Existing strengths are taken into account, the expansion is promoted and new offers in cooperation and interfaces to other industries are created. It is becoming increasingly difficult to differentiate clearly between the sectors and industries, since high-tech and IT are represented in economic and research areas and this will be reinforced in the future (Bundesministerium für Bildung und Forschung, 2017).

Examples from practice are above all the cross-sectoral subject areas, as well as university cooperation (cf.Education and medicine): robotics, sustainable mobility, environmental technology, renewable energy and resource efficiency, healthcare, life sciences, information and communication technology (ICT), green IT and intelligent Products (Ministerium für Wirtschaft, Arbeit und Wohnungsbau Baden- Württemberg, 2017).

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In that regard, the role of technology is advancing, as a natural process of development in general. And – consequently – the develompent of high tech solutions and products new technical approaches are being refined. One of those is recently becoming more dominant in urban planning: smart city (as defined in Chapter 3). Smart City developments aim towards technological solutions as job replacements and strategies for revitalization. Besides modifications of local governance and increased efficiency, they introduce technological applications to urban planning and cities (Schackmar et al. 2018).

Obviously not every city can be the next high tech centre or a new festival . It depends - as allways- on the involved actors such as the location, citizen, political class and leaders, governance and other factors involved. As the urban context is complex, it is difficult to predict which strategy or project will be succesful and which will not. It has also been investigated by Sorensen that a specific momentum might be needed in order to trigger a thriving project or strategy (Sorensen, 2016, p. 25f).

Despite that, the question arises whether smart city technology might bring around a new way to revitalise a shrinking city and strengthen them in many ways possible?

4 SMART CITIES

4.1 Identifying the smart city

With the advance of the concept of a smart city, a new promising solution in urban planning has emerged. A complex digital and intelligent solution has arisen. As a new problem-solving component, the smart city approach is a beacon of the ever-faster development in the digitalisation branch. Chicago, Boston, Hong Kong or Vienna, as prospering citys, have identified this as a chance to become more resilient in the global competition among cities. Somewhat ‘future proofed’ in an ever-changing world, but these cities are not nor were effected and dominated by the shrinkage issues mentioned (Bundesinstitut für Bau-, Stadt- und Raumforschung, 2015; Schober, 2014, p.11f.).

Sophisticated technology has risen and been developed, especially during the last two centuries. Through the integration and use of those innovations in urban planning, it has changed and transformed our cities.

Furthermore, introduced technological applications to urban planning and consequently cities, technology has sustainably modified local governance as well as increased efficiency wherever possible (Goodman et al, 1999).

The term of a ‘smart city’ has emerged and is recently being used more frequently as a general leitmotiv for cities, as well as part of the discussion among urban and regional development models and planning in general (Vanolo, A, 2013). The term smart cities are widely being used and defined in literature but still has no specific character or universal definition, as there are many different ways to include or exclude certain applications or ways to it. Combined by overarching innovation processes of changing cities in a connected and intelligent way (Jakubowski, 2014; Angelidou 2014).

In the literature the term is defined by Osborne and Rose as being framed as an efficient, green and socially inclusive and technologically advanced city (Osborne, T et al., 1999).

Others like Caraguliu, Del Bo and Nijkamp have characterized smart city as including a networked infrastructure to achieve social, cultural and urban inclusion as well as social and environmental sustainability with a focus on including urban residents in public services (Caragliu et al, 2011).

A more recent attempt on defining what elements smart city could foster was published in the ISOCARP Review 2017, determining four pillars– sustainability, efficiency, people and security – of smart city. Those pillars include the subthemes of combined natures (Isocarp Review- Smart Communities, 2017).

Contemplating the term smart city from a practical perspective, it comes clear that it is used by many cities as an advertising element in city branding. Used as a so called buzzword to illustrate sustainable urban development, not necsesary defining or interpretation smart city as well but rather use it in the sense that resilience and sustainability have been used before for marketing purposes and to take zeitgeist action and plans into account (Batty et.al., 2012, p.481; Colding and Barthel, 2017).

Narrowing the termini down to what it could encompass is, as depicted, a rather difficult approach- due to the fact that different authors as well as institutions in theory as well as practice are having different opinions about the term and how it should be defined.

Interestingly, even though to the fact that the number of literature publications, dealing with smart cities, has increased over the last 15 years, from about a dozen in 2005 to over 2000 in 2016 (Colding and Barthel, 2017).

In technical terms smart city is the intelligent management of digital data, networking in real-time and analysing data of various sources to create knowledge with new links of data to find answers (Libbe, 2018). The overarching tenor is though that intelligent networking technology is revolutionizing the way cities will look and function in the future, resulting in different urban planning approaches today. Specifically in the way that will enhance the effectiveness of city governance with the help of smart city technology interacting with citizens in so-called feedback loops. Made possible by sensors, digital communication and processing (Zanella et al., 2014, p.22).

With smart city applications, scale becomes less of a problem since it is easy to make most applications fit different city scales and (re-) development goals (Rager, 2019). Furthermore, a smart city is known for its ability to be "responsive". This means that in contrast to usual measures undertaken in urban planning, such as the construction of physical infrastructure like roads that can not changed or adapted quickly and easily without spending resources, a responsive feature will be able to react to changes with much less effort. For that matter (Bundesinstitut für Bau-, Stadt- und Raumforschung, 2015, p.7). This quality contrasts the usual toolbox of urban planning which is rather static once implemented in the built up environment. Responsive features could make a real difference when it comes to engaging the rather fast and hard to predict challenges in shrinking cities.

In conclusion, there is none exact definition of what a smart city is and what it isn't, rather an agglomeration of aspects that overlap the different approaches to finding a definition. Overarching and rather unspecific are the general leitmotivs of a sustainable, resilient and environmentally friendly town. More accurate this includes the definition of smart cities being on the forefront of technological advance by connecting governance systems, public and social infrastructure with digital and intelligent technology and but also includes its citizens of being aware and self- decisive in being consumers and data sources to increase the overall efficiency of a city.

On a critical note, smart city being often used in close proximity with resilience the question arises, that with being dependent on technology on such a higher smart city level, dependence on functioning technology as well as cybersecurity become pressing. Can a smart city be resilient?

4.2 Smart city revitalization approaches

Especially shrinking cities, urban spaces in despair and disadvantaged cities as a whole are looking for ways to revitalise themselves. Find a road to stabalize population numbers and find ways to regrow the local economy. The Hi-Tech and IT industry presents itself to cater to those needs (see Chapter 2.3). Especially with the profit from the positive aspects of technological advance in terms of smart city products and strategies, this seems like the way forward.

Experimentation grounds for new smart city technology can be found in these rather difficult individual circumstances since every city has a different reason for shrinkage related problems. As these cities are actively trying to shape a better future for themselves, they are willing to go the extra mile and use many state-of-the-art instruments to reinvent. Job creation seems to be one of the highest priorities, since some other approaches such as culture lead regeneration have not always been as successful as planned, in economic terms (Schackmar et al., 2018).

This could be partly because of the project's nature and partly because the measures were not fitting the scale of the problems (Bundesinstitut für Bau-, Stadt- und Raumforschung, 2015). This quality contrasts the usual toolbox of urban planning which is rather static once implemented. Responsive features could make a real difference when it comes to engaging the challenges in shrinking cities.

In that regard, smart cities are linked very closely to digitalisation in general. Resulting in difficulties to know where exactly draw the line between a smart city project and 'just' a digitalisation or technological project in a city. As smart city projects are information and communication technologies that are somewhat intelligent, they aim not only at new solutions to problems but also to enhance the quality of life (Libbe, 2018).

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This could be achieved not only by providing new jobs for residents in future-oriented economic branches but also by marketing the city, its workforce and its economic potential by actively changing the output prerequisites using smart city solutions. This usually is initiated and managed by the city administration. Bottom-up initiatives can ignite such a process in local politics but to work in an entire city this can only be managed by a city (Libbe, 2018; Batty et al., 2012).

This results in different possible actions to undertake for any city, not only shrinking ones, to become involved in becoming a smart city.

- New revitalization approach: Active business promotion, trying to attract and get smart city / high tech firms active in this resort to resettle to town in order, to generate new jobs and revitalise as well as push existing firms working in the field. Building on existing strengths.
- 'Standard' revitalization approach: Use smart city solutions to adapt existing revitalization strategies, as seen in chapter 2.3 and put the four pillars of sustainability, efficiency people and security in terms of smart city strategies forward

The City of Bochum, Germany and the City of Cincinnati, Ohio, USA have chosen to become smart cities amongst other initiatives due to similar initial settings of structural change and population decline. Depicting their efforts in doing so it comes clear that both cities have different approaches in doing so. Bochum is pursuing a rather active business promotion whereas Cincinnati is using smart city strategies to adapt existing revitalization approaches.

4.3 City of Bochum, Germany

The City of Bochum is located in mid-western Germany's agglomeration of cities called Ruhrgebiet. A former center for coal and steel production as well as the manufacturing industry in the State of North rhine Westphalia. Having endured structural socioeconomic change over the last decades, many initiatives and strategies have been proposed and implemented in the past as well as the present (Stadt Bochum, 2018; Regionalverband Ruhr, 2013).

The most concise problems in Bochum are the development of its population over the last decades, the economic change, spatial challenges, infrastructure and mobility, city finance, social problems and housing among others.

The population reached an all-time high in the 1970s at around 435.000 inhabitants and has declined ever since to around 365.000 in 2015, due to a bad economy. In the last couple of years, it seems that it has been stabilized and is not shrinking anymore, even rising a bit. This Goal has been on the agenda of urban politics for years. At the same time, the economy was stabilising (Peuling, 2017).

Strategies for the economic turnaround have been implemented by the city administration since the coal and steel industries shut down, but especially since the late 2000s, when Opel and Nokia, as the city's biggest (manufacturing) employers, have cut jobs and eventually have closed their company branch in Bochum. The city has initiated a strategy among others on the former premises of Opel, to create new jobs and attract new companies with future-oriented business. Today an industrial park called "Bochum Perspektive 2022" has been established. A range of firms have chosen to settle here, like High Tech Start-Ups, a Technology Campus of the Ruhr-University, Cybertech companies and branches of bigger companies engaging in research and development here (Terpitz, 2018). The "Strategy Bochum 2030" is taking matters to a coordinated citywide level with

As a city in a very dense metropolitan area, that wants to become a smart city region and is pressing for Ruhrgebiet cities to become smart cities, the smart city goal of Bochum, becoming the first "gigabit city", where every citizen has access to a fast internet connection. Furthermore, it aims at becoming a center for Start-Ups companies and firms working in developing smart city hard- and software. Mirroring the fields and areas of living, housing, working and mobility as well as IT- security (WAZ, 2018).

Bochum is building on existing strengths with its strategies to promote and foster firms working in the field of smart city (technology) and further connecting them with strong links to education institutes. The city is home to nine universities with 60.000 students and adjacent researchers and today the biggest employer in town (RUB, 2020). Connecting this potential further to existing economic branches creates potential. Part of

the active business promotion is the competence of firms working in IT-security and the digital communication sector in general (Eiskirch, 2019; Bochum Wirtschaftsentwicklung, 2020).

The city can offer many, economic change brownfields as an incentive for industry or start-up companies to stay in the metropolitan region or to relocate. The current situation is "overall good," according to a study of the Institut der deutschen Wirtschaft (Institute of German Economy) (WAZ, 2018).

Linking and supporting these close ties has lead to a generation of new jobs and revitalise as well as push existing firms working in the field. The latest numbers of 2019 confirm the success of this approach. 2.500 new jobs were created in future-oriented branches in 2018. Regarding the digital communication and IT-security branch, 800-1200 jobs have been set up (Bochum Wirtschaftsentwicklung, 2019).

In summary, Bochum is persuing a strategy to become a smart city- both in terms of being smart as in an infrastructural focused smart city but also taking advantage of the smartness that already exists in the city with its educational institutions and adjacent industries. Resulting in strategies to strengthen this position and productive links, as part of the smart city initiatives to support Start-Ups and related enterprises operating in the field of smart city tech.

4.4 City of Cincinnati, Ohio, USA

The City of Cincinnati is pursuing a different approach to become a smart city and push revitalization forward, even though the initial situation was not that different than in Bochum.

Located in the State of Ohio, Cincinnati is at the edge of the former coal, steel and manufacturing industries center of the US, called infamously rustbelt today. The rustbelt in general but also the City of Cincinnati in particular have largely suffered from socioeconomic decline and accompaning population loss, increasing numbers of declining property (values) and abandoned properties (City of Cincinnati, 2017, Mallach and Brachmann, 2010).

The City of Cincinnati has lost population since the 1950s peak number of citizens and has not recovered to its previous population. The population declined from an estimated 504.000 in 1950 to 296,020 in 2011. Since then the number of the citizen has stabilized and grown again to about 302.605 people in 2018 (World Population Review, 2020). The natural population development though is, unlike most other rustbelt cities, positive with a higher average fertility rate. Resulting in positive population growth, but not outnumbering the losses of migration during the period of decline (Stone, 2018).

The strategies of the past were rather scattered and not connected by overarching strategies and coordination. Attempts undertaken during the 2000s have been much more comprehensive and are successfully targeting issues and initiating revitalization (City of Cincinnati, 2017, Mallach and Brachmann, 2010).

The way Cincinnati is regenerating itself is a unique mix of comprehensive planning and outsourcing of political constraint decisions. For example, after years of decline the old urban neighbourhood of Over-the-Rhine was called the "most dangerous neighbourhood in the USA" (Woodard, 2016) in 2009. The city then decided to take matters to an experimental stage of outsourcing revitalization in terms of planning and economy to a corporate-funded and private entity, the Cincinnati Center City Development Corp. Today, it seems this worked out to be a best-case example of public-private partnerships: The neighbourhood is not only gaining residents, stopped shrinking and is a tourism destination due to architectural heritage (Anchor District Council, 2020; Woodard, 2016).

With the state capital of Ohio, Columbus, having succsessfully applied for a national smart city grant on transportation, Cincinnati is seeking to become a smart city as well and has embedded this goal into city politics, since local competition between the two is high (Pyzyk, 2019).

Today, the city has a comprehensive strategy to become a smart city. Mainly focusing on the goal to become the "smartest" municipal administration nationwide and therefore become more (cost) efficient, to become more competitive as a city and furthermore involve and engage citizens better through bottom-up participation (City of Cincinnati, 2017; Pyzyk, 2019).

To complement the already successfull revitalization of Over-the-Rhine the city is rolling out a free Wi-Fi Project, connecting the CBD with Over-the-Rhine along a public transport corridor. This will enhance the efforts to further grow the economy sustainably within this part of town to foster engagement in the cities

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society and bridge the digital divide. With this effort, the city looks specifically at how smart city technology can be used and installed to help the disadvantaged communities first (Pyzyk, 2019).

Other projects include the upgrade of infrastructure when necessary anyway to smart infrastructure. Using Smart Sewers and meters to save costs in the long run and to better predict maintenance. Moreover, the digitalization of city services leads to new possibilities like the "Fix it Cincy! app" where residents can submit service requests directly to the city works. This is working well especially in neighbourhoods with derelict infrastructure or poor maintenance, due to shrinkage processes in the past, to highlight areas in need of public attention. The open data strategy of the city is one key to becoming a truly smart city, with an open data portal providing transparency to all data collected and all analysis resulting (City of Cincinnati, 2017; Maddox, 2017).

Through projects like that, Cincinnati is using smart city strategies to adapt to existing revitalization approaches. To reach its goal, to produce better public services and implement better (digital) communication for citizens. Furthermore, the improvement of public safety as well as public health has been a goal (Maddox, 2017).

Concluding, Cincinnati pursues a path of re-growth after deep-decline, both economically and population-wise, with a mix of public-private partnerships and complementing smart city strategies. Structural blighted neighbourhoods are being revitalized as well as city administration "smartened" up to increase overall efficiency.

5 CONCLUSION

Ways forward for Smart Cities in Shrinking Cities are the strategies and approaches of the case studies municipalities, which contribute to the revitalization of these (shrinking) cities. It can learn from these historical developments that monostructural economic structures in municipalities create difficult situations when this economic sector is in a crisis. Resulting in the socio-economic structural change, where emigration has consequences for the town and all residents.

However, urban planning and development have always been subject to constant change and are constantly faced with new challenges. Because of this, there are always new challenges and impacts that must be taken into account when recruiting and locating replacement industries and the consequences of which for the urban environment are often still unknown. There is no guarantee of successful revitalization. The digital revolution in terms of smart city is an example in the case study cities of a rather positive nature, the positive effects have outweighed the negative ones.

From the experiences of the briefly presented city examples, it can be concluded that there is no clear answer to what a smart city is and what kind of initiatives there can be involving a smart city. As well as that there are many ways to include smart city aspects in urban politics.

A step in the right direction for Bochum and Cincinnati to push further revitalization including smart city developments to provide the ongoing or new revitalization initiatives or strategies with new energy. The adaptability or scalability of different smart city approaches comes to an advantage for cities with limited resources such as shrinking cities are.

However, at the same time, not every municipality has the same conditions and potential and therefore cannot rely on the same strategy, like Bochum with its smart city companies. The market potential for each industry is limited and once established somewhere an attempt to locate or create it somewhere else would be less successfull. Also critically viewed must be the Cincinnatis approach to outsourcing revitalization to a public-private partnership as urban planning is then out of the cities immediate control.

Furthermore, on a critical note, smart city being often used in close proximity with resilience the question arises, dependence on functioning technology as well as cybersecurity become pressing. Can a smart city be resilient? And what does it take for it to be? Also, the dependence on public subsidies or private firms can be crucial to projects being initiated but it's not clear whether the city remains in control.

Another lesson learned is that the case study cities are not shrinking anymore but due to the long-lasting (negative) effects of decline one must still speak of shrinking cities to explain the range of issues at hand.

Concluding the paper, it has to be stated that structural economic change never stops. Replacing the old coal and steel mining structures with more modern technologies is not a one-time affair. The technological race is constantly changing and so is the one at the top.

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Smart Cities brauchen Smarte Räume – Szenarien für die Zukunft eines energie- und ressourcenwirksamen Quartiers durch smarte Stadtgestaltung am Beispiel von Smart City Waagner Biro in Graz

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1 ABSTRACT

Weltweit werden in Städten unter anderem Informations- und Kommunikationstechnologien eingesetzt, um den aktuellen urbanen Herausforderungen wie globale Erwärmung, Umweltverschmutzung und Ressourcenknappheit zu begegnen. Der Bedarf nach neuen, modernen, energieeffizienten Stadtquartieren steigt. Sie sollen vieles können: ressourcenschonend, sozialverträglich, kostengünstig, resilient sein, energetisch nachhaltig und allgemein die Lebensqualität der Bürgerinnen und Bürger erhöhen.

Das angestrebte Ziel die Energieeffizienz bis 2030 auf 30 Prozent zu erhöhen und jährlich um 1,5 Prozent effizienter zu werden birgt gleichzeitig das Potential auch durch qualitative Gestaltungsmaßnahmen im öffentlichen Raum, die Lebensqualität in Stadtquartieren zu erhöhen.

Im Jahr 2018 wurden in Österreich rund 13,3 Petajoule durch den Industriezweig Bau verbraucht.(Kords, 2019) (siehe Abb. 1) Dieser Verbrauch findet nicht nur in Gebäuden statt, sondern vor allem durch Klimaanpassungsmaßnahmen im Quartier. Das Gelingen der räumlichen Integration der energetischen Maßnahmen entscheidet wesentlich über die Aufenthaltsqualität im öffentlichen Raum und die Lebensqualität im Quartier. Das Konzept der Smart City wird dadurch eine wichtige Rolle bei der Umstellung auf erneuerbare Energien spielen. Nicht nur die wirtschaftlichen, energetischen Regeln müssen erneuert werden, sondern auch die räumliche Gestaltung in den Quartieren. Die Gebäuderichtlinie soll verschärft werden, sowie eine neue Öko-Design-Richtlinie erlassen werden.

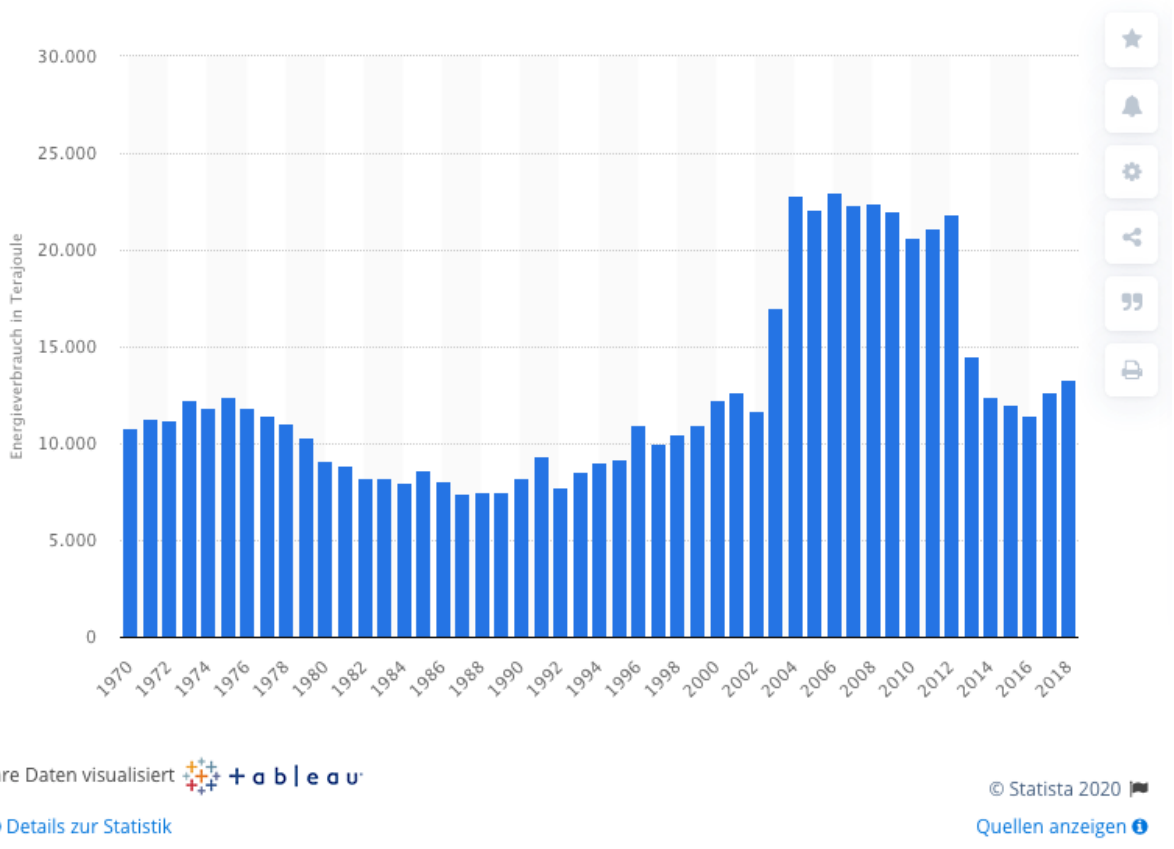

Abb. 1 Energetischer Endverbrauch des Bausektors in Österreich. Quelle: Statista. Die Statistik zeigt die Entwicklung des Endenergieverbrauchs des Bausektors in Österreich in den Jahren 1970 bis 2018

Globale Pilotprojekte wie Songdo, oder Masdar City zeigen, dass die einseitige Ausrichtung auf technologische Lösungen zwar die Effizienz im Quartiererhöhen können, jedoch nicht die räumlichen

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Qualitäten und damit die Lebensqualität der Bürgerinnen und Bürger steigert. In diesem Kontext fehlt es an einer räumlichen Auseinandersetzung mit dem urbanen Digitalisierungsprozess an der Schnittstelle zwischen Energieeffizienz und Stadtraumgestaltung und macht die Notwendigkeit eines Smart-Spatial-Nexus deutlich.

Smart City Konzepte wirken zunehmend auf den urbanen Raum. Die räumlichen Wechselwirkungen zwischen dem physischen Stadtraum und den digitalen Technologien und Energieinnovationen müssen zusammen gedacht werden, um das Potential der Energieeffizienz im Quartier ausschöpfen zu können. Ziel ist es daher, die Raumwirksamkeit urbaner Szenarien mit Fokus auf Mobilität und Umwelt auf der Quartiersebene räumlich zu untersuchen um herauszufinden, welchen energetischen und gestalterischen Mehrwert der Stadtraum durch den technologischen Fortschritt erfahren kann, um die Energieziele zu erreichen und gleichzeitig die Stadträume der Zukunft zu qualifizieren und somit die beste Voraussetzung für hohe Lebensqualität der Bürgerinnen und Bürger zu schaffen.

Dabei wird der These nachgegangen, dass Smart City Quartiere, auch bei optimalen technischen Voraussetzungen, nur dann das erklärte Ziel der energetischen Ökonomisierung und Effizienzsteigerung im seinem vollen Potential ausnutzen können, wenn diese Quartiere räumlich-energetisch integriert gestaltet werden.

Dazu werden drei unterschiedliche räumlich-energetische Szenarien am Beispiel des Smart City Quartiers Waagner Biro in Graz erstellt und dadurch technologische Maßnahmen inhaltlich und zeichnerisch zunächst auf ihre Raumwirksamkeit untersucht. Diese dienen als räumliche Empfehlungen für energetisch smarte Räume und zeigen das räumliche Potential der Energieeffizienz auf. Die Szenarien richten sich nach den aktuellen städtebaulichen Themen wie Urbane Gemeingüter, Stadt als Ressource und produktive Stadt.

Die Ergebnisse tragen dazu bei, dass räumliche Smartness als zusätzliche dritte Dimension des Smart City-Kozeptes zu etabliert um zu ermöglichen, dass Raumgestaltungsstrategien dazu beitragen können, das Konzept der Smart City und damit Energieinnovationen im Stadtraum physisch zu materialisieren und die Lebensqualität der Bürgerinnen und Bürger zu erhöhen. Denn das größte Potenzial für ein nachhaltiges, robustes, integratives, lebenswertes und energieeffizientes Quartier mit hoher Lebensqualität liegt vor allem in der Smartness seiner Räume und weniger in seinen Technologien.

Keywords: Städtebau, Smarte Räume, Smart City, Smart Space, Stadtraum, Lebensqualität, Resiliente Stadt

2 LITERATURÜBERSICHT UND -VERSTÄNDNIS

Der Begriff Smart City (SC) sowie verwandte Begriffe wie Digital City oder Creative City, tauchen seit zwei Jahrzehnten zunehmend in wissenschaftlichen Artikeln und technischen Berichten auf. Kommunen, Politiker und Dienstleistungsanbieter verwenden diese Begriffe, um eine Vorstellung von einer Stadt zu vermitteln, in der Technologien helfen, die Wünsche und Bedürfnisse der Stadtbewohner zu erfüllen (Hollands, 2008). Aber auch Herausforderungen der zunehmenden Urbanisierung, wie Verkehrsbelastung, Energieverbrauch, Umweltverschmutzung oder Abfallwirtschaft, zeigen die Notwendigkeit auf, mögliche Lösungen für den Umgang mit diesen städtischen Problemen zu finden (Caragliu et al., 2011).

Zwei große Denkschulen dominieren die Literatur: der technologiegeleitete (Batty et al., 2012, C. Harrison, 2010) und der sozialgeleitete (Hollands, 2008, Caragliu and Del Bo, 2018, Caragliu et al., 2011, Giffinger, 2007b) Ansatz zu Smart City. Doch in der Diskussion hinterlässt eine Lücke bezüglich des Raums.

Während sich ein Teil der Literatur auf neue Technologien wie Informations- und Kommunikationstechnologien (IKT) konzentriert und die Stadt als ein funktionales System versteht, das mit Hilfe großer Datenmengen die betrieblichen Abläufe optimiert, konzentriert sich ein anderer Teil der Literatur auf weiche Faktoren wie Lebensqualität, Humankapital oder die Innovationsfähigkeit einer Stadt.

Betrachtet man das technologieorientierte Verständnis von SC, das durch verschiedene digitale Technologien gekennzeichnet ist, so erweist sich die Steigerung der Produktivität und der reibungslosen Funktionalität städtischer Systeme als ein Hauptziel der Befürworter. Es werden große Mengen an Echtzeitinformationen gesammelt, übertragen, interpretiert und verarbeitet, um Prozesse zu optimieren und die zuständigen Verwaltungsstellen bei Problemen oder Gefahren zu informieren (Hall, 2000, Marsa-Maestre et al., 2008, Jaekel, 2015, Greenfield, 2006). Auf diese Weise können die verarbeiteten Daten dazu beitragen, dass der Verkehr trotz des Berufsverkehrs reibungslos verläuft oder der Energieverbrauch gleichmäßiger verteilt wird

und damit die Energiekosten gesenkt werden. Der Einsatz von IKT allein kann jedoch nicht zu einer Entwicklung hin zu einer SC führen, die die Lebensbedingungen in den Städten verbessert.

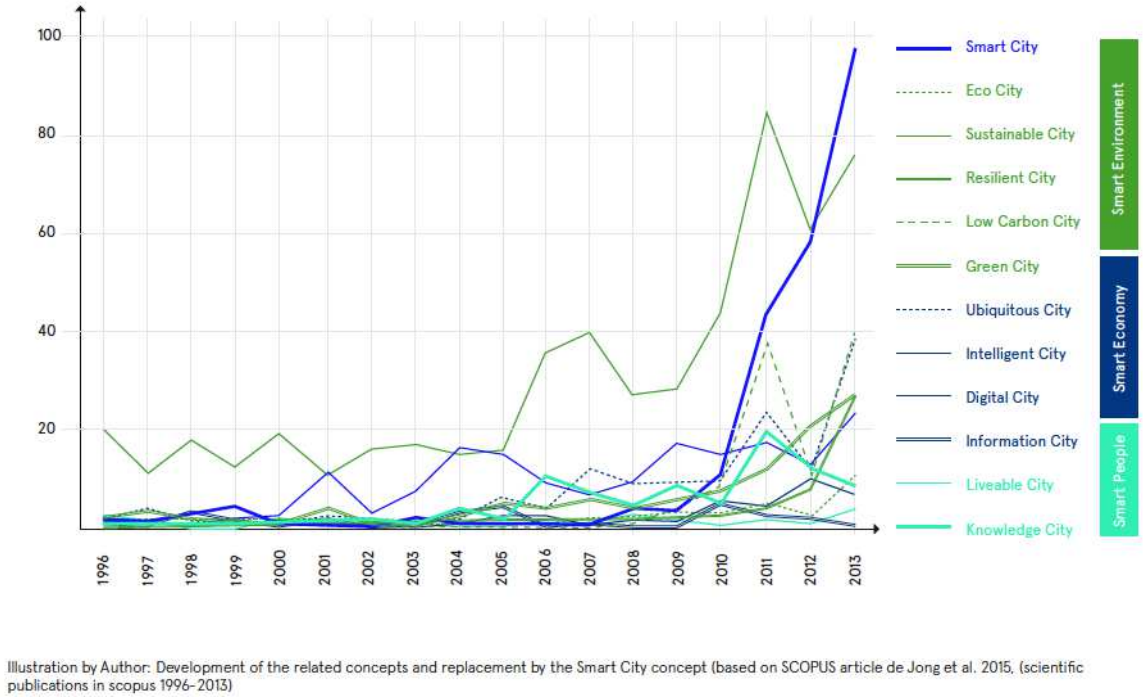

Illustration by Author: Development of the related concepts and replacement by the Smart City concept (based on SCOPUS article de Jong et al. 2015, (scientific publications in scopus 1996-2013)

Abbildung 2 Entwicklung von Begriffen im Zusammenhang mit Smart City. Quelle: Illustration Autorin, Daten basieren auf SCOPUS-Artikel laut de Jong et al. 2015

Dazu gehören auch weiche Faktoren wie menschliche Erfahrung, Wissen, Fähigkeiten und Innovation. Der andere wesentliche Teil der Literatur befasst sich mit der Lebensqualität, den Bildungs- oder Beschäftigungsmöglichkeiten in Städten. Hier stehen die Selbstbestimmung und die Fähigkeiten der Stadtbewohner im Vordergrund, um die Qualität der Stadt zu verbessern oder zukunftsweisende Geschäftsmodelle zu etablieren (Caragliu et al., 2011, Giffinger, 2010, Hollands, 2008, Giffinger, 2007a, Townsend, 2013).

In diesem Spektrum erscheinen andere Bereiche des SC-Verständnisses, wie z.B. die "Intelligenz" der Kommune oder der Verwaltung. Ihre Fähigkeit, Dienstleistungen, Informationen oder Kommunikation der lokalen Bevölkerung auf innovative Weise zur Verfügung zu stellen, ist eine wichtige Säule des SC-Modells unter dem Begriff E-Governance (Sangeetha G, 2016, Luciano, 2014, Hollands, 2015).

Das von der Forschungsgruppe der Technischen Universität Wien (Giffinger, 2015) entwickelte SC-Modell basiert auf insgesamt sechs Kernbereichen: Smart Mobility, Smart Environment, Smart People, Smart Living, Smart Governance und Smart Economy. Es wurden 27 Anwendungsfelder definiert und 90 Indikatoren ermittelt, um den Effizienzgrad einer Stadt quantitativ zu bewerten und damit ein europaweites Ranking zu ermöglichen. Laut Giffinger ist eine Stadt dann smart, wenn sie in der Kombination dieser sechs Bereiche gute Leistungen bietet. Zu den Kernbereichen gehören detaillierte Anwendungsbereiche wie Smart Mobility: Nahverkehrssysteme, internationale Erreichbarkeit/Vernetzung, IKT-Infrastruktur und Nachhaltigkeit der Verkehrsmittel. Der Bericht „Mapping Smart Cities in the EU“ zeigt die höchste Anzahl von Initiativen in den Merkmalen smarte Mobilität und smarte Umwelt (siehe Fehler! Verweisquelle konnte nicht gefunden werden.).

Der Aspekt der räumlichen Dimension von SC bleibt jedoch nicht berücksichtigt. Adam Greenfield bietet einen kritischen Blick auf das SC-Modell. In seinem Buch Against the Smart City diskutiert er das Konzept, das überwiegend von Technologieanbietern und Dienstleistern genutzt und verbreitet wird, und formuliert kritische Fragen im Zusammenhang mit Zweck, Nutzen und Bedarf eines solchen Konzepts. Dazu untersucht er Prototypen von SC - Songdo City in Südkorea, Masdar in Abu Dhabi und PlanIT Valley in Portugal - und filtert Möglichkeiten zur Definition des Begriffs SC aus der Perspektive weltweit führender IKT-Unternehmen. Seine Untersuchungen gehen auch nicht auf Aspekte der räumlichen Gestaltung von SC ein. Und auch bei der Konferenz Digital Clouds - Urban Spaces - City as Information System, organisiert von der

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Zeitschrift Dérive und dem World-Information Institute in Wien (2014), wird die räumliche Dimension nicht berücksichtigt.

In der Urban Age-Konferenz The Electric City, organisiert von der London School of Economics (LSE), beschreibt Ricky Burdett, wie sich die Dynamik des digitalen Zeitalters nicht nur in der technologischen und sozialen, sondern auch in der physischen Struktur von Städten auswirkt (Burdett, 2012). Viele Wissenschaftler beschreiben wie urbane Technologien und IKTs Stadtplanung und Raum beeinflussen (Mandeville, 1983) (Nijkamp and Salomon, 1989) (Grentzer, 1999) (Ogawa, 2000) (Sohn et al., 2002) (Talvitie, 2002) (Sassen, 2011) (Comin et al., 2012) (Zawil, 2017), jedoch nicht im Zusammenhang mit der räumlichen Produktion, wie durch das Smart City Konzept bedingt ist.

Daher ist eine enge räumliche Definition des Begriffs „Smart City“ wesentlich, um die Tragkraft des Papers zu verstehen.

2.1 Operative Definition

Obwohl es noch keine globale Definition des Begriffs Smart City gibt, versuchen viele Wissenschaftler, die Bedeutung zumindest aus akademischer Sicht zu verorten und aus verschiedenen Perspektiven zu diskutieren. (Caragliu et al., 2011, Anthopoulos, 2017, Albino et al., 2015, Mosannenzadeh and Vettorato, 2014, Lazaroiu and Roscia, 2012, Hollands, 2008)

Allen Definitionen gemeinsam ist die IKT-getriebene Entwicklung. Diese neuen Technologien versprechen, die Städte als Systeme und als Gesellschaft zu verändern. Einige Wissenschaftler beschreiben das SC-Konzept als ein mehrstufiges System, das aus mehreren Kategorien besteht, wie z.B. natürliche Umgebungen, harte Infrastrukturen, sowohl IKT-basiert als auch nicht IKT-basiert, weiche Infrastrukturen und intelligente Dienste. (Anthopoulos, 2017). Trotz aller bedeutenden Forschungsarbeiten, die in den letzten zwei Jahrzehnten zu SC durchgeführt wurden, fehlt es an einem signifikanten räumlichen Verständnis des Konzepts. (Hall, 2000, Marsal-Llacuna and López-Ibáñez, 2014, Picon, 2015, Roche, 2016).

Um das Konzept aus einer städtebaulichen Perspektive diskutieren zu können, müssen wir sein Verständnis auf den Raum fokussieren.

Nach meinem Verständnis ist ein SC ein Gebiet mit Systemgrenzen beliebiger Größe, in dem IKT nicht nur im städtischen Raum implementiert sind, sondern physisch zusammen mit dem städtischen Raum gedacht und gestaltet werden, also IKT im Raum verkörpert werden. Dieser SC-Prozess ist in die Stadtgestaltung integriert und verfolgt spezifische Schlüsselziele, um das Leben der Menschen zu verbessern, indem räumlich-technische Lösungen für aktuelle soziale, ökologische und wirtschaftliche Herausforderungen präsentiert werden. Ich schlage vor, die daraus resultierende physische Wechselwirkung zwischen Technologien und Raum als "Smart-Spatial-Nexus" zu bezeichnen (siehe Abbildung 4).

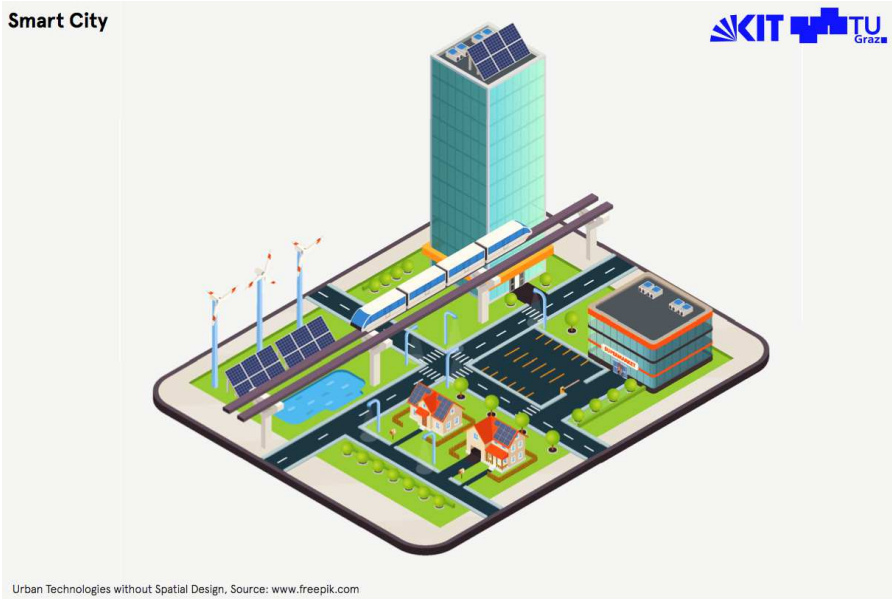

Abbildung 3 Räumliche Produktion des Smart-City-Ansatzes. Quelle: Freepik.com

Abbildung 4 Smart Spatial Design, Ansatz IKT-Design im Raum (Smart Spatial-Nexus). Quelle: Grafik erweitert durch Autorin von der Ausgangsgrafik von Freepik.com

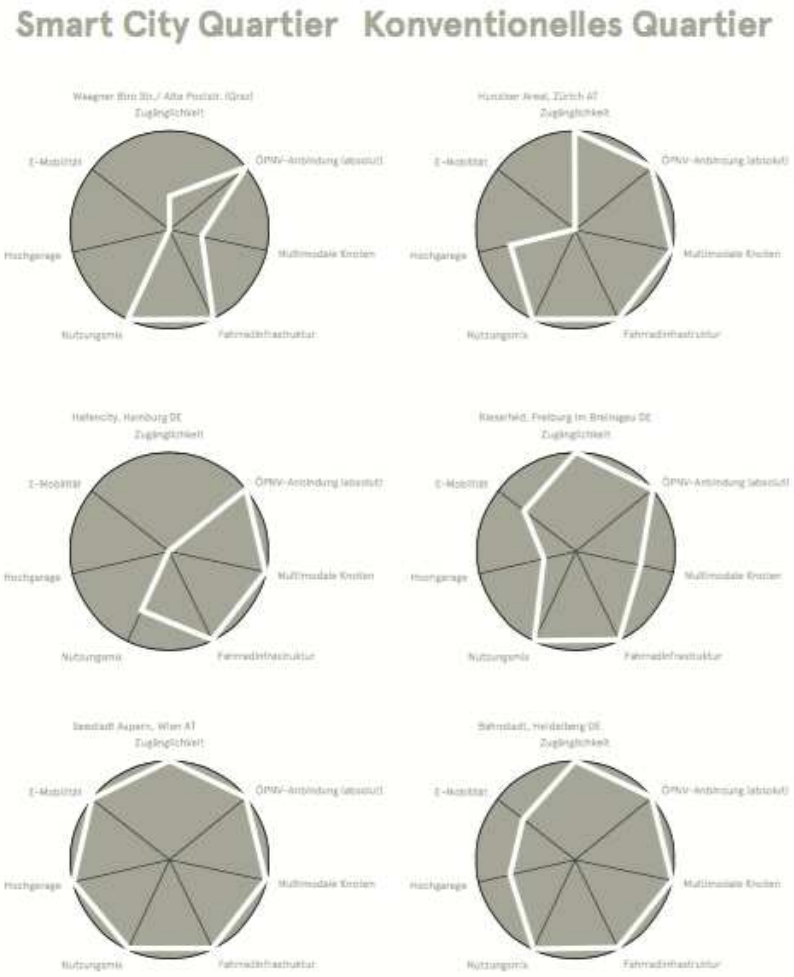

Abbildung 5 Analyse Fallbeispielpaare von Smart City Quartieren und konventionellen Quartieren

3 SZENARIEN ALS RÄUMLICHE POTENTIALE EINER ENERGIE- UND RESSOURCENWIRKSAMEN QUARTIERSPLANUNG

Vor diesem Hintergrund bleibt unklar wie das Modell einer SC energieraumplanerisch und räumlich gestalterisch dargestellt wird. Wenn schließlich die Stadt das Forschungsobjekt ist, dann müssen

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energetische Maßnahmen auch eine dreidimensionale, räumliche oder gar atmosphärische Konsequenz haben, um ihr Potential als urbaner Katalysator in vollen Zügen auszuschöpfen.

Bei einer vorangegangenen Fallstudienprofilanalyse der Autorin von drei Smart City Quartieren und drei konventionellen Quartieren im deutschsprachigen Raum stellte sich heraus, dass zwei der drei konventionellem Projekte besser abschneiden im Vergleich zu den Smart City Quartieren. Es wurden sieben Aspekte untersucht, die einen wesentlichen Einfluss auf die strukturelle Energieeffizienz haben, also im Bereich der Energieraumplanung wirksam sind und primär den Energieverbrauch durch Raum- und Siedlungsstrukturen und -infrastrukturen vermeiden.(Schwab, 2019) Es wurden die Kriterien der fußläufigen Zugänglichkeit, die ÖPNV-Anbindung, Multimodale Knoten, Fahrradinfrastruktur, Nutzungsmix, Hochgaragen und E-Mobilität ausgewertet (siehe Abbildung 5).

Daraus ergibt sich die Frage wie energetische Maßnahmen durch neue Technologien in Smart City Quartieren so umgesetzt werden können, dass sie einen nachhaltigen Einfluss und einen räumlichen Wirkungsgrad erreichen, der die Lebensqualität im Quartier erhöht. „Dichte und Nähe sind dabei die wesentlichen Parameter, um auf Energiesysteme Einfluss nehmen zu können und gleichzeitig räumlichen Leitbilder für eine hohe Lebensqualität entsprechen zu können, da sich darin Fragen der Mobilität sowie der Bereitstellung und Verknüpfung von Daseinsgrundfunktionen (wie z.B. Wohnen, Arbeiten, sich Versorgen, sich erholen, sich bilden etc.) behandeln lassen. Neben den Gebäuden sind die öffentlichen Räume dafür wesentlich.“ (Schwab, 2019)

Um dies zu erreichen müssen neben der allgemeinen Richtlinien auch zeitgenössische städtebauliche Entwicklungsrichtung und aktuelle urbane Themen aufgegriffen werden, um eine langfristige, robuste und spezifische Entwicklungsrichtung einschlagen zu können. Dazu dient die Szenarienbildung, durch die räumliche Qualitäten und energetische Maßnahmen für Klimaanpassungsstrategien ausgelotet und überlagert entwickelt werden können.

Die drei Szenarien greifen aktuelle Tendenzen im Städtebau auf und zeigen die räumlichen Potentiale eines ressourcen- und energiewirksamen Smart City Quartiers anhand des Beispiels von Smart City Waagner Biro in Graz auf.

In der aktuellen Situation in derzeitigen Entwicklungsstand stellt sich der Stadtraum karg und trist dar mit einem hohen Versiegelungsgrad, viel Oberflächenparken, vereinzelte Bäume und solitären Gebäude mit inaktiven Erdgeschoßzonen (sieheAbbildung 6). Dieser Stadtraum wird in den folgenden Szenarien in Hinblick auf urbane Gemeingüter, städtische Ressourcen und urbane Produktion durch energetische Maßnahmen räumlich qualifiziert.

Abbildung 6 Aktuelle räumliche Situation im Straßenraum in der Smart City Waagner Biro in Graz. Quelle: Google Street View Graz

3.1 Urbane Gemeingüter

Das Teilen von urbanen Ressourcen, Infrastrukturen und Räume ist energieeffizient und sozial. Es hilft dabei graue Energie zu einzusparen und ist kosteneffizient. Unter dem Begriff des Sharings sind nicht nur Gemeingüter zwischen einzelnen Privatpersonen zusammengefasst, sondern auch Institutionen, der öffentliche Sektor, oder Unternehmen können durch die Einbindung von Privatpersonen in Form unterschiedlicher Sharing-Modellen einen Beitrag zur Effizienzsteigerung und Energieeinsparung leisten. Das gemeinsame Nutzen dieser Güter bezieht sich auf die kurzzeitige Nutzung von Gegenständen, wie Werkzeug, oder Fahrzeug, kann aber auch auf Wohnraum, Arbeitsstätten, oder Räume für Freizeitaktivitäten übertragen werden. Besonders interessant und wirksam sind Sharingmodelle, die im Stadtraum Anwendung finden. (siehe Abbildung 7)

Der Stadtraum im Smart City Quartier Waagner Biro könnte potentiell mit einem hohen Grad an Nutzungsoffenheit gestaltet sein, um sehr unterschiedliche Aktivitäten aufnehmen zu können. Gemeinschaftsgärten im Stadtraum und auf den Dächern wirken nicht nur der Entstehung von Hitzeinseln vor, die energieaufwendig heruntergekühlt werden müssen, sondern sparen auch durch die lokale Versorgung die Energie für den Lieferverkehr. Die Verfügbarkeit von Car-Sharing mit niederschwelliger Nutzungsmöglichkeit tragen ebenfalls dazu bei den Verbrauch zu verringern, das Oberflächenparken im Quartier zu reduzieren und gleichzeitig den Versiegelungsgrad zu minimieren.

Mobile Stadtmöbel in der Nachbarschaft tragen zur Gemeinschaftsbildung bei und sind nebenbei so flexibel, dass der Stadtraum bedarfsorientiert von den Bewohnerinnen und Bewohnern gestaltet und genutzt werden kann.

Anhand dieser Beispiele wird deutlich wie urbane Gemeingüter und Sharingmodelle graue Energie einsparen können und gleichzeitig die Lebensqualität im smart City Quartier steigern können.

Abbildung 7 Räumliches Szenario Urbane Gemeingüter am Beispiel der Smart City Waagner Biro in Graz. Quelle: Autorin, Institut für Städtebau, TU Graz

3.2 Stadt als Ressource

Der urbane Metabolismus in einem Quartier umfasst alle energetischen und stofflichen Abläufe und Ströme und führt diese in ein Kreislauf zusammen. Diese urbanen Kreisläufe in Form einer effizienten Nutzung und Integration, von produktiven Abläufen oder in der Gestaltung des öffentlichen Raums wirksam werden. Der

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lineare Prozess der der Versorgungs- und Entsorgungsflüsse wird zunehmend im Zyklus gedacht und vorhandene Ressourcen weiter, oder wiederverwertet.

Die Fähigkeit des Stadtraums im Quartier diese zyklischen Prozesse zu ermöglichen und aufzunehmen entspricht somit dem Grad an Ressourcen- und Energieeffizienz. Damit wird nicht nur die Abhängigkeit von Ressourcen reduziert, sondern mit diesem Stoffwechselsystem wird das Quartier durch entsprechende Raumplanung und Stadtentwicklung in seinem Übergang zur Energieeffizienz unterstützt. (siehe Abbildung 8)

Solaraktive Fassaden an Gebäuden, Windräder auf Dächern, oder solarbetriebene Straßenbeleuchtung Energie lokal erzeugen und somit Verluste minimieren. Retentionsflächen fangen Regenwasser bei Starkregenereignissen auf und entlasten somit die Kanalisation. Versickerungsoffene Oberflächen im Straßengebelag unterstützen die Versickerung und langfristige Verdunstung von Regenwasser, was im Sommer einen Kühlungseffekt erzeugt und Hitzeinseln vorbeugt. Regenwasserzisternen liefern Wasser für das Sprühnebelsystem an den Straßenlaternen und großzügige Grünflächen dienen als Regenwasserpuffer.

Begreift man die Stadt als Ressource und schließt möglichst viele urbane Kreisläufe können energieeinsparende Klimaanpassungsmaßnahmen zur Qualifizierung des Stadtraums beitragen und die Lebensqualität erhöhen.

Abbildung 8 Räumliches Szenario Stadt als Ressource am Beispiel der Smart City Waagner Biro in Graz. Quelle: Autorin, Institut für Städtebau, TU Graz

3.3 Produktive Stadt

Findet Wohnen und Arbeiten in fußläufiger Erreichbarkeit zueinander statt erhöht das sowohl die Lebensqualität, als auch die ökonomische Nachhaltigkeit und trägt zum ökologisch-nachhaltigen und energieeffizienten Stadtquartier bei. Durch die Digitalisierung der Produktionsbedingungen in Form einer saubereren, emissionsfreien Produktion wird eine Differenzierung der Nutzungsmischung im Quartier ermöglicht und somit auch neue zeitgenössische Formen von Wohnen und Arbeiten begünstigt.

Die Transportlogistik vom Produzenten zum Konsumenten, aber auch die täglichen Arbeitswege der Angestellten können damit wesentlich reduziert werden. „Sie fördert robuste und anpassungsfähige bauliche Strukturen und bietet potenzielle Synergien im Energieverbrauch sowie eine effiziente Ausnutzung der

räumlichen Ressourcen in unterschiedlichen Maßstäben und unterschiedlichen tageszeitlichen Rhythmen.“ (Schwab, 2019) (siehe Abbildung 9)

Urbane Produktion von Lebensmitteln, Energie und anderen Produkten im Quartier in unmittelbarere Nähe zum Endverbraucher sichert eine energiesparsame und effiziente Distribution. So können vorhandene Wertstoffe lokal im Quartier recycelt, oder upgecycelt werden. Digitale Produktionsformen im Fab-Lab und eine nachhaltige Mobilität des Logistiksystems sichern einen geringen Energieverbrauch im Quartier.

Dieses Szenario macht die Wirksamkeit der Nutzungsdurchmischung und der emissionsfreien Produktion, als energieeffiziente Maßnahmen deutlich.

Abbildung 9 Räumliches Szenario Produktive Stadt am Beispiel der Smart City Waagner Biro in Graz. Quelle: Autorin, Institut für Städtebau, TU Graz

Mit all diesen Ansätzen kann die Lebensqualität im Smart City Quartier gesteigert und Ressourcen geschont werden und somit die strukturelle Energieeffizienz erhöht werden.

4 ZUSAMMENFASSUNG

In diesem Beitrag wurde das räumliche Potential der Energieeffizienz aufgezeigt und der Zusammenhang zwischen urbanen Qualitäten im physischen Raum der Smart City und möglichen Klimaanpassungsmaßnahmen. Der Stadtraum des Beispielquartiers Waagner Biro wurde in drei Szenarien in Hinblick auf urbane Gemeingüter, städtische Ressourcen und urbane Produktion durch energetische Maßnahmen räumlich qualifiziert und das Potential der energetischen Maßnahmen für die Lebensqualität der Bewohner darstellerisch nachgewiesen.

Neue Entwicklungen der IKTs können also helfen, Ansätze und Instrumente der Energieraumplanung neu zu denken. Die räumlichen Szenarien können dazu dienen, mit aktuellen urbanen Entwicklungstendenzen eine ressourcen- und energiewirksame Richtung aufzuzeigen.

Städtische Technologien könnten der Energieraumplanung und Stadtgestaltung zugute kommen und zur Qualifizierung des öffentlichen Raums beitragen. Smart Space Design kann zu einer stärkeren städtebaulichen Wahrnehmung energetischer Potenziale und einem ganzheitlichen Verständnis des Konzepts der Smart City beitragen. Wenn wir jedoch in Smart City-Quartieren leben wollen, müssen wir diese zunächst einmal energetisch gestalten und räumlich intelligent machen.

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Die Frage, wie die Energieraumplanung den technologischen Fortschritt der Smart City nutzen kann, um die Stadträume der Zukunft nicht nur effizienter zu machen, sondern auch zu qualifizieren und damit die besten räumlichen Voraussetzungen für eine hohe Lebensqualität der Bürger zu schaffen, konnte nur exemplarisch beantwortet werden. Es besteht weiterer Forschungsbedarf bezüglich der Frage wie Energieeffizienz durch urbane Technologien und eine spezifische Stadtgestaltung, qualitativ hochwertige und robuste Stadträume der Zukunft geschaffen kann, um die Lebensqualität der Bürger zu verbessern.

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🏆 *reviewed paper*

Smart Cities for Smarter Citizens: Participatory Planning in Housing Renovation using 3D BIM Tools: the Case of Eckart Vaartbroek

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1 ABSTRACT

The Triangulum Project is one of the first Smart Cities and Communities (SCC1) Lighthouse projects under the European Commission's Horizon 2020 programme for research and innovation, developing urban laboratories in Eindhoven (NL), Manchester (UK) and Stavanger (NO). These labs serve as testbeds where new technologies and innovative approaches integrating energy, transport and ICTs[1] solutions are tested so that successful cases can be replicated in other areas of the city and beyond. In Eindhoven, one of the objectives is to change the concept of the Eckart-Vaartbroek neighbourhood from a low-priced housing area to a modern, energy-efficient one (approx. 15,000 m2 of living area). With an ICT-based 3D BIM tool (WoonConnect) the tenants can customise energy-retrofit packages for their dwellings. Within the combinations, the residents can choose between options that include insulation, improved glazing, solar panels and increased use of renewable energy. Furthermore, the co-creative approach aims at raising awareness of the opportunities for reducing the energy bill, including recommendations such as changing human behaviour. Thus, it allows all parties to identify appropriate measures to be taken to achieve maximum energy savings. At the same time, the tool intends to empower the user through the architectural design process and to enhance citizen engagement. During the project lifetime, this neighbourhood is turning towards a renovated and sustainable district. The experience of Eindhoven in implementing this solution provides a starting point for initiating replication of similar projects in any city willing to invest and promote smart participation and citizen participation in planning and implementation.

This paper explores Eckart Vaartbroek's dwelling refurbishment use-case as a reference for a co-creative process of architecture and urbanism using ICT and 3D BIM-based solutions.

Keywords: Netherlands, energy saving, digital tools, co-creation, Smart Cities

2 INTRODUCTION

2.1 The Triangulum project

The Triangulum project was one of the first three projects chosen to receive funding within the Smart Cities and Communities Lighthouse projects under the EU's Horizon 2020 framework programme for research and innovation. The Lighthouse Cities Manchester (UK), Eindhoven (NL) and Stavanger (NO) serve as a testbed for innovative smart city solutions focusing on energy, mobility, ICT and business opportunities. In parallel, the three so-called Follower Cities of Leipzig (DE), Prague (CZ) and Sabadell (ES) are developing a strategical plan to become a smart city based on the experience, challenges, and lessons learned observed from the Lighthouse Cities. This deployment of solutions shows their potential beyond the technology to create positive energy districts, reduce greenhouse gas emissions and energy consumption, improve the public transport and quality of life as well as to promote the innovation ecosystem and citizen engagement.

2.2 Lighthouse City of Eindhoven

Eindhoven is the centre of the so-called "Brainport" Region, which has the vision to become the largest Dutch and European leading innovation and technology hub until 2030. Today, the city is one of the three most economically prosperous areas of the Netherlands, delivering about 14 % of the national gross domestic product (GDP) (Garrido-Marijuan et al., 2017). Within Triangulum, two districts - Strijp-S (former Philips headquarters) and Eckart Vaartbroek – are being transformed into sustainable living environments. Eckart Vaartbroek is a residential area in Eindhoven, where energy-efficiency renovations were carried out on the social housing stock that predominates in this area.

[1] ICT: Information and communications technology

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3 REFURBISHING SOCIAL HOUSES IN ECKART VAARTBROEK WITH WOONCONNECT

Within Triangulum, the neighbourhood Eckart Vaartbroek is being transformed from social housing from 1960 into a smart social housing district, aiming to become Eindhoven's leading innovative low energy district.

3.1 Eckart Vaartbroek

Located in the north of the city, the neighbourhood contains around 5.000 housing units that are either privately owned or owned by housing associations. An example of the latter is the social housing company Woonbedrijf[2] that owns 1.900 units, of which 70 were refurbished within the Triangulum project. The building typology is quite homogeneous in the area, as many lower-price European districts. However, the current population diversity, where senior and retired citizens are cohabiting with young lower-middle-class families, needs an upgrade of the public and social environment.

3.2 WoonConnect: an ICT-based use-case and 3D BIM-based solution

WoonConnect, a software developed by the dutch company De Twee Snoeken (Fig. 1), was developed outside the Triangulum scope. It was chosen for testing co-creational housing refurbishment by the housing association Woonbedrijf in Eckart Vaartbroek. The tool was designed to enable an interactive renovation process by providing tenants or homeowners with the opportunity to manage their energy consumption through renovation measures and behaviour insights (Gemeente Eindhoven et al., 2018). This is possible since the digital 3D-tool allows the housing association and apartment owners to improve their dwellings and see the impact of their actions in terms of energy consumption (i.e. showering, heating), contrasted with the expected results of a renovation. In the case of Woonbedrijf tenants, the set of measures was predetermined. The measures chosen can be visualized along with the respective rent/cost implications of each dwelling, allowing the inhabitants to make a more informed decision regarding the refurbishment of their buildings.

This use case aims to involve tenants in the process of renovating and maintaining the homes that are owned by the social housing association Woonbedrijf. Tenants can initiate their home refurbishment, as they have the chance to customize and plan the renovation start at a time that is most convenient for them. The tool enables tenants to make informed decisions on what pre-defined renovation options they want to realize. To use it, each tenant gets an own login code to the platform. The tool provides direct feedback on the web-application what the influence of renovation is. Thus, the tenant can directly receive an offer for a renovation option.

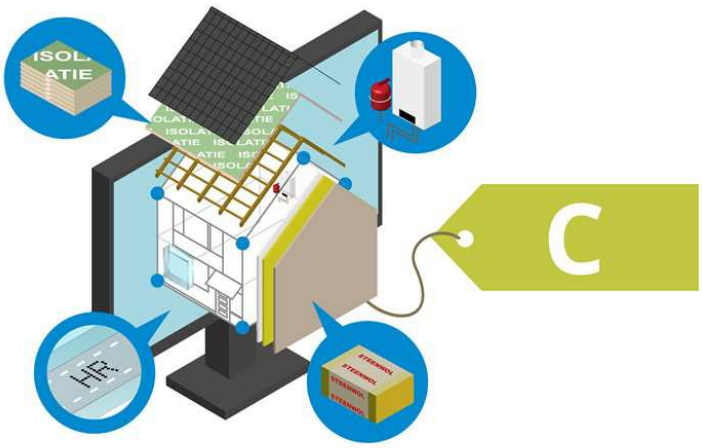

Fig. 1: Illustration of the WoonConnect tool with an energy label C. Source: De Tween Snoken.

More than 50% of the tenants have used WoonConnect by themselves or with the assistance of friends or family after a short demonstration of the program. The latter was facilitated by the tenant-guidance-worker of Woonbedrijf (Wijngaard, 2020). The hands-on experience with the tool creates a new sense of influencing power and was accompanied by several direct interactions to capture the preferences of the tenants. Besides,

[2] Also known as Stichting Woonbedrijf SWS.Hhvl

the renovation allows the housing association to directly interact with the tenants, working together on improving the living conditions in an individual household level. Conversations face to face with them at their kitchen tables was part of Woonbedrijf´s unique approach, which opted for the individual renovation of houses according to the tenant wishes as opposed to what housing associations usually do. A total of 225 out of the 254 homes that were part of the Triangulum project used WoonConnect for renovations. The missing 29 houses did not use the tool due to initial technical challenges of the instrument and also difficulties to carry on with a renovation process at that time. The latter tend to renovate whole housing blocks at the same time and in the same way (Gemeente Eindhoven et al., 2018).

The WoonConnect tool offers several renovation options. A basic renovation package with a selection of measures is paid by the company with funds from the European project. The selected measures available in this package are new insulated roof, exchange of single-glazing to double-glazing, new ventilation system based on a CO2 sensor, new layout of homes (i.e. bigger bathroom), among the most relevant ones. Installing a new or larger skylight, solar panels on the roof, and specific toilet, shower and kitchen artefacts are considered additional measures and therefore paid by the tenants by an increase of their rent. (Woonbedrijf, 2018). In the area, according to the information collected and monitored within the project, 7918 m2 social housing buildings have been renovated, reducing GHG emissions by 20.43%. The estimated energy bill reduction is 61%. For the digital renovation platform of Woonconnect, 284 people (28.6%) used it (74 houses were refurbished within the project scope), and 174 made a plan (scenario) for the renovation of their home (Evans et al., 2020).

The payback period varies from 18 years for the houses installing solar panels and upgrading the mechanical ventilation of their home to between 35-50 years for the rest of the basic renovation measures. The payback for the basis renovation for Woonbedrijf comes in the future when increasing the rent and reducing their budget for regular maintenance. In the case of the tenants, they have a lower energy bill and therefore, an overall decrease in their living costs (Wijngaard, 2020). In terms of energy savings, an improvement of the energy label[3] for each renovated house is foreseen. As a result of this demonstration in Eckart-Vaartbroek, 20% of the homes are at energy label A, and 51 of the 74 tenants from the houses funded by EU-funding chose as an extra measure to improve the energy label.

Furthermore, the Eindhoven partners have conducted three tenant surveys with an above-average tenant satisfaction rate of 7.5. The first survey took place two weeks before the start, the second during and the third one five weeks after the renovation. Moreover, more than 50% of the tenants are making use of the digital tool by themselves.

After each renovation, an increment in the energy and resource efficiency is expected. The implementation also builds a database of possible solutions and measures adapted to a specific type of housing. Thus, a live 3D BIM[4] record of the housing stock is created to be used for later maintenance, and it will support the renovation process by producing the necessary documents and tracking decisions (Gemeente Eindhoven et al., 2018).

The co-creative approach was based on an active participation model. The use of this tool is called co-creative design process as the tools enables tenants to customize and make their own choices for the renovation of their home, especially compared to a standard renovation process of social housing. The participation model started with direct kitchen-table interviews in 200 homes and followed with the preparation of the renovation plans based on the outcome. All renovation measures and upgrades were designed and developed based on these participative sessions with the tenants. To prepare the tool for the tenant, the plans were entered into the Woonconnect tool, and a guided process to familiarise them with the platform accompanied this phase (See Fig. 2). This enabled tenants to make informed decisions on the renovation options. In total, the development of the 3D tool took between 2-5 years, whereas the implementation time of the renovation is less than half a year (Lämmel & Stöffler, 2020). According to Woonbedrijf, the development time took longer because of the innovative nature of the tool. In future implementations, this time is expected to be reduced to 1-2 years (Wijngaard, 2020).

[3] According to the Dutch regulations, houses and other buildings must have an energy label that measures the energy performance certificate of the edification (Business.gov.nl, 2020).
[4] BIM: Building information modeling

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Fig. 2: Explanation of how to start the renovation process. Source: Woonbedrijf.

Apart from the refurbishment scenarios and the savings calculations in the energy bill, WoonConnect also features an online survey which collects input provided by the household. The survey collects qualitative information that provided the Municipality of Eindhoven and Woonbedrijf with an idea of the resident´s involvement in sustainability projects as well as an overall view of the satisfaction with the neighbourhood (Gemeente Eindhoven et al., 2018).

Also, to measure the energy savings, smart meters have been installed in all the houses. The main idea of having these devices was also to create a visual tool to make users aware of the behavioural changes they can pursue to reduce their energy consumption. Therefore the data is being used by the network operator to develop other tools that might help users to translate the energy consumption of the user into a user-friendly platform for the user to understand their behaviour based on their energy consumption. The energy network operator pays instalment and maintenance of the smart meters and is also in charge of feeding back the excess of energy generated into the grid.

Moving to the implementation of the use-case, supporting factors framed in legal, infrastructural, and social areas were crucial. In legal terms, the housing association is bound by law to maintain and improve the houses (Government of the Netherlands, 2019). In terms of infrastructure, the type of homes where the digital tool and the renovation were executed is present in the Netherlands in high proportions, approximately one million times (Lämmel & Stöffler, 2020). This represents the opportunities for scaling-up the ICT solution in the country. The last supporting factor is the social one, which proved to be a base element but at the same time a challenge. In general terms, there is a high usage of new technology; however, it is not always common in several relevant tenant groups.

4 DISCUSSION

This section addresses the challenges and lessons learnt throughout the Triangulum project and hand by hand with the implementations. Furthermore, it reflects on the importance of ICT in urban development.

4.1 Lessons learnt

In the specific case of this 3D-ICT tool WoonConnect, these were highly related to the users' engagement. As part of the lessons learned the direct and personal interaction at kitchen-tables was highly crucial for the success of the project. To get to know the customer was identified as a key to reach the implementations trying to foresee if the digital tool was right for the user. Before starting, the design of a customer journey is crucial. From this, two things were identified. First, the user needs some help to get started; and second, a 100% self-service tool is not entirely realistic. The user's engagement is vital but needs to be promoted from the neighbourhood level through social groups, etc.

4.2 Challenges

In terms of challenges, the privacy issues were very relevant for the tenants, which at first were not keen to share their data. It was necessary to create enough trust to collect the data. The involvement of many partners and their interest in different types of data made the households feel afraid about the questions and uses of the information, for instance, the energy data collection was only possible through the energy provider company and the consent of the tenants. The scepticism affected baseline construction and monitoring. Another challenge was the digital-friendly level of tenants. In some cases, older people were not able to use the tool by themselves but only sometimes with the help of the family. Moreover, the high maintenance costs and some technical problems were an issue.

4.3 The importance of ICT in urban development

The smart city infrastructure includes the physical and ICT aspects of the city. The physical infrastructure consists of the actual structural elements of the city, including buildings, streets, railways, electricity and water supply facilities. In contrast, ICT infrastructure refers to any communication infrastructure such as fibre optics, Wi-Fi networks and wireless access points, along with service-oriented information systems. ICT is considered a vital component of the smart city concept, supporting the integration of different urban systems and their operational processes to improve the quality, performance and interactivity of urban services. The use of information and communication technology and real-time data processing enabled the development of safer, faster and reliable smart city infrastructure systems (e.g. energy, transport, governance) (Mohanty et al., 2016). ICT also seeks to reduce costs and consumption of resources and encourages citizen participation. Some of the most widespread ICT solutions are energy management systems, traffic control systems, intelligent networks, urban data platforms, mobile applications, etc. In terms of the benefits experienced with the implementation of the use-case in Eckart Vaartbroek, ICT proves to benefit stakeholders in different levels and sectors (Fernandez et al., 2019). The revenues of the implementation were visible in the civil society by reducing the energy bill for tenants; in the private sector, by providing new business opportunities to contractors; and in the public sector, where the initiative was started (Lämmel & Stöffler, 2020).

Although in this case, the main actor was not the municipality or the local authority –Woonbedrijf is a non-profit private company– this solution might be interesting to stimulate a more inclusive real state sector that responds with more sustainable solutions to the citizens' needs. Moreover, this kind of projects are for the public sector attractive as it brings technology closer to their citizens, as well as raising awareness and comply with the city's commitment and goals to tackle climate change. Enabling the weakest, most excluded and powerless citizens to gain or regain power over their lives is what empowerment is all about so under a bottom-up approach, empowerment can be reflected through people' s involvement in the development and decision-making process (Chambers, 1997; Fors et al., 2002). Thus, this case study not only includes the residents but empowers and makes them owners of the renovation process.

Besides the impacts identified and measured within the Triangulum project, external studies about WoonConnect have been executed. The independent consulting organisation Fakton, which works for the Government of the Netherlands, calculated the impact of the ICT tool and 3D BIM solution WoonConnect for municipalities and households. By giving some examples, the results of the study demonstrate substantial

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costs savings on permits, demolition, renovation, and home improvements. For instance, in the category, smarter home improvements the costs and benefits of the refurbishment are instantly evident, providing a transparent process, clear client communication and the facility of working with KPIs. The savings in this field are calculated around €200 to €1200 per home annually with and 8% of savings on home improvement costs. In terms of more efficient sustainability, Fakton found that the insight into the construction of houses, the possible recycling of materials and building elements and the possibility to identify the presence of harmful substances represents savings of €2,400 per home, meaning and 8% of the sustainability costs (WoonConnect, 2018).

ICT, therefore, plays an essential role in helping cities reduce their carbon footprint and make them a better place to live.

5 CONCLUSIONS

The tool has proven to be a good practice within the project, as it fulfils the mission of reducing greenhouse gas emissions and energy costs, as well as involving residents in a co-creative process. Despite the technological barriers, this case study successfully demonstrates the integration of users into the decision-making process of a co-creative design process. Moreover, it stresses the importance of not only involving citizens in such processes but also educating and raising awareness of several opportunities available to reduce their energy consumption.

Furthermore, a city vision where all efforts strive for the same goal must also be taken into account. In the case of Eindhoven, this is the Brainport vision, which rediscovers and highlights the importance of the ICT sector in stimulating further urban development in the city. These city visions must be accompanied by the political will of the city's leader and governments to ensure acceptance and adequate resources. While much effort is focused on other sectors (energy, mobility), ICT has great potential due to its role in unified communications, becoming an integral and fundamental sector for the cities of today and tomorrow. Investing in such solutions should, therefore, be a priority to tackle climate change and foster urban transformations.

The process of becoming a smart city can be seen as a tool that helps to improve the quality of urban life and makes cities more sustainable and resilient. The only way to improve people's quality of life in this context is to involve them in the city planning process and giving them the necessary role for actively shaping this transformation process. In the end, this transformation affects themselves.

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🏆 *reviewed paper*

Smart Through Gender+: Kernthemen für eine inklusive Stadtplanung am Beispiel Linz (Austria)

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1 ABSTRACT

Damit Stadtregionen funktionsfähig, nutzerinnen- und nutzerfreundlich und alltagstauglich für die vielfältigen Bewohnerinnen und Bewohner und temporäre Bevölkerung bleiben, müssen die Ziele der neue Urbane Agenda (Basiert auf die SDG2030) in konkrete Planung übersetzt werden. Im Rahmen des Forschungsprojekts Smart through Gender+ wird am Beispiel der Stadt Linz ein replizierbares Tool-Set an Analyse- und Planungsinstrumenten entwickelt, welches die vielvältigen und unterschiedlichen Bedürfnisse und Nutzungsansprüche an Alltagsinfra¬strukturen, Straßenfreiräume und Grünräume möglichst genau erfasst.

Für die Operationalisierung wurden aktuelle Handbücher von Pionierstädten zu gleichstellungsorientierter, „gegenderter“ Planung (Berlin, Barcelona, Paris und Wien) gesichtet und fünf Kernthemen für eine Gender+-Planung definiert. Diese erweitern das ursprünglich feministische Planungsleitbild „Stadt der kurzen Wege“ mit drei Perspektiven: Umfassende Barrierefreiheit und (digitale) Vernetzung sowie stadt–regionale Verflech¬tungen. Damit wurde eine Standortbestimmung durchgeführt im Rahmen von Gleich¬stellungs- Normen und Werthaltungen und Planungszielen. Im nächsten Schritt wurden die Kernthemen mit übergeordneten Planungs¬leitbildern und Planungsstrategien aus dem Planungs-Mainstream und den fach¬spezifischen Programmen der Stadt Linz verbunden.

Vielversprechend ist die Umlegung der Kernthemen und Leitbilder auf die stadträumliche und sozial-räumliche Erfassung und Beschreibung der Alltagswege von lokal orientierten Gender+-Gruppen mit charakteristischen Raumnutzungsprofilen. Derzeit arbeitet das Projektteam an der Operationalisierung dieses Planunskonzepts in der Stadt Linz und zwar in drei Maßstabsebenen: Stadtregion, Stadtteil (Bezirk) und Teilgebiet (Baublock, Park oder Straßenfreiraum).

Letztlich reflektieren wir die Frage, inwieweit Planerinnen und Planer durch „Gender+ Stadtplanungsinterventionen“ zu einer Transformation der ungleichen Geschlechterrrollen beitragen können, oder als Rollenstereotypisierung eher am Fortbestand der Macht- und Geschlechterverhältnisse mitwirkt.

Keywords: barrierefreie Stadt der kurzen Wege, inclusive & feminist urbanism, Stadtplanung, Grenzen der Raumplanung, Gender Mainstreaming

2 EINLEITUNG

Städte und Stadtregionen stehen vor großen Herausforderungen, um funktionsfähig, nutzerinnen- und nutzerfreundlich und alltagstauglich für Bewohnerinnen und Bewohner und temporäre Bevölkerung zu bleiben. Dies ist mit dem Anspruch verbunden, die Energiewende, die Klimawende, den demographischen Wandel zu bewältigen, ohne Kollateralschäden für das Sozialgefüge und die stadträumlichen Qualitäten zu generieren. Nicht zuletzt die Debatte um die Umsetzung der Agenda 2030[1] verlangt nach inklusiver Stadtplanung und Stadt¬entwicklung (inclusive urbanism). Bewohnerinnen und Bewohner haben vielerorts schon ihre Teilhabe an der Stadtentwicklung eingefordert. Digitalen Stadt-planungstools zur Analyse sozial-räumlicher Strukturen und zur Simulation der Wirkung von Planungsvarianten fehlt derzeit meist eine Integration von geschlechts- alters- und gruppenspezifischen Anforderungen.

Zwar ist in Pilotprojekten die Operationalisierung von Inklusion, von Geschlechter- und Freiraumgerechtigkeit in Analyse- und Planungsinstrumenten erprobt worden, jedoch fehlt noch ein strukturell verankertes Instrumentarium für den „Planungsalltag“ (Roberts, 2013). In langjähriger Erfahrung mit „gleichstellungs-orientierten“ und „gegenderten“ Planungsprojekten hat sich gezeigt, dass das transformative Potential und das Ziel von Gender Mainstrreaming, nämlich die tatsächliche strukturelle Verschiebung der gesellschaftlichen Machtverhältnisse und Rollenverteilungen, immer wieder in

[1] https://www.2030agenda.de/de/article/die-neue-urbane-agenda-was-bedeutet-sie-fuer-kommunen-und-regionen (Zugriff 2.2.20)

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nutzerinnen- und nutzerfreundlicher und bedürfnis¬orientierter Planung zu verschwinden droht (Tummers und Wankiewicz, 2009).

Das Forschungsprojekt „Smart through Gender+. Integration von Gender+ in digitale Stadtplanungstools und Entwicklung eines Tool-Sets zu gendergerechter Stadtplanung“, der Titel ist Programm[2], will diese Lücke zumindest teilweise schließen. In der drittgrößten österreichischen Stadt, Linz an der Donau (Hauptstadt von Oberösterreich), wird geprüft, inwieweit mit üblicherweise vorhandenen und verfügbaren Daten eine quantitative Analyse sozialer und räumlicher Strukturen unter Berücksichtigung des Gender+ Ansatzes erfolgen kann, um damit die Qualitäten, Defizite und Potentiale für die Gender+ Gruppen in den Stadtteilen sichtbar zu machen. Aufgabe der beiden Autorinen in der Startphase des Forschungsprojekts war u.a. die Entwicklung eines thematischen Anforderungsprofils für das digitale Tool, sowie Analysethemen und Indikatoren zu formulieren, die zugrundeliegenden Gleichstellungsziele in Planungsleitbilder zu übersetzen und davon Analyse- und Planungskriterien aus Sicht einer gendergerechten Planung abzuleiten.

In diesem Beitrag beschreiben wir die Herangehensweise und präsentieren erste Ergebnisse. Der Artikel ist folgendermaßen strukturiert: Zunächst präsentieren wir im Kapitel „Kontext“ einige Eckdaten über das Forschungsprojekt, die Methode, und die Pilotstadt Linz. Im Abschnitt 3 folgt der theoretische Rahmen und eine Begriffserklärung. Abschnitt 4 stellt die fünf Kernthemen vor und beschreibt ein Beispiel. Danach diskutieren wir unsere Ergebnisse im Rahmen des Gender Planning. Last but not least sprechen wir die Metaebene an und stellen die substantiellen Fragen, die auch die REAL CORP 2020 stellt: Inwieweit kann Planung “urban change” gestalten? Der Tagungstitel „SHAPING URBAN CHANGE - LIVABLE CITY REGIONS FOR THE 21st CENTURY“ angewendet auf gendergerechte inklusive Stadtplanung heißt daher: Inwieweit können Planerinnen und Planer durch inklusive Stadtplanung zu einer Transformation der ungleichen Geschlechterrollen beitragen?

3 KONTEXT UND METHODEN: THEORETISCHE BASIS

3.1 Das Forschungsprojekt „Smart through Gender+.

Übergeordnetes Ziel ist ein Proof of Concept des Tool-Sets, be¬stehend aus quantitativen digitalen Analyse- und Simulationstools sowie qualitativen Instru¬menten aus der Stadt- und Landschaftsplanung und der Soziologie.

Im Projektkonsortium unter der Leitung der Boku-Wien (ILAP) arbeiten die Forschungspartner AIT (digitale Toolentwicklung) und Boku (Institut für Landschaftsplanung und Institut für Land¬schafts-architektur - ILA) mit den drei Businesspartnerinnen planwind und raumSinn (Salzburg, AT) und Tussen Ruimte (Rotterdam, NL) zusammen. Eine begleitende Arbeitsgruppe der Stadt Linz gibt regelmäßig Feedback zu Methoden, Interpretation von Teilergebnissen und zu Bewertungsschlüssel. Sie unterstützt auch bei der Auswahl der Stadtteil-Fallstudie für die qualitative Analyse. Die Wahl fiel auf den Bulgariplatzbezirk, ein sehr dynamischer und hervorragend erreichbarer Stadtteil südlich des Haptbahnhofs mit vielfältiger Bewohnerinnen- und Bewohnerstruktur, guter ÖV-Anbindung (Nord-Süd-stadtquerende Tramlinien) sowie starker Flächenkonversionsdynamik: neue Wohngebiete auf ehemaligen Großindustrie- und Gewerbeflächen.

Zur projektbezogenen Ansprache der vielfältigen Gruppen in Bezug zu Raumstrukturen und Freiraum-funktionen in der Stadt Linz war es Aufgabe der beiden Autorinnen ein theoretisches und thematisches Konzept einer smarten Gender+ Stadtanalyse und Stadtplanung zu entwickeln.

Ausgewählte Forschungsfragen für die erste Projektphase waren:

- Was heißt „inklusiv & geschlechtergerecht“ im Bezug auf räumliche Strukturen?
- Smart Gender+ Stadtplanung: Welche Kernthemen sind aus Sicht der Alltagstauglichkeit und Geschlechtergerechtigigkeit für eine inklusive Stadtplanung relevant in einer barrierefreien Stadt der kurzen Wege?

[2] Das Forschungsprojekt Smart through Gender Plus (09/2018 – 02/2021) wird vom Österreichischen Bundesministerium für Technologie, Innovation und Verkehr im Talente-FEMtech Programm kofinanziert. Projekthomepages: https://boku.ac.at/rali/ilap/projekte/smartthroughgender, https://projekte.ffg.at/projekt/3010493

- Gender Mainsteraming (GM) in den Planungs-Mainstream bringen: Auf welche Planungs-leitbilder kann zurückgegriffen werden, um Gender+ gruppenspezifische Differenzierung in der Raumnutzung für die Stadtanalyse angemessen zu beschreiben und für die Stadtplanung nutzbar zu machen?
- Mapping Gender+: Wie lassen sich die Gruppen erfassen und dabei Stereroypisierung von (statistischen) Gruppen vermeiden und welche Daten fehlen dazu?
- Welche Wechselwirkungen bestehen zwischen der Gestaltung und Ausstattung des öffentlichen Raums und der Diversität der Nutzung (Gender+ spezifisch) sowie der sozialen Interaktion im Raum?

Diese Fragen sprechen wir im Folgenden an.

3.2 Methodik: Auswertung von GenderMainstreaming/GenderPlanning-Handbüchern

‚Inklusiv und geschlechtergerecht' planen bezieht sich auf ein vielvalt an Planungsleitbilder, unter anderm:

- Stadt der kurzen Wege & Walkable City
- Alltagsrerechte & alltagstaugliche Stadt & Region
- Barrierefreie und sichere Stadt
- Fair geteilte Stadt / fair geteilter öffentlicher Raum
- Recht auf Stadt und Aneignung von öffentlichem Raum

Die Definitionen bleiben aber meistens abstrakt oder sogar implizit - diesen Punkt sprechen wir in der Diskussion weiter an.

Um die Themen und Kriterien für eine „Smarte Gender+ Stadt" zu identifizieren, griffen die Autorinnen auf empirische Forschungsergebnisse und Projekterfahrungen zurück (Tummers/Wankiewicz 2020: Tab. 1; Tummers/Denèfle/Wankiewicz 2019). Wichtige Ressource war dabei die Auswertung der Handbücher Gender Planungs-Handbüchern von europäischen Städten. Insbesondere Wien (2013), Berlin (2011, 2017), Barcelona (2012, 2014) und Paris (2017) publizierten in den letzten Jahren Guidelines die eine thematische, prozessuale und institutionelle Umsetzung einer feministischen und geschlechtergerechten Raumplanung „in den Mainstream" bringen wollten. Für Gender+ wurden Haupt- und Subthemen, Analysekriterien und Indikatoren zur geschlechtsspezifischen und sozialräumlichen Differenzierung („Mapping Gender") erarbeitet. Weiters interessierten uns die angesprochenen Räume (lokale Nachbarschaft bis Gesamtstadt) und die Konzeption von Gender/Geschlecht und Stadtraum sowie die Aufbereitung des Wissens und der Daten in Karten, Schemata, Bildern und Beispielen.

Während im Paris-Guide das „Recht auf Stadt" und die unterschiedlichen Nutzungsmuster der Stadträume von Frauen und Männern im Vordergund stehen, ist es in Berlin (2011) die Vereinbarkeit in einer Stadt der kurzen Wege, die Nachhaltigkeit und der Ressourcenschutz sowie durchmischte Quartiere, Wohnhäuser und differenziert nutzbare öffentliche Räume. Barcelona und Wien stellen die Alltagsinfrastrukturen, die Nutzbarkeit für unterschiedliche Altersgruppen und Familien sowie die faire Verteilung des öffentlichen Raums (Wien) in den Mittelpunkt, Barcelona hebt noch hervor, dass die stadträumlichen Strukturen für die Bewohnerinnen und Bewohner unterstützend oder behindernd sein können (Barrieren und Hindernisse). Der öffentliche Raum und dessen Qualität ist in allen Manuals zentral als Ort der Identität oder fehlender Identität und Repräsentation (von Frauen), als Ort der (Un-)Sicherheit und als Handlungsraum für Planungsinterventionen. In den romanischsprachigen Städten Paris und Barcelona ist auch die Repräsentation und Identitfikation von Männern und Frauen z.B. durch Straßennamen und Denkmäler ein wichtiger Punkt. Zuletzt unterscheiden sich die Manuals auch in den Zielgruppen und in der Position der Verfasserinnen und Verfasser: Innerhalb der Verwaltung (Wien, Paris, Berlin 2017) oder von außen: Berlin 2011 wurde von den Planungsfachfrauen ehrenamtlich erarbeitet, in Barcelona enagiert sich seit 2006 das „CollectiuPunt6", ein unabhängiges Kollektiv aus Planerinnen, Planern, Forscherinnen und Forschern.

Die Auswertung zeigt, dass in der feministischen Planung, Inhalte (Substance nach Greed 2005) und Prozesse (processes) als stark verknüpft und voneinander abhängig wahrgenommen werden. Die Auswertung zeigt außerdem wie kontextspezifisch die Definition und Konzeptualisierung von Geschlecht/Gender und Raum ist, welche Zugänge und Leitbilder gewählt werden und wie wichtig die Offenlegung der Konzepte ist. Nichtdestotrotz können auf der inhaltlichen Ebene Hauptthemen quer durch alle Handbücher

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herausgearbeitet werden, die die Autorinnen für Smart Through Gender+ auf fünf Kernthemen zusammenfassten. Im Abschnitt 4.2 werden die Kernthemen kurz beschrieben. Weitere notwendige Arbeitsschritte waren die Zuordnung von Planungsleitbildern und die Präzisierung von Planungsaufgaben für die drei Maßstabsebenen des Projekts - Gesamtstadt – Stadtteil und Nachbarschaft oder Baublock.

3.3 Planungssystem und GenderMainstreaming in Österreich und in Linz

Für dieses Paper nutzen wir den Begriff ‚Planungssystem' um die formelle Planung, zB Gesetze, Bauordnungen und Verfahrensvorschriften zu umfassen. Das Planungssystem in Österreich ist sehr föderalistisch organisiert: Österreich hat keine nationale Raumordnungsgesetzgebung, sondern neun verschiedene Bundes¬länder-Gesetze für die Raumordnung, für die Bauleitplanung und auch neun verschiedene Baurechtsgesetze mit sehr unterschiedlichen Regelungen und Instrumenten. Das Planungssystem in Österreich gibt den Kommunen eine zentrale Rolle für die Erstellung der räumlichen Strategien (Entwicklungskonzepte) und der rechtlichen Umsetzung in Flächenwidmungsplänen und in die Bauleitplanung (Bebauungsplan).

Was nun die Gleichstellung der Geschlechter und den Abbau von Diskriminierungen betrifft, so weisen wir kurz auf die Rechtsgrundlagen und die Historie von Gender Mainstreaming (GM) hin: Die Bestimmungen des Vertrags von Amsterdam (1999), mit der verbindlichen Anwendung der Gender Mainstreaming Stragie für die faktische Gleichstellung der Geschlechter wurde in Österreich 2002 in die Bundesgesetzgebung übernommen und seither im Rahmen einer Interministeriellen Arbeitsgruppe GM/GB in der Umsetzung begleitet (IMMAG-GM/GB 2019). Nach Wien waren die Bundesländer Salzburg und Oberösterreich sehr rasch in der Umsetzung von strategischen Pilotprojekten zur Gender Mainstreaming in der Raumplanung, im Wohnbau, in den öffentlichen Haushalten (Erster Gender-Budgeting-Haushalt 2004-2007) und in der Förderabwicklung generell (Land Oberösterreich 2009).

Smart through Gender+ wird in der drittgrößten österreichischen Stadt Linz an der Donau erprobt. Das Bundesland Oberösterreich, in welchem das Testgebeit Linz liegt, hat bei der Implementierung von Gleich¬stellungs¬politik und Gender Mainstreaming einen umfassenden Weg eingeschlagen: So war Oberösterreich das erste Bundesland mit einem Gender-Budget-Landeshaushalt, welcher im Rahmen des Interreg-Alpen¬raum¬programms GenderAlp! umgesetzt wurde[3] (GenderAlp! 2007, Buchinger et al 2006). 2008 wurde das System einer wirkungsorientierten Verwaltung (WOV) eingeführt. Dabei werden alle Landedienststellen – Raumplanung und Regionalentwicklung eingeschlossen – verpflichtet, die Auswirkungen aller Entscheidungen auf unterschiedliche gesellschaftliche Gruppen nach Geschlecht, Alter, Herkunft, Lebensphase etc. abzuschätzen und Gegenmaßnahmen gegen Diskriminierung oder nachteilige Wirkungen zu bewerten[4] (Land Oberösterreich 2008).

Bemerkenswert ist die ausdrückliche Forderung nach Gleichstellungszielen in dieser Verordnung:

Gender Budgeting als Bestandteil der wirkungsorientierten Verwaltungsführung (WOV 2015)

Im Rahmen des ZPS-Prozesses sind gemeinsam zwischen den politischen Referentinnen und den Direktionen bzw. Fachabteilungen in Bezug auf das Budget politische Gleichstellungsziele und davon abgeleitet neue Indikatoren zu definieren: in den 12-Jahreszielen, in den 6-Jahreszielen und auch in den 1-Jahreszielen.

Gleichstellungsziele machen es möglich zu überprüfen, inwieweit eine Leistung Geschlechtergerechtigkeit unterstützt oder verhindert. (Land OÖ 2008: 1)

Somit hat Oberösterreich ein „Gender+-Konzept" bereits in Kraft und mit einem Leitfaden umgesetzt[5], allerdings eingeschränkt auf Verwaltungsstellen, die Fördermittel auszahlen. Die aktuelle Linzer Raumstrategie und das örtliche Entwicklungskonzept Siedlung undVerkehr aus dem Jahr 2013 (Magistrat Linz 2013) führt daher auch diese Verpflichtung für die Planung an. Die Umsetzung ist jedoch – zumindest in der Planungsabteilung der Stadt Linz – nicht erfolgt (Gesprächsnotiz vom 24.06.19 - Begleitgruppe).

[3] GenderAlp! Raumentwicklung für Frauen und Männer – online-www.genderalp.at . Zugriff am 12.01.20

[4] Diese Gender-Budgeting-Pflicht wurde 2009 im Verfassungsgesetz Art. 3(3) B-VG and Art. 51 (8) B-VG) für alle Gebietskörperschaften in Österreich (Gemeinden, Länder und Bund) rechtsverbindlich.

[5] Dieser Leitfaden baut auf den Methoden und Ergebnissen der ersten Gender-Budget-Haushaltsanalyse für das Land Oberösterreich auf als Teil des GenderAlp!-Projekts. (Buchinger et al. 2006, Land Oberösterreich 2008).

Ein differenzierter Blick auf die Bevölkerungsstruktur der Stadt Linz (Abb 1) zeigt die Komplexität der Bewohnerinnen-und Bewohnerstruktur. Die Alterspyramide und Geschlechterverteilung Bewohnerinnen und Bewohner unterscheiden sich stark: Die Zahl der Linzerinnen und Linzer mit Migrationshintergrung in den Altersgruppen über 55/60 ist kontinuierlich kleiner gegenüber jener der 25/30- Jährigen (Pyramidenform der Grafik); ab 50, vor allem ab 80 gibt es fast ausschließlich Linzerinnen und Linzer ohne Migrationshintergrund.

Nimmt man dazu noch die Lebensphasen Kindheit, in Ausbildung, Berufstätigkeit, Babypause etc. und die Familiensituation dazu – Singlehaushalt, Paar mit/ohne minderjährige Kinder, Patchwork-familie – erhöht sich die Komplexität um ein Vielfaches. Die Heraus¬forderung war nun, die räumlichen Strukturen, Lage undAusstattung der Freiräume mit den unterschiedlichen Bedürfnissen der vielfältigen Bewohnerinnen- und Bewohnergruppen im Hinblick auf funktionelle, stadträumliche u.a. Qualitäten und Defizite zu bewerten. Dazu ist das Begrif Gender+ eingeführt.

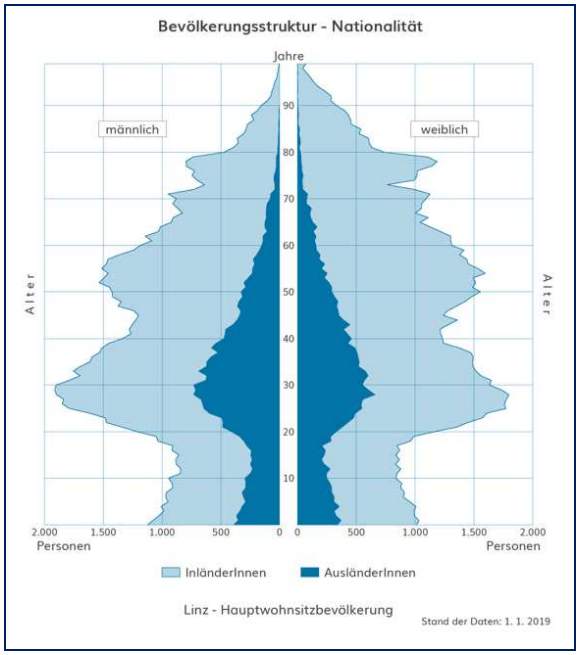

Abb. 1: Gender+ sichtbar gemacht: Bevölkerungsstruktur der Stadt Linz a.D., AT nach Geschlecht, Altersgruppen und Nationalität. Quelle: https://www.linz.at/zahlen/040_Bevoelkerung/070_Auslaender/ Online- Zugriff am 12.01.20

4 GENDER+ UND RAUMPLANUNG

4.1 Gender+ und Gender Plannning Arbeitsdefinitionen

Der im Projekt verwendete Begriff „Gender+“ beschreibt einen erweiterten Gender-Begriff, der erstmals vom QUING-Projektkonsortium unter der Leitung von Mieke Verloo verwendet wurde (Verloo 2012). Er ist ein Statement gegen das Verschwinden der Geschlechterfrage im Diversitätsdiskurs und gegen die Widerstände gegenüber dem Wort und dem Konzept „Gender Mainstreaming“. Er signalisiert, dass das Geschlecht immer mit anderen Merkmalen überlagert wird, auf denen strukturelle Ungleichheit basiert, wie zum Beispiel Alter, Herkunft, Bildung, Beruf oder Religion. Gender+ sichtbar macht der Blick auf die Alterspyramide der Stadt Linz, die im vorigen Abschnitt erläutert wurde (Abb. 1).

Für Smart through Gender+ wurde die programmatische Arbeitsdefinition der Gender Planung von Damyanovic (2007:7) durch die Autorinnen folgendermaßen adaptiert:

(1) Planung mit GM/G+ fokussiert auf die Beziehungen und Rollenerwartungen unterschiedlicher Bewohnerinnen- und Bewohnergruppen, insbesondere auf Frauen und Männer differenziert nach Alter, Herkunft, Einkommen, Bildung, Beruf, Lebensabschnitt etc.

(2) Rollen- und gruppentypische Aktivitäten werden in die Bewertung der Raumstrukturen und des Designs von Nutzungsqualitäten für die vielfältigen und unterschiedlichen Lebensalltage der Bewohnerinnen und Bewohner berücksichtigt.

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(3) G+ Planung macht gesellschaftliche Rahmenbedingungen, Normen und Werthaltungen in der Planung sichtbar (demonstrates and validates the differences e.g. CARE).

(4) Ist transformativ, d.h. zielt auf die Veränderung von Strukturen, Werthaltungen und Planungskonzepten ab

(5) Ist partizipativ und gibt unterrepräsentierten Gruppen eine Stimme und ein Gewicht im Planungsprozess.

Das normative Fundament einer smarten Gender+ Stadtplanung (Punkt 2 der Arbeitsdefinition) knüpft unmittelbar an internationale Konventionen an. Diese sind der Vertrag von Amsterdam mit den EU-Gleich¬stellungszielen und der Strategie des Gender Mainstreaming, die UN-Behindertenrechtkonvention (2008 in Österreich ratifiziert) und die UN-SDGs 2030.[6] Von den 17 SDG Zielen sind vor allem Goals 5: die Gleichstellung der Geschlechter (Gender Equality), 10: Reduce inequalities und 11: Sustainable Cities and Communities von Bedeutung. Während Ziel 5 anstrebt, bis 2030 Geschlechter¬gleichstellung zu erreichen und alle Frauen und Mädchen zur Selbstbestimmung zu befähigen, zielt SDG 10 auf ALLE gesellschaftlichen Gruppen, die derzeit benachteiligt sind. Bis 2030 sollen alle Menschen unabhängig von Alter, Geschlecht, Behinderung, Rasse, Ethnizität, Herkunft, Religion oder wirtschaftlichem oder sonstigem Status zu Selbst¬bestimmung befähigt und ihre soziale, wirtschaftliche und politische Inklusion gefördert werden. SDG 11 hingegen strebt einen bessereren Zugang aller Bewohnerinnen- und Bewohnergruppen zu den städtischen Infrastrukturen und Ressourcen an.

4.2 Gender Gap in der Verteilung der unbezahlten Versorgungs- und Reproduktionsarbeit

Zur Sichtbarmachung aktueller gesellschaftlicher Rahmenbedingungen und Normen (Punkt 3 der Arbeitsdefinition) und zur Analyse der rollen- und gruppentypischen Aktivitäten ist ein Blick auf die Zeitverwendung und geschlechtsspezifische Arbeitsteilung nötig: EU-weit ist statistisch nachgewiesen, dass Frauen den überwiegenden Teil der unbezahlten Versorgungs- und Familienarbeit – Kochen, Waschen, Putzen, Kinder betreuen u.a. erledigen (Eurofounds 2012, Table 9).

Für Raumanalyse und Planung mit Gender+ bräuchte es empirische Daten für Städte und Stadtteile zu Gender+-differenzierten Alltagen und Raum-Zeitnutzungsmustern je nach Familiensituation, Alter, Geschlecht und Erwerbsstatus. Die letzen Daten für österreichische Bundesländer sind aus dem Jahr 2008 und diese Mikrozensusergebnisse.[7] Für die Aktualisierung 2018 hat sich Österreich aus der EU-weiten periodischen Erhebung der Zeitverwendungsmuster von erwerbstätigen Männern und Frauen ausgeklinkt. Deutschland hat mit den Zeitverwendungserhebungen im 10 Jahresschnitt zuletzt 2012 empirische Daten für Gender+ Gruppen, allerdings ohne räumliche Differenzierung nach Gemeindetypen vorgelegt: Demnach verbringen Frauen im Schnitt pro Tag 2:28 Stunden mit einkommensbringender Erwerbsarbeit, 5:45 mit unbezahlter Versorungsarbeit; bei Männern liegt das Verhälntis mit 5:18 bezahlter vs. 3:10 unbezahlter Versorungsarbeit (Klünder & Meier-Gräse 2017). Diese Ungleichheit und Rollenfixierung zeigt sich schon bei Teenagern: 10- bis 17jährige Mädchen arbeiten bereits täglich 67 min im Haushalt und haben 90 min Freizeit, während gleichaltrige Buben nur 47 min mit Hausarbeit aber105 min mit Freizeit verbringen (Wirth 2017; siehe auch Panova et al 2017).

Regional differenzierte Aussagen zu Wegezweck, Verkehrsmittelwahl und Wegelänge nach Geschlecht, Altersgruppe und Erwerbsstatus bieten lediglich die Verkehrserhebungen der Länder (z.B. Land Oberösterreich 2012).

Für eine smarte Gender+Planung ist nun die Frage, welche Konsequenzen diese ungleiche Verteilung auf die Raum-Zeit-Nutzungsmuster und die Bedürfnisse und Ansprüche an die Ausstattung der Freiräume und die Stadtstruktur hat. Eine der Herausforderungen für inklusive und gegenderte Forschungs- und Planugns¬ansätze ist außerdem, die sektoralen Analyse- und Konzeptzugänge nicht nur zu hinterfragen, sondern sie auch zu überwinden: Aufgrund von Verwaltungsstrukturen und Kompetenzbereichen werden Stadträume bzw. der Blick auf diese segmentiert in Sektoranalysen und -planungen: Verkehrsplanung,

[6] Offizielle Seite des Bundeskanzleramtes AT: https://www.bundeskanzleramt.gv.at/themen/nachhaltige-entwicklung-agenda-2030.html und SDG-Watch AT, zivilgesellschaftlicher Initiativen, die sich für die sich für eine ambitionierte Umsetzung der SDGs einsetzt: https://www.sdgwatch.at/de/ - beide Zugriff am 20.01.20

[7] Statistik Austria. Zeitverwendungserhebung 2008 – online https://www.statistik.at/web_de/statistiken/menschen_und_gesellschaft/soziales/zeitverwendung/zeitverwendungserhebung/index.html - Zugriff am 20.01.20

Umweltschutz, Eltern¬beratung, Abfallbeseitigung, Stadtgartenamt, Kindergärten und Pflichtschulen, Wohnungsamt, Seniorinnen- und Seniorenheime, Sozialarbeit, Jugend-, Frauen- und Integrationsbüros, Mindestsicherung und Heiz¬kosten¬zuschüsse, Markt- und Gewerbeamt, Forschung und Wissenschaft, oder Raumordnung und Bauleitplanung, um nur einige zu nennen.

Mit einem Zugang über Kernthemen wird in Smart through Gender+ bewusst der Blick der Bewohnerinnen, Bewohner, Einpendlerinnen, Einpendler, Unternehmerinnen, Unternehmer oder Studierenden eingenommen und versucht, die räumlichen Strutturen und Funktionen aus Sicht der Nutzerinnen und Nutzer zu denken und zu betrachten.

Im nächsten Abschnitt werden Kernthemen für eine smarte Gender+ Stadtanalyse und Stadtplanung, basierend auf explizit feministischen oder Gender Mainstreaming verpflichteten Handbüchern vorgestellt. Die Kernthemen strukturieren die Diskussion, Auswahl und Interpretation von Kriterien zur räumlichen Analyse und zur Definition von Planungsaufgaben.

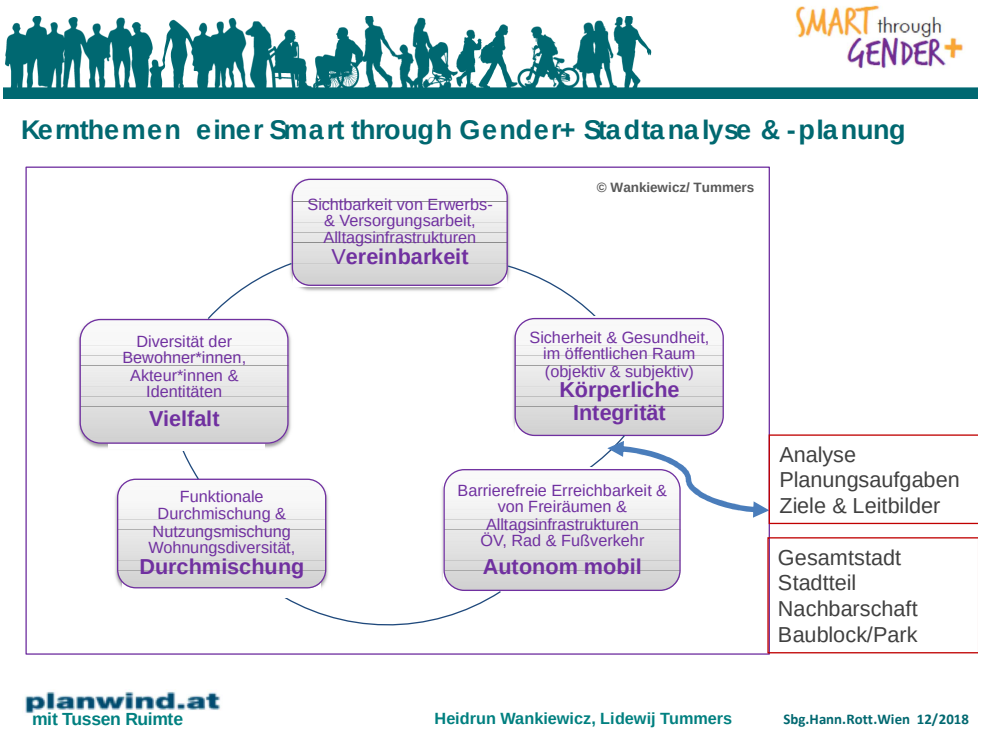

Abb. 2: Kernthemen für eine Smart through Gender+ Stadtanalyse und Stadtplanung © Wankiewicz/Tummers 2018

5 KERNTHEMEN FÜR SMARTE GENDER+ PLANUNG

5.1 Kernthemen für inklusive und geschlechtergerechte G+ Stadtanalyse und -planung

Für die Konzeption haben wir uns für folgende Zuordnung entschieden:

(1) Vielfalt bezieht sich auf die Diversität der Identitäten von Akteuren und Menschen, die Planungsprozesse gestalten und davon betroffen sind. Wir bezeichnen sozialräumliche und sozio-ökonomische statistische Auswertungen (z.B. Clusteranalyse, Differenzpläne etc.) als „mapping Gender“.

(2) Vereinbarkeit/Sichtbarkeit des versorgenden Alltags (CARE): Im Mittelpunkt ist die Ausstattung der Stadt mit Nahversorgungsangeboten, für sorgebedürftige oder sorgeabhängige Personen, sowie Erleichterung für Sorgende (Care-givers).

(3) Autonom mobil/Erreichbarkeit und Zugänglichkeit: die räumliche (barrierefreie) und soziale (sichere) Zugänglichkeit der Wegenetze für Fuß- und Radverkehr und ÖV; sowie Netzqualität und Nutzungsqualität von Alltagsinfrastrukturen, Grün- und Straßenfreiräumen.

(4) Körperliche Integrität, Sicherheit & Gesundheit: Im Analysefokus sind unterschiedliche Auswirkungen der Gefahrenzonen (Unfallhäufungszonen, gefährliche Kreuzungen), Umwelt¬belastungen (Lärm, Luftemissionen) und die Sicherheit (subjektiv und objektiv).

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(5) Durchmischung von Nutzungen, Wohnungstypen: belebte Räume durch feinmaschige funktionale Vielfalt und Nutzungsvarietät statt Segregation und Monofunktionalität. Methoden sind u.a. Durchmischung, Wohnungstypologien und städtebauliche Kennzahlen: Einwohner¬dichten, Grünflächenanteile, u.a.

5.2 Verknüpfung von Planungsleitbildern & Auswertung von Planungsdokumenten

Zum Anschluss an den aktuellen Planungsdiskurs verbinden wir die Auswertung der Gender-Planungshandbücher mit Planungsleitbildern aus den fach¬spezifischen Programmen der Stadt Linz und des Landes Oberösterreich, z.B. das örtliche Entwicklungskonzept (Magistrat Linz 2013) und das Sozialleitbild (Magistrat Linz 2011). Die fünf Kernthemen sind in einer Matrix für die drei projekt-relevanten räumlichen Bezugsebenen Stadtregion, Stadtteil und Baublock mit Planungsleitbildern und Planungsstrategien verknüpft. Dabei werden für jedes Kernthema relevante Analyse- und Planungsaufgaben definiert. Die folgende Tabelle zeigt exemplarisch für die zwei Kernthemen „Vereinbarkeit“ und „autonom mobil“ wie diese Zuordnung und Konkretisierung der Leitbilder und der Planungsstartegien der Stadt erfolgt (Tabelle 1).

Daraus wurden Gleichstellungsziele und Planungsziele definiert, die die Positionierung des Projektteams im Hinblick auf Geschlechtergerechtigkeit offenlegen und die Grundlage für die Auswahl und Interpretation von statistischen Daten, Kennziffern und Auswertungen darstellen.

Leitbilder - Planungsgrundsätze Planungsziele & Planungsaufgaben	Vereinbarkeit Sichtbarkeit von Versorgung & Vereinbarkeit	Autonom mobil Erreichbarkeit & Zugänglichkeit physische und soziale Zugänglichkeit
Stadt der kurzen Wege: Stadtraum & Infrastrukturen sind so vielfältig und qualitativ hochwertig in allen Stadtteilen angeboten, dass keine weiten Wege notwendig sind Alle Versorgungseinrichtungen und Infrastrukturen sind im Wohnquartier/Stadt vorhanden oder über ÖV/Rad gut erreichbar	Planen für Lebensphasen & Wechselfälle des Lebens (Damyanovic 2007.) …, dass ‚Versorgenden‘ Haushalt, Betreuung/Pflege problemlos möglich ist. … dass Vollzeitjob, Familie & Freizeit für alle möglich sind (Mütter/Väter,) …, dass Kinder selbständig spielen, Natur erleben, ihre Freundinnen und Freunde treffen können. (SDG 5.4). Unbezahlte Pflege- und Hausarbeit durch die Bereitstellung öffentlicher Dienstleis-tungen und Infrastrukturen, Sozialschutz - Maßnahmen und die Förderung geteilter Verantwortung innerhalb des Haushalts und der Familie anerkennen und wertschätzen. Linz-OEK: Verstärkung der Vereinbarkeit von Beruf und Familienarbeit Ausbau von Krabbel-stuben & Hortplätzen Linz – Sozialprogramm: Lebensnetze: Hilfestellung im Krisenfall, Garantie des würdevollen Älterwerdens	Barrierefreie Stadt der kurzen Wege: Erreichbarkeit ÖV und barrierefreie Gestaltung der Stationen und Fahrzeuge unterstützen die Ver-kehrsteilnahme für mobilitätseingeschränkte Menschen (GM HB Wien) Diese unterstützen aber auch Personen mit Versorgungs- und Betreuungsaufgaben (Transport von Einkäufen, Kinderwagen, Begleitwege) Linz: Chancengleichheit für alle – Lebensmuster; gruppen-spezifische Mobilitätsmuster als Planungsgrundlage Nachhaltige Siedlungsentwicklung d.h. ÖV-Orientierung, Vorrang Nahmobilität Netz an öffentlichen Spielplätzen, Treffpunkte im öffentlichen Raum für Jugendliche, Seniorienzentren, Begegnungsstätten. Open public space / Open-Commons-Region Linz: virtuelle Freiräume durch gratis Zugang zu Web & Speicherplatz
Alltagsgerechte Stadt, alltagsgerechtes Planen und Bauen für alltagstaugliche Raumstrukturen (GM HB Wien): Die Gestaltung der Bebauung und der Freiräume soll sich an den An-forderungen des Alltags und damit der Alltagsarbeit orientieren.	Zentrale Orte Konzept/Polyzentrische Stadt: OEK Linz: Stadtzentrum, Stadtteilzentren, lokale Zentren/Teilzentren. Statt Nutzungstrennung gibt es Nutzungs-mischung mit Wohnen, Arbeitsplätzen, Versorgungs- und Dienstleistungsangeboten in allen Stadtteilen.	Polyzentrische Siedlungssentwicklung (Linz) – Verdichtung und Durchmischung an ÖV-Knoten & bestehenden/neuen Stadtteil- und lokalen Zentren Fußgängerfreundliche Stadt/Walkable City: Vorrang Umweltverbund (Fußgänger, Radfahrer, ÖV)

Tab. 1: Planungsleitbilder und Planungsaufgaben für zwei Kernthmen © Wankiewicz 2019)

Sowohl für das Verständnis der verwendeten Begriffe für die Kernthemen, als auch für die Auswahl von Indikatoren und die Interpretation der Ergebnisse ist eine Offenlegung von zugrundeliegenden Normen und Werthaltungen und die Definition von Gleichstellungs- und Planungszielen notwendig gemäß der Definition von Gender Mainstreaming von Damyanovic, dass GM in der räumlichen Planung gesellschaftliche Rahmenbedingungenm, Normen und Werthaltunten sichtbar macht (Damaynovic 2007, 7). Die Kernthemenbeispiele aus Tabelle 1 fortzetzend wurde das beispielhaft wie folgt umgesetzt:

Werthaltung explizit gemacht:

Smarte G+ Stadtplanung und Stadtentwicklung ist sich der Vielfältigkeit, Vielschichtigkeit und Veränderbarkeit von Identitäten – sei es Geschlecht, Status, Herkunft, Kleidung, Hautfarbe etc. und der Vielzahl an Rollenzuschreibungen und Rollenerwartungen, Stereotypen und Vorurteilen bewusst.

Smarte G+ Stadtplanung und Stadtentwicklung weiß von der gesellschaftlichen Schieflage bei der Verteilung der unbezahlten Betreuung von Kindern und Erwachsenen (inklusive Pflege), bei der Versorgungsarbeit (Einkaufen, Kochen, Putzen, Waschen etc.) und beim Zugang zu gut bezahlter Erwerbsarbeit und Pensionsbezügen.

Diese Werthaltung ist verbunden mit (international vereinbarten) Gleichstellungszielen:

- Alle Menschen verfügen über die Möglichkeit zur Erwerbsarbeit und ökonomische Unabhängigkeit; zur Familien – und Versorgungsarbeit und zur Teilhabe und Mitgestaltung ihres Lebens- und Wirtschaftsraums.
- Vereinbarkeit von Familien- und Erwerbsarbeit sicherstellen und Teilhabe durch Freiwilligenarbeit & politische Mitbestimmung fördern.
- Geschlechtergleichstellung erreichen und alle Frauen und Mädchen zur Selbstbestimmung befähigen
- Unbezahlte Pflege- und Hausarbeit durch die Bereitstellung öffentlicher Dienstleistungen und Infrastrukturen, Sozialschutz ¬Maßnahmen und die Förderung geteilter Verantwortung innerhalb des Haushalts und der Familie entsprechend den nationalen Gegebenheiten anerkennen und wertschätzen (5.4).

Aufgrund dieser Gleichstellungsziele werden Planungsziele gesetzt:

- Planungskonzepte wirken transformativ und vergrößern das Recht auf Stadt und Bewegungsfreiheit, d.h. Planung zielt auf die Veränderung von Strukturen und Werthaltungen ab
- Städte und Siedlungen inklusiv, sicher, widerstandsfähig und nachhaltig gestalten (SDG Ziel 11), um allen Bewohnerinnen und Bewohnern körperliche Integrität zu bieten
    - 11.1: Zugang zu angemessenem, sicherem und bezahlbarem Wohnraum und zur Grundversorgung für alle sicherstellen und Slums sanieren
    - 11.7: den allgemeinen Zugang zu sicheren, inklusiven und zugänglichen Grünflächen und öffentlichen Räumen gewährleisten, insbesondere für Frauen und Kinder, ältere Menschen und Menschen mit Behinderungen
- Planungsprozesse konsequent mit GM Strategien und Methoden konzipieren und umsetzen.
    - 11.3: (…) die Kapazitäten für eine partizipatorische, integrierte und nachhaltige Siedlungsplanung und -steuerung in allen Ländern verstärken
    - Gender+ governance: Investitionen und Budgeting werden beweisbar gleich zugunsten von Männern und Frauen angewendet

6 DISKUSSION: PLANUNGSLEITBILDER UND WERTHALTUNGEN

Wenn solche Gleichstellungs- und Planungsziele außer Streit stehen, ist auch die Diskussion über Rollenerwartungen und Ganztagsarbeit bei der Arbeit am Kernthema „Vereinbarkeit & Versorgungsarbeit“ leichter zu führen: Dann steht nämlich der Zugang von Vätern zur Elternarbeit und zur Haushaltsführung genauso im Fokus wie der Zugang von Müttern zu einkommens-bringender (Vollzeit-) Erwerbsarbeit.

Ohne diese Positionsbestimmung, die immer wieder neu im Kontext einer Planungsaufgabe oder Dateninterpretation hinterfragt werden muss, ist keine gegenderte Raumanalyse und Planung möglich: Wenn Vielfalt und Diversität als „Problem“ und nicht als Bereicherung wahrgenommen werden, wenn die Bewegungsfreiheit und der Zugang zu den Ressourcen einer Stadt - Plätze, Parks, Arbeitsstätten, Bildungsangebote, Märkte, Kindergärten für alle Bewohnerinnen und Bewohner umstritten ist oder wenn ökonomische und ethnische Segregation eher erwünscht ist, kann kein Gender+-Projekt realisiert werden.

Gender Mainstreaming ist zwar formell in Planungsystem verankert, jedoch eher selten Teil der ‚informellen‘ Planungskultur. Die Planungskulturen blicken auf die Planungspraxis: was, in welcher Form, in welchen Kooperationen und wie‘ angewendet wird. Planungsleitbilder, eher Teil der Planungskultur als formell-juristisch gültig, sind Grundlage für alle Planungsprozesse. Leitbilder unterliegen starken Interpretationsunterschieden je nach Ort der Anwendung - in welchen Planungskulturen die Leitbilder diskutiert werden – aber auch in welcher Zeit sie „aufpoppen“ und neu rezipiert werden. Ein Beispiel ist die Verschiebung des feministischen Blickwinkels der „Stadt der kurzen Wege“ als Kritik an einer Planung, die

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den versorgenden Alltag und die Reproduktionsarbeit von Frauen ausblendet (z.B. Dörhöfe/ Terlinden 1998) hin zur Walkable City als einem Nachhaltigkeitsleitbild und Kritik der Windschutzscheibenperspektive der Verkehrs- und Stadtplanung (Tummers/Wankiewicz 2020).

Planungleitbildern liegen Werthaltungen und häufig nicht explizit gemachte Annahmen über Gruppen und Geschlechterrollen zugrunde, die als Visionen strukturierend auf die Problemwahrnehmung, auf die ausgewählten Analyseparameter und auf die Blickrichtung für Lösungen wirken.

Vereinbarkeit zwischen Erwerbs- und Familienarbeit wird zum Beispiel häufig als Frauenthema verstanden und die stadtplanerischen Interventionen zielen auf die Erleichterung der Alltagswege und Versorgungsarbeit von Müttern, pflegenden Töchtern und Ehefrauen (Tummers, Denefle, Wankiewicz 2019). Daher stellen die Autorinnen auch in Smart through Gender+ mit der exemplarischen Bearbeitung des Kernthemas Vereinbarkeit und Sichtbarkeit der Versorgungsarbeit für das Proof of Concept in den Fokus. Anspruch ist, Rollenstereotypen und Zuschreibungen offenzulegen und das transformative Potential einer smarten Gender+Planung zu heben.

In diesem Zusammenahng taucht auch immer wieder die Frage auf, ob und in welchem Ausmaß Planung gesellschaftliche Veränderungen herbeiführen oder zumindest unterstützen kann, im Sinne des Tagungs¬mottos „shaping urban change“. Welche Rolle den Planerinnen und Planern dabei zukommt in einem Feld, dessen Wirkungszeiträume von Planungsinterventionen langfristig sind, überschreitet die Reichweite dieses Papers. Hier halten wir es mit Moser (2014), die vorschlagen zwischen strategic and practical gendered needs zu unterscheiden; dabei sind die „practical gender needs“ die aktuell notwendigen Planungs¬interventionen, die während einer Projektlaufzeit für Bewohnerinnen- und Bewohnergruppen, zB. Ein-Eltern-Familien (mehrheitlich Frauen) realisiert werden können, dabei aber die „strategic gender needs“-nämlich eine faire Aufteilung der unbezahlten Versorgungs- und bezahlten Erwerbsarbeit zwischen den Geschlechtern – immer mitgedacht und in der Debattte bleiben müssen.

7 FAZIT: PLANUNGSLEITBILD BARRIEREFREIE STADT DER KURZEN WEGE

7.1 Rückblick

Wesentlich für das Verständnis unseres Forschungszugangs ist die ungleiche Verteilung der unbezahlten Versorgungs- und Familienarbeit, die zum überwiegenden Teil von Frauen geleistet wird und mit verantwortlich ist für den Gender Pay Gap, den großen globalen Einkommensunterschied zwischen Frauen und Männern, insbesondere im Pensionsalter.

Erste Ergebnisse aus der Forschung und Anwendung in Linz zeigen die Aktualität und Anwendbarkeit des ursprünglich feministischen Planungsleitbildes „Stadt der kurzen Wege“ zur Operationalisierung der Kernthemen. Vielversprechend ist auch die Umlegung der Kernthemen und Leitbilder auf die stadträumliche und sozialräumliche Erfassung und Beschreibung der Alltagswege von lokal orientierten Gender+-Gruppen mit charakteristischen Raumnutzungsprofilen. Für das Smart Through Gender+ Forschungsprojekt haben sich die Alltagswege und Wegeketten als ein gut geeigneter Fokus zur Beschreibung G+-gruppenspezifischer Unterschiede und zur räumlichen Analyse der Qualitäten und Defizite in den Kernthemen Vereinbarkeit und Autonom mobil (Erreichbarkeit & Zugänglichkeit) herauskristallisiert.

Trotzdem hinterfragt das Paper das Planungsleitbild „Stadt der kurzen Wege“ und die häufig sehr kleinräumig und lokal ausgerichteten Gender(+)-Projekte: Aus Sicht der Autorinnen ist es unabdingbar, den eingeschränkten lokalen räumlichen Blick auf einen „kleineräumigen Alltag“ (Nahversorgung-Nahmobilität-Nachbarschaft) zu überwinden und auf stadtregionale Wegeketten und Aktivitäten sowie auf weltweite digitale Kommunikationsformen, multilokale Lebensformen und transnationale Familienformen auszuweiten (z.B: 24-h-Pflegerinnen betreuen ihre Kinder via Skype, lokale Baugruppeninitiativen sind europaweit digital vernetzt).

Allerdings stehen wir bei der Datenlage vor großen Datenlücken und Herausforderungen. Forschungslücken bestehen bei der Beschreibung von gruppenspezifischen Präferenzen von Alltagsinfrastrukturen. Auch fehlen belastbare Daten zu Zeitverwendung und zu Raum-Zeitmustern differenziert nach Geschlecht, Familiensituation, Alter, kultureller und ethnischer Hintergrund, Einkommen etc. auf Stadtteil-Ebene, insbesondere für kleinräumigere Analysen und Simulationen.

7.2 Ausblick

Es zeigt sich, dass ein erweitertes Modell der Stadt der kurzen Wege sich konzeptionell gut für die Ableitung und Beschreibung von Kernthemen, für die Definition von Planungszielen und Planungsaufgaben Entwicklung von Analysemethoden und die Auswahl von Indikatoren eignet.

Die Erweiterung der Stadt der kurzen Wege bezieht sich einerseits auf den Inhalt: Barrierefreiheit im umfassenden Sinn, welche neben physischen Barrieren auch emotionale Barrieren („Vermeidungsräume, ethnisch besetzte oder gentrifizierte Räume) auch sprachliche (Orientierungstafeln und Informationen) und ökonomische Barrieren beim Zugang zu städtischen Ressourcen.

Die Erweiterung bezieht sich aber auch auf die räumliche Situation: nämlich vom Stadtteil über die Gesamtstadt und deren ÖV-Netze auf die Stadtregion und auf die digital vernetzte Welt.

Von September 2019 bis Juni 2020 entwickeln und erproben die Autorinnen mit dem Forschungsteam ein Modell von Raumnutzungstypen je nach Lebenssituation und Sorgepflichten.

Im Rahmen eines Stadtteildialogs mit Expertinnen, Experten, Bewohnerinnen und Bewohnern werden Qualitäten und Defizite im Stadtteil für Alltagsbedürfnisse und Alltagswege erfasst. Diese Ergebnisse fließen in die Programmierung des digitalen Tool ein und werden als Methoden Teil eines Werkzeugkoffers, der am Ende des Projekts für künftige Planungsprozesse mit Gender+ Fokus zur Verfügung stehen soll.

Die größte Herausforderung als Planerin ist es, Planungsinhalte und Planungsprozesse zu dekonstruieren und wiederholt Gender-Stereotype und nicht reflektierte Annahmen und Normen zu hinterfragen, während man gleichzeitig die Geschlechterrollen und gesellschaftlichen Machtverhältnisse dekonstruieren muss. Beides mit dem Ziel, mit einer „gender co-governance“ die Planungspraxis neu zu erfinden.

8 DANKSAGUNGEN

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🏆 *reviewed paper*

Solar Energy Simulations in Historical Districts for Retrofitting and Evidence-Based Decision Making: Data Challenges for Low Carbon Cities in the EU Neighbourhood & Accession Countries

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1 ABSTRACT

Transformation of cities to low carbon cities is a global policy priority that attracts a wide range of actors, including policymakers, local governments, scientists as well as associated technology companies. On the other hand, the geographic, climatic, and structural variations across cities are high not only at the global level but also in sub-continental regions. Besides, the cities also contain highly varied districts with respect to their built environment, land use, microclimatic conditions, and geographical and topological features, where some type of districts may require similar solutions adopted in other cities rather than the district's own city. Historical districts constitute a particular category from this perspective, where retrofitting and application of smart energy systems and energy-efficient solutions depend on different issues than in other districts.

Historical districts have unique problems with respect to the adoption of smart and energy-efficient technologies. While positive carbon districts imply energy production at the site, low carbon districts instead focus on decreasing energy usage and carbon footprints. The selection of the appropriate basic strategy at the district level relies on sound scientific assessment. The assessment should be able to evaluate whether the district is capable of locally producing positive energy outputs without significantly altering or destroying the historical characteristics and ongoing or proposed socio-economic functions. As an example, assessment of the application of solar energy panels in historic neighbourhoods require building based modelling approaches for: a) understanding whether solar energy panels may function within a required technical operation range in built environments; b) if the energy produced locally may be distributed to other buildings in the district; c) if historical buildings can safely accommodate solar energy panels and associated infrastructure; d) if energy storage is necessary and if buildings possess suitable interior spaces for safe storage of electric energy.

All these categories of assessment require standardised, rich, transmissible data on various properties of the interior and exterior of existing buildings, of open spaces, and of existing infrastructure. Often, historical neighbourhoods consist of a large number of buildings and extensions which have been subject to an unknown number of interventions over time with varying quality. It is highly unlikely that any existing databases could provide the basis for the extraction of relevant information, as in the past the purposes of such data collectiond did not involve objectives regarding energy efficiency or positive energy potentials. On the other hand, it would be costly and technically challenging to collect all such data from the site by traditional surveys. This problem is exacerbated as many cities now face sudden policy pressures to apply sustainable energy action plans at short notice. All these issues force the stakeholders to seek effective solutions for collecting data, structuring of data and conducting integrated-holistic retrofit simulations in historical districts that provide the evidence-based information for the selection of the suitable technological approach and strategic choices to transform historical cities into low carbon cities. In addition, such simulations might enable a healthier assessment of making use of carbon credits and other incentives in line with such strategies and interventions.

This paper discusses the general situation of historical districts and their assessment as positive or low energy districts, in the context of EU Neighbourhood countries. As a first step, the paper evaluates the regulatory framework regarding the UNDP Sustainable Development Goals, global climate change, EU Energy Policy, cultural heritage preservation, retrofitting in historical districts, and research-policy connections. Next, the paper surveys the literature associated with the data problems in the simulation of the application of sustainable energy systems and provides a critical evaluation of the general case of historical districts. Third, the paper explores the situation of data assets in the EU, its neighbourhood and Turkey, with

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a particular emphasis on building level data about buildings in historic districts. The paper discusses alternative approaches to effective data collection and joining strategies that would serve for different levels of PV solar energy simulations in historical districts. The paper concludes by providing a research agenda on PV Solar Energy simulations in historical districts for improving relationships between scientific research and policies addressing Climate Change.

Keywords: positive energy district, European Neighborhood Countries, retrofitting, simulation, solar energy

2 APPLICATION OF SUSTAINABLE ENERGY SYSTEMS IN CITIES: POLICY, LEGAL ISSUES AND IMPORTANT FACTORS IN HISTORIC DISTRICTS

The transformation of cities to low carbon cities is a global policy priority today. By the year 2018, 4.2 billion people lived in cities and this number will rise to more than 6.5 billion people by 2050. Cities occupy only 3% of the Earth's land but account for 60 to 80 percent of energy consumption and at least 70 percent of carbon emissions.[1] It is expected that the Earth could be 3–5 C warmer than pre-industrial levels by 2100, if current trends are not changed, making sustaining life in Earth extremely difficult. 195 countries in 2015 signed the Paris Agreement to challenge this threat.

2.1 Global and Continental Policy Targets on Climate Change

2030 of the United Nations Development Programme's 11th Sustainable Development Goal is about Sustainable Cities and Communities. The programme sets targets on reducing the adverse per capita environmental impact of cities, paying special attention to air quality and waste management, increasing the number of cities adopting and implementing integrated policies and plans for resource efficiency and adaptation to climate change, supporting positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning, and building sustainable and resilient buildings utilising local materials. The programme claims that a rapid reversal of the current upward trend in greenhouse gas (GHG) emissions, and an eventual halving of global GHG emissions by midcentury is necessary.[2]

The European energy and climate change policy was adopted by the European Union in 2008. One of the five pillars of this policy was increasing renewable energy usage, by tripling the usage to reach 20% by the year 2020. The Lisbon Treaty that entered into force in 2009 gave new powers to Europe and to EU citizens to act in several policy areas such as the areas of energy, climate change and scientific research. These policies shaped the design of the Europe 2020 Initiative that was launched in 2010, aiming at smart, sustainable and inclusive growth in the EU. EU's Roadmap to a Low Carbon Economy in 2050 sets 80-95% of the reduction of GHG emissions. A cost-effective and gradual transition to such an economic system requires almost halving current GHG emissions by the year 2030 compared to 1990. The European Environment Agency's (EEA) latest 'State of the Environment' report warns that Europe will not achieve its 2030 goals without urgent action. While targets on renewable energy for the year 2020 were largely on track, the situation was dire for the year 2030 and beyond (Martin et al., 2015). In line with this situation, one of the three thematic priorities in the Seventh Environment Action Programme (7th EAP), is to turn the EU into a resource-efficient, green and competitive low-carbon economy. In addition, the Horizon 2020 programme now has a specific focus on low carbon cities and positive energy districts, aiming at the development and diffusion of associated technologies.

With the Treaty of Lisbon, fighting climate change at an international level has become a specific objective of EU environmental policy (da Graça Carvalho, 2012).

[1] Sustainable Development Goals of UNDP for 2030: 11th Goal - Sustainable Cities and Communities- targets: Accessed by 30th Jan. 2020. https://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-11-sustainable-cities-and-communities.html#targets

[2] IPCC Secretariat/World Meteorological Organisation/United Nations Environment Programme: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK and New York, NY, USA: Cambridge University Press; 2007.

2.2 Building Ties Between Research and Policy to Improve Impact of Interventions Regarding Renewable Energy Systems in the EU Neighbourhood Countries

Within this context, successful diffusion of renewable energy systems in the EU Neighbourhood Countries and Accession Countries like Turkey becomes an important issue not only for these countries but also for the EU. These countries have structural and economic problems that slow the transition and increase costs of GHG emissions reduction, despite their geographical advantages in renewable energies, such as solar energy. Built areas and particularly historical districts of the cities in the EU Neighbourhood pose unique challenges in the diffusion of renewable energy systems. The costs and benefits of such transformation are not clear which, in turn, drags interventions and applications below the desired rates. That is why improving the information base for costs and benefits of solar energy applications in built areas is important for improving the effectiveness of policies targeting the diffusion of renewable energy systems in these countries.

Informing policy-making through scientific research improves the efficiency and effectiveness of policies. Translation of scientific evidence into the language and information type that is useful and relevant to policymakers is difficult due to possible conflict between different types of evidence, differences in values that drive scientific inquiry and policymaking, and different paces of the scientific world and the policy world. In addition, science and policy communities are often cognitively disconnected, leading to frustrations and feedback problems (Bogenschneider and Corbett,2006). Establishing strong ties between research and policymaking is a supported practice through the 6th and 7th EU Framework Programmes and Horizon 2020 to help solve real-world problems (COM, 2011), (Sinozic et al., 2015).

The development of policies for the successful deployment of PV systems in the urban environment, including financing schemes, utility planning or accommodating grid capacity, critically depends on the assessment of the local potential which is determined by local realities, meteorological data, reference technologies and economic factors (Wittmann et al., 1997). Solar energy simulations have become crucial scientific assessment tools for the creation of valuable scientific evidence that could improve the effectiveness of policies at multiple spatial scales, given that they are provided with data and information as discussed above. However, the status of the required building level data assets for urban areas is not clear in the EU Neighbourhood countries. In addition, the amount of information and data required for historical districts is higher, as is discussed below.

From this perspective, the evaluation of Turkey's building and district level data assets for the utilisation of solar energy simulations provides important opportunities for the identification of important obstacles against building links between research and policy practice. Although being an Accession country to the EU, Turkey shares a common history and similar socio-economic features with many other European Neighbourhood countries, as well as similar geographic features, that have played a role in the development of both historical and contemporary urban settlements. This makes it an ideal case for such evaluations. In this paper, we focus on historical districts as they pose interesting and unique legal, cultural, economic and technical challenges for solar energy simulations in built areas.

2.3 Energy efficiency regulations and heritage protection

Following the adoption of the Kyoto Protocol in 1997, the European Union approved regulations to lessen the energy consumption in existing residential buildings including residential built heritage. Major actions have been taken by the European Environment Agency by Energy Performance Building Directives (EPBD). Directive 2002/91/EC mentions energy efficiency in buildings both new and existing with major renovations, and their energy performance calculations. (DIRECTIVE 2002/91/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2002 on the energy performance of buildings, o. J.) Directive 2010/31/EU stresses over the issues of historic buildings over the minimum energy performance requirements. (Directive 2010/31/EU on the energy performance of buildings (recast) - 19 May 2010 | Build Up, o. J.) (Jurošević & Grytli, 2016)

Historic districts require the sustainable and proper implementation of energy retrofitting. The decision making process has to consider the utilisation of proper tools and technologies for a smooth and respectful change. Complexity in historic districts in terms of energy systems requires a multiscale perspective approach for retrofit. The EFFESUS project (Energy Efficiency for EU Historic Districts Sustainability) developed a system for the selection of the most appropriate strategies. (Jurošević & Grytli, 2016) (Egusquiza & Izkara, 2016)

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Local and international legal challenges (Directive 2010/31/EU on the energy performance of buildings (recast) - 19 May 2010 | Build Up, o. J.) and the local requirements need to be elaborated by all the stakeholders for better implementation of sustainable energy systems. Innovative approaches proposed by some European research projects[3] need to be further improved for current energy efficiency requirements.

Interventions targeting energy efficiency in historic districts do not have proper regulations and protocols for data collection and the design process. This situation creates ambiguity about data requirements for the interventions in historic districts. Italian GBC (Green Building Council) implemented a Historic Building Protocol into LEED standards to solve this issue. This protocol is compatible with LEED standards and guidelines and it allows innovative designs and suitable material selection while also taking into account the preservation of cultural heritage.

The financial concerns challenge the regulation and application of the energy efficiency systems in accession countries and EU Neighbourhood countries, unlike some of the European countries that provided incentives both for Public Administrations and private citizens.[4]

Turkey started to take measures by delivering the new energy efficiency standard TS 825 (Thermal Insulation Requirements for Buildings) in 2000 and the Directive on Building Energy Performance (BEP-TR) sets lower limits[5] for the building envelope (Şahin et al., 2015). The BEP-TR covers existing and new buildings. Clause 2/c, of BEP-TR states that retrofits in historical districts is to be done in harmony with the official authorities without compromising the heritage value of the buildings, reflecting the Energy Performance of Buildings Directive (EPBD) (Directive 2010/31/EU on the energy performance of buildings (recast) - 19 May 2010 | Build Up, o. J.). However, BEP-TR does not include any further instructions regarding the proposed interventions for historic buildings. A non-governmental agency in Turkey, Turkish Green Buildings Council (ÇEDBİK) has established the B.E.S.T. (Ecological and sustainable design for buildings) certificate system only for new residential buildings. However, it might be useful to develop a special certificate system for new and historical buildings in historical districts.

Another issue is the choice of appropriate strategies at the district level for large-scale and rapid transformation of cities in line with the 11th SDG while taking into account other goals regarding cultural heritage preservation. Currently, it is very difficult to assess whether a low carbon policy focusing on decreasing energy usage by multiple interventions to historic districts is more suitable than a positive energy policy which rather focuses on on-site production of renewable energies via application of systems like PV panels. These two policy options would rely on highly varying technological interventions both at building and at the district levels to be effective and efficient. As a consequence, simulation approaches and methods utilised could be quite different. In both cases, simulation approaches have to take into account the historical value and socio-economic functions in these districts. Simulation-based assessment of solar energy technology applications in historical neighbourhoods may use building-based modelling techniques, taking into account various factors or standards such as operational range, storage, and safe accommodation of solar energy panels, the condition of the associated infrastructure and components of the buildings. In order to produce district-level information to feed policy decisions, the simulations also have to be able to represent the highly varying features of historical buildings which could be subject to non-standard interventions. These issues are likely to be more important in countries where regulations are weaker and users prefer ad-hoc interventions to historic buildings.

[3] [ENCULT Project, Efficient Energy for EU Cultural Heritage. Seven Framework Program (FP7-EeB.ENV.2010)] [SECHURBA Project (2008). Sustainable Energy Communities in Historic Urban Areas. Intelligent Energy Europe IEE-07-695 SECHURBA]- [SuRHiB Project (2011). Development of Technical and Architectural Guidelines for Solar System Integration in Historical Buildings, supported by CCEM- Retrofit, WP-7. SFOE [2009-2012]-[SOLNUC Project (2007): PV and Solar Collectors in Historical Centers. University of Applied Sciences and Arts of Southern Switzerland(SUPSI) by order of DT, Ufficio della Natura e del Paesaggio, Consiglio di Stato del Canton Ticino].

[4] As an example, Ministerial decree in Italy provides such incentives [Ministerial Decree 16/02/2016. Aggiornamento della disciplina per l'incentivazione di interventi di piccole dimensioni per l'incremento dell'efficienza energetica e per la produzione di energia termica da fonti rinnovabili.].

[5] [TS825-Thermal Insulation Requirements in Buildings (Recast), TurkishStandard, Turkish Standards Institute, May 2008, Available: http://www.mmo.org.tr/resimler/dosya ekler/cf3e258fbdf3eb7 ek.pdf (in Turkish),(accessed: 20.02.2014).] [Directive on Building Energy Performance (BEP Directive), Off. Gaz., Issue:27075, 5 December 2008]

There are various legal restrictions regarding historic districts and buildings in Turkey; both exterior and interior alterations require approval from the pertaining preservation board according to Law no. 5366 and Law no. 2863.[6] Proposed alterations have to be in compliance with local preservation laws for designated conservation areas and registered historical buildings, where restrictions may arise not only due to the attributes of buildings themselves but also due to their relationship with neighbouring parcels. Some partially collapsed or heavily damaged historic and cultural heritage structures are allowed to be reconstructed and put in use by the law, but there still exist uncertainties regarding the appropriateness of applications (Kaplan, 2017). The situation of applications targeting low carbon emissions or positive energy objectives is unclear, leading to a waste of opportunities arising in such reconstruction works. If conservation policies and associated laws could be connected by policies targeting the Climate Change and renewable energies, through scientific information based on evidence, the probability of effective implementation of appropriate technologies would likely increase.

3 DATA REQUIREMENTS FOR BUILDING BASED SOLAR ENERGY SIMULATIONS IN HISTORIC DISTRICTS

For new and existing buildings both at building and district levels, the primary aim is to achieve a reduced carbon footprint level and improve comfort conditions. The desired alterations in historical districts require necessary permits from the preservation boards. Buildings in historic districts require specific micro-climatic conditions, therefore, balance is essential between the occupants and the requirements of the building, the final use of the building's desired energy performance and comfort level (Del et al., 2010). New buildings and retrofitted buildings require specific approaches for window frames, opaque surfaces, and claddings, efficient thermal or passive solar techniques to reduce energy consumption of the building at the beginning of the design stage. (López & Frontini, 2014)

Directive 2010/31/EU of the European Parliament for retrofit of the historic buildings require an original approach to each building. However, the costs of such works could be extremely high, depending on the needs to collect primary data and establish relationships between different data sets which may not be compatible. A mid-level solution could be to develop common models feeding on joint databases that could provide adequate information for the purposes of solar energy retrofit applications in such districts. This might also improve building bridges between appropriate policy options such as positive energy districts and cultural heritage preservation, which might help closing the potential gaps at strategic levels and contribute to the sustainable development targets.

3.1 Solar Energy Technology & Alternative Simulation Options

Densification of cities increased the significance of solar technology and their proper integration and application to historical buildings (López & Frontini, 2014). Solar energy technology is basically categorised under two options, one as solar thermal technologies, and the other is solar photovoltaic (PV) panels as a passive solar heat system to produce electricity. There are examples of building integrated active systems, like building integrated solar batteries, solar collectors, both solar battery and collectors. On the other hand, there are roof or façade integrated solar systems (Özeler Kanan, 2012). However, visual concerns of solar thermal technology systems within historic districts may potentially create problems, so PV systems are a better choice. The solar potential of a district can be addressed at various levels in terms of resource, technical, economic, and market potential (Bódis et al., 2019). Evaluation of the solar potential requires data like the amount of solar radiation, usable sunlight, environmental parameters, efficient surface area, technical performance of the system, sustainability criteria, technology cost, and legal issues (Bódis et al., 2019).

The assessment of solar potential depends on the method used. Currently used methods are classified as low, medium, and high-level methods based on the utilised statistical, spatial, and detailed spatial and solar irradiation data. The low-level methods use aggregated statistical data, medium level methods use the spatial data derived from the geographic information system (GIS) and light detection and ranging (LiDAR) methods, and the high-level methods use detailed spatial data along with the solar radiation analysis (Bódis et al., 2019) (Castellanos et al., 2017)

[6] Law no. 5366: Yıpranan Tarihi ve Kültürel Taşınmaz Varlıkların Yenilenerek Korunması ve Yaşatılarak Kullanılması Hakkında Kanun, Law no. 2863: Kültür ve Tabiat Varlıklarını Koruma Kanunu

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Low-level methods	Example: population density as a proxy for the building/rooftop area. Assumption: homogeneity of the data throughout the area. Concern: limited reliability, ignores local interactions of buildings, ignores the design differences of buildings. Suitable: for homogenous districts.
Medium level methods	Feature: spatial data allows heterogenisation of the aggregated statistical data. Benefits: Better reliability. Concern: ignores local interaction of buildings. Suitable: for districts with a low building design heterogeneity
High-level methods	Feature: Highly reliable in estimating the performance of PV Solar Energy systems on buildings. Advanced methods to collect microdata and the detailed spatial information takes into account local interactions, design differences, rooftop slopes. Suitable: for heterogeneously developed mixed-use districts or historic districts.

Table 1: Features and uses of different methods according to their level of complexity.

3.2 Critical evaluation of simulation models for integrated solar energy retrofitting in historic districts

Transforming a historic district into a positive energy (historic) district requires the effective utilisation of renewable energy systems locally, such as PV solar systems. The prior simulation of the PV systems may help local governments to choose whether it is better to pursue a positive energy district or go for a different strategy like being a low carbon district by employing other technological and organisational solutions.

Especially historical districts in EU Neighbourhood countries face challenges in the assessment of potentials with respect to local application of renewable energy systems. Historical neighbourhoods in general consist of a large number of buildings and extensions which have been subject to an unknown number of interventions with varying quality, in countries where regulations are weak and social change are strong. Many of these interventions severely alter the structural properties of the buildings, but the resulting changes in the structural properties of buildings often remain completely unrecorded.

While at first glance, the above mentioned high-level simulation methods seem to be appropriate to assess PV solar system utilisation in historical district contexts, in reality, it may be almost impossible to employ them due to their expansive reliance on micro-level building data which is not available. On the other hand, low-level methods lack the ability to capture the heterogeneity of the districts which eventually increases the risk of successful implementation of PV solar systems. Even though this line of thinking leads us towards medium level methods, there are other issues that have to be taken into account;

(a) How detailed the available spatial data sets are,

(b) Whether existing spatial data will provide the desired level of representation of the heterogeneity of the historic district,

(c) Whether aggregated statistical data on socio-economic activities makes sense for modelling objectives.

Based on the International Energy Agency (IEA) PV rooftop potential is calculated by the use of rooftop area per capita, population density, solar insolation, total city population, rooftop PV system efficiency, and performance ratio and orientation factor. Some of the data like population density, rooftop PV system efficiency and population can be obtained as statistical data for historic districts. GIS data is available for most districts, but data collected by LiDAR methods are not readily available for every district.

Roof structural system, building use category, multiple ownerships are also important factors for the selection of the methods in the determination of the solar potential. Some multiple-owner estates are not registered despite being located in the historic district. Any kind of intervention and/or retrofit for the buildings in historic districts requires compliance with rules and regulations of the conservation boards. Multiple ownership in some states and especially in historic districts are important issues to get necessary permits from the owners even if there are no preservation rules and regulations.

4 EXISTING DATA STRUCTURES IN THE EU, ITS NEIGHBOURHOOD, AND TURKEY

4.1 Data structures in the EU with respect to solar energy simulation

EU and its southern and southeast Mediterranean neighbours' collaboration resulted in the Mediterranean Solar Plan (MSP) to promote solar energy production in North Africa. Morocco is one of the examples of the EU Neighbourhood countries within MSP which is expected to provide increased green energy production

and employment by means of the new green energy trade scheme, that was put in effect with EU 2009/ 28 Directive (Tahri et al., 2015).

Infrastructure for spatial information in Europe (INSPIRE) was initiated in 2007. The INSPIRE Directive aims to create a European Union spatial data infrastructure for the purposes of EU environmental policies or activities which may have an impact on the environment. This European Spatial Data Infrastructure will enable the sharing of environmental spatial information among public sector organisations, facilitate public access to spatial information across Europe and assist in policy-making across boundaries.

4.2 Evaluation of the data structure in Turkey as a representative country of the EU neighbourhood.

Parallel to the INSPIRE directive, Turkey as one of the EU accession country which started the implementation of a geographical Information system based on building an inventory registry in several municipalities (Toybıyık, 2017)(Toybıyık, 2017). Turkey's national geographical information system-based (TUCBS) thematic building data includes both the BuildingsExtended2D requirements from INSPIRE and the local city information system (KBS) in 3D detail classification.

Besides, there have been many municipalities which have used geographical information systems to implement a cultural heritage inventory (Kudde et al., 2019; Savran et al., 2017). Inventory projects for cultural and historical assets are well-formed databases and they may be extended even more to encompass the required data for solar energy utilisation in historical districts. Besides, these databases have to be integrated with the TUCBS. Thematic building data in TUCBS inventory can be useful for building scale solar energy estimation, however, the calculations of solar capacity at district level may require further assessment of local solar obstructions. Therefore, TUCBS data may be extended with the help of aerial mapping of the district with the utilisation of methods like LiDAR. This information may be integrated into the TUCBS database. With that the medium-level methods will be attainable. To the best of our knowledge, LiDAR data for Istanbul is available prior to 2013 (Kayı & Erdoğan, 2015). However, it is not certain if the data from different LiDAR applications elsewhere in Turkey are compatible with each other.

For the overall energy performance evaluation, the energy demand of the historic district also depends on envelope materials. In the reconstruction and retrofitting of historic buildings, a current database on the environmental performance of materials would be useful. In this context, there is a database called TurCoMDat[7], about the environmental performance of building materials based on the international norms and standards produced in Turkey. The database may be extended by the addition of data on materials specifically designed for retrofit use for the historic districts. Utilisation of both energy demand determination with the help of building envelope data and calculated solar potential enables to deduce an appropriate strategy for the energy efficiency system.

5 CONCLUSION

In this paper, we have briefly discussed the possible ways of utilisation of PV Solar Energy simulations in built-up areas as it is an important issue for informing policies regarding the Climate Change and international role of the EU. We have focused on the specific case of Turkey as a representative country of the EU Neighbourhood, and the subject of historic districts as a special case where diffusion of innovation faces significant challenges.

Although the paper is the product of ongoing research, it provides some perspectives on the development level of building-level databases and their utilisation for PV Solar Energy simulations in historical districts in the EU Neighborhood context, assuming that Turkey is a good representative. To the best of our knowledge, it is likely that up-to-date LiDAR data for wide-scale use is not cırrently available in the EU Neighbourhood countries. Due to their unique features historical districts might need advanced LiDAR data and building envelope data available at the district level so as to facilitate high-level simulation methods.

High-level simulation methods may help practitioners to obtain a fine-tuned balance between energy efficiency and the historical heritage conservation priorities that would be crucial in the decision of appropriate strategy between low carbon and positive energy district, However, it could be possible to use medium level simulation methods in historical districts in some cities which have collected LiDAR data. We believe that even medium-level simulation methods applied to historical districts might improve the

[7] https://turcomdat.com

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provision of evidence-based information to feed policies targeting Climate Change in the EU Neighborhood countries, which could reduce stress to meet sustainable development targets set by various international, national and local actors.

For the case of Turkey, the rise in the number of studies focusing on building level data inventories seem to be increasing, while modelling capabilities seem to be developing depending on the limited data available. There are also significant efforts to avoid coordination pitfalls and waste of resources due to thematically and geographically duplicated works.

A relevant research agenda might focus on at least three subjects. First, approaches have to be developed, which enable joint use of existing building data structures in modelling works for PV Solar Energy. This might still provide benefits as the costs and benefits of choosing alternative strategies would be assessed better than it can be done today. Second, cultural heritage inventory data collection efforts by various local governments and other public bodies should be coordinated and subject to standards so that they take into account the data needs of medium or higher level PV solar energy simulations, depending on their budget. Third, hybrid approaches that use strengths of sampling and high-level methods have to be developed to open an alternative path for the production of scientific evidence for policy making. Alternative approaches may provide opportunities for faster development of simulation capabilities in the overall region, conditional on the capability in the EU Neighborhood to establish research partnerships aiming at establishing stronger ties between research and policy making to help solve real-world problems associated with Climate Change.

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Spatial Transformations in Urban Areas During the Past 50 Years

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1 ABSTRACT

This research examines the dynamics of spatial transformations in highly urbanized areas and in particular the urban agglomeration of Ghent (Belgium). To this end we go back 50 years in time (1963-2013). The hypothesis is assumed that three major spatial transformations take place during this period: (1) the population increase leads to sub-urbanization or the spreading of functions around the city center until the 1980s and (2) is followed by a period of compaction processes in which remaining open areas are filled within the suburban area. It is mainly about new construction. This condensed nebula - which presents itself as a city edge – (3) finally, together with the city core, transforms both in nature and in use of the existing built-up tissue. This mainly concerns renovation and reuse. The dynamics of these processes can be reconstructed on the basis of building and allotment permits.

Based on this, neighborhoods can be distinguished with low or high dynamics regarding transformations. Finally, it will be investigated where transformations will occur in the future. Socio-economic characteristics of starters on the residential market can be an indication of expected transformations in the future in other neighborhoods. The article introduces the concept of Napoleon plots to carry out statistical and spatial analysis. Dynamics and patterns are mapped.

Keywords: Belgium, urban, transformations, history, mapping

2 INTRODUCTION

This article examines the dynamics of spatial transformations in highly urbanized areas and in particular the urban agglomeration of Ghent (Belgium). To this end, we will go back up to 50 years in time (1963-2013). The dynamics of these processes can be reconstructed on the basis of building applications and allotment applications. Based on this, neighborhoods can be distinguished with low or high dynamics regarding transformations. The transformations relate both to the existing built-up tissue and open space that is occupied by new buildings.

Knowing transformations within the existing built-up tissue is important to have an insight into dynamics and the capacity to accommodate present and future housing needs within the existing heritage without going to expansion by cutting open space.

In order to explore the possibilities of the licensing database on the one hand and spatial patterns on the other, the case of the Ghent city region is being investigated. This includes both the urban core and the suburbs and can therefore represent processes and patterns that occur both in the center and in the periphery.

3 RESEARCH HYPOTHESIS

The hypothesis is that three major spatial transformations take place in the period 1963-2013: the population increase leads to suburbanization or the spreading of functions around the city center until the 1980s and is followed by a period of compaction processes with remaining open areas be completed within the sub-urban nebula. It is mainly about new construction. This condensed nebula - which presents itself as a city edge - finally, together with the city core, transforms both in nature and in use of the existing built-up tissue. This mainly concerns renovation and reuse.

4 TRANSFORMATIONS AND FORMS OF SHARED SPACE

A shared space can be created by various underlying transformation processes down to the level of the building that inter alia act upon the physical tissue and are steered from private ownership (Louw, 2008). Location selection, zoning plans, subsidies, taxes, permits, residual land value, use value, land development, ... are leading in this. In contrast to the Netherlands, the transformation in Flanders still happens mainly through self-realization (private initiative):

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4.1 Dividing up buildings

For example, dividing a single-family home into a multi-family dwelling. In order to have an idea of the pace of such a transformation, permit applications for demolition and new construction for the year 2015 were analyzed for the whole of Flanders. In 2015, 57,667 urban applications were approved. In 4,588 files it concerns the demolition of a house or a building with a different function (e.g. bakery, joinery, ...). 45% relates to the demolition of a residential building. A total of 2,315 residential units were demolished. A residential unit can be a house, a villa, an apartment, etc. In the same period (2015), 5,143 residential units were built on these plots. The demolition led to more replacement construction. This means that for every demolition permit 1.1 dwellings will disappear, but will be replaced by 2.5 new housing units. Usually these are flats. Or, 2.2 for each housing unit. If the pace of 2015 continues, approximately 3,000 residential units will be added to the existing built-up area annually. That is about 10% of the annual housing demand in Flanders. Aproximatly 33,000 building permits for new one-family homes were handed out in 2015. Such compaction means a saving on the cutting of open space and the realization of additional new land developments. In this way, nature and agricultural land can be spared and housing production increased.

For comparison, the annual production of housing through demolition and renewal is much higher in the Netherlands: for the period 2001 until 2005 this amounted to 52,900 new homes each year (Buitelaar et al, 2008: 37). Almost a third of that is realized within existing built-up area.

4.2 Dividing the space

For example, the divide of land into parcels. This transformation was also recently investigated for Flanders. Pisman et al. (2016) showed that over the past 50 years 285,900 approved plots were delivered. This concerns new, changes and cancellations of allotments. 150,000 relate to new housing developments. Throughout this period, the number of plots has declined from 4,800 per year in 1963 to 2,100 in 2013. Especially after the regional zoning plans were drawn up (1976-1980), the number of allotments declined because they were then only delivered in residential destinations. Over the past two decades, the number of land plots has remained stable. The lot size has been decreasing systematically since the 1980s.

4.3 Redistribution or redevelopment of space

For example demolishing a building and replacing it with a new building with a different function. The possibilities offered by reuse are not easy to estimate for the whole of Flanders (Tritel and UGent, 2012). The method of registration plays a role in this. Nevertheless, the reuse potential of the existing vacancy in Flanders is estimated at around 19,700 residential units. In addition, there are approximately 5,700 stores that can be redeveloped and approx. 3,000 ha of industrial estates (TV SUM and Atelier Romain, 2017).

In the Netherlands, Buitelaar et al. (2008) estimates that 23,000 ha of outdated business parks with empty buildings can yield up to 150,000 new homes. The objectives of the Spatial Planning Memorandum (VROM, 2004) are, just as for the White Paper on the Spatial Policy Plan Flanders (Flemish Government, 2017), relevant for identifying the transformation task: the number of homes to be built each year and the share that has to be built up within the existing built-up tissue must be built.

4.4 Sharing or interweaving space

For example by stacking functions (e.g. houses on top of a supermarket or a school building). Research by Loris and Pisman (2016) provided insight into the possibilities of stacking homes on top of supermarkets. Such a transformation could theoretically accommodate the housing needs for the next ten years, without sacrificing green space.

The above forms of transformations come back under the three waves that are presented as research hypotheses: suburbanization (from the city center) through subdivision, densification (of those suburban areas) by further subdivision, interweaving and redevelopment of buildings, and renovation (within the city centers and the sub-urban area) through reuse, demolition and reconstruction. These spatial processes are tested in the urban region of Ghent (including agglomeration, core city and city center).

5 DATA AND METHODOLOGY

5.1 Data and data quality

The basic data used for the research are license applications for the period 1963-2013, as collected by the municipalities according to the guidelines of the Flemish Government. Spatial planning is a regional competence in Belgium and most town planning applications are granted by municipalities.

Within the study area of the Ghent urban district, a total of 250,940 urban development applications are analyzed over the past 50 years. Less than 10% of the applications are refused by the municipalities; more than 90% led to a permit for the creation of new lots or the building up of buildings (e.g. housing, businesses, retail etc.). We assume - in view of the long period that is being considered - that these permits are actually being realized. After all, an application takes a long time and is costly for the applicant.

The number of applications varies annually and follows the general Belgian and Flemish economy (decline during the (oil) crises of the 1970s and 1980s, the banking crisis of 2008 and the revival during the 1990s and 2000s). The changing housing market is also reflected in the data: stagnation of new construction versus the increase of renovation of the existing housing stock. New market shares take off proportionally over time (Pisman et al., 2016).

Preliminary analysis of the quality of the data of 2,464,661 licenses for the whole of Flanders, indicated that only 1.5% of these permits could not be assigned to a Napoleon plot (corresponding CAPAKEY coding, see below). This may be considered as an acceptable margin of error for carrying out such historical research over the last 50 years.

The data is the most detailed for an individual cadastral parcel.

Finally, data that reflect the housing dynamics in the short and long term are used: on the one hand property that is for sale (apartments, building plots and houses offered for sale via the internet) and on the other hand the inventory of vacant lots in the urban region (currently or not) for sale. Research by Antea and KUL (2017) shows that the used real estate offer is large enough to carry out meaningful analysis.

5.2 Methodology

5.2.1 Spatial exploration of the data by means of heat maps

The exploration of the data is done on the basis of heat-maps for the case of the urban region of Ghent. Heat maps indicate the incidence of a particular phenomenon per grid of 500 m, e.g. to prevent the number of renovation requests for a certain time, e.g. the year 1963, or over a certain period, e.g. 1963-2013. The advantage of this is that the data that is analyzed is easier to understand for the reader and can expose patterns for interpretation (Lukez, 2007).

5.2.2 Entry of the concept of Napoleon plots

Over the past 50 years, many cadastral parcels have been parceled out, divided, merged or renumbered. In order to be able to trace permits over time on a certain cadastral plot, the ground number of the original plot is used. The whole of parcels with the same ground number is called the Napoleon plot. After all, Napoleon has introduced the land register in our regions, hence. For example, the cadastral parcels 100a7 and 100b are assigned to Napoleon plot 100 (fictitious example). Napoleon plots are more stable over time; the statistical processing is therefore easier and more accurate.

The Napoleon plots are then assigned to a fixed grid cell of 500m by 500m. In this way patterns and changes in permits can be animated over time. The generalization of the maps helps to limit the complexity on the one hand, and on the other hand to reflect the essential spatial processes without sacrificing the aesthetics of the maps (Weibel & Dutton, 1999).

5.2.3 Case study city district Ghent

The choice falls on the urban region of Ghent (Figure 1) because of technical and substantive reasons. On the one hand, we only have permit dates for Flanders (and not for the Brussels-Capital Region and Wallonia) and in the case of the Ghent city region also data for both the city of Ghent and its peripheral municipalities (Zelzate, Wachtebeke, Lochristi, Destelbergen, Melle , Merelbeke, De Pinte, Gavere, Nazareth, St-M-Latem, Nevele, Lovendegem and Evergem) is available. This way a coherent urbanized region can be investigated.

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On the other hand, the urban district of Ghent is characterized by growth in the area of households, both in the city of Ghent and in its peripheral municipalities (SVR, 2014) despite the continuing suburbanisation (SVR, 2016). This indicates that there is a dynamic in space. The region is also characterized by a dynamic in the field of property transactions (see below).

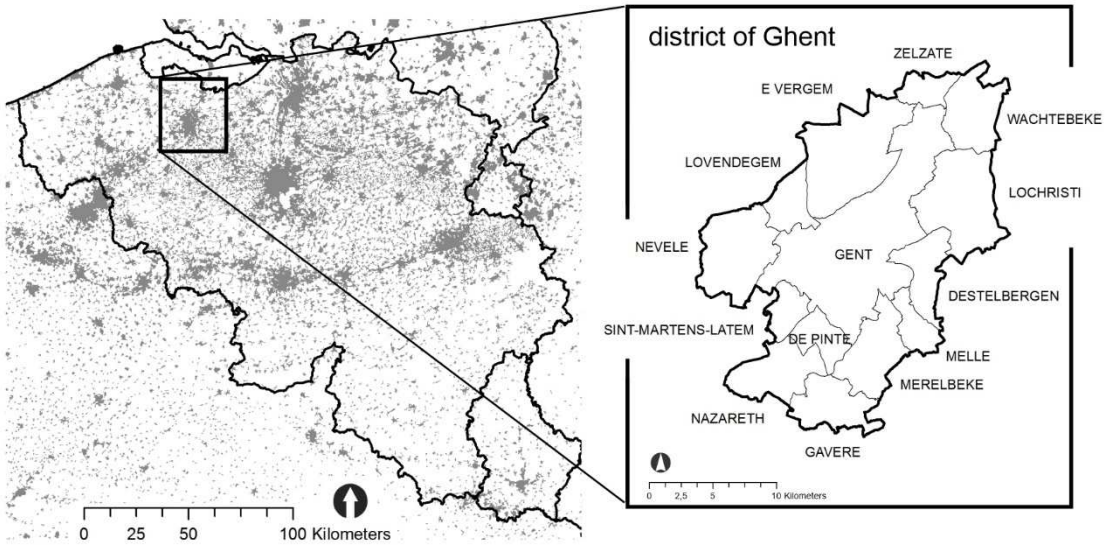

Fig. 1: Situation of the urban district of Ghent in Belgium. The study area includes the municipalities of Ghent, Zelzate, Wachtebeke, Lochristi, Destelbergen, Melle, Merelbeke, De Pinte, Gavere, Nazareth, St-M-Latem, Nevele, Lovendegem and Evergem. Source: left: UMZ, right: own processing.

6 SPATIAL EXPLORATION OF THE DATA - CASE URBAN REGION OF GHENT

6.1 Global trends in the city and its periphery

Until the beginning of the 1980s, the number of new-build projects in the city of Ghent as in its peripheral municipalities is in line with both trend and size (Figure 2). After a decrease in the number of licenses at the end of the 1970s, there has been a renewed increase in the number of new construction projects, both in the city and in the periphery until the mid-1990s. However, the increase in the city of Ghent is much more limited and stagnates in the period from mid-1990-2013. The growth in the peripheral municipalities, on the other hand, peaks until the mid-1990s, after which a decline also occurs, but still remains above the growth of the city in absolute numbers. The dynamics in the area of new construction are greater in the suburbs than in the city.

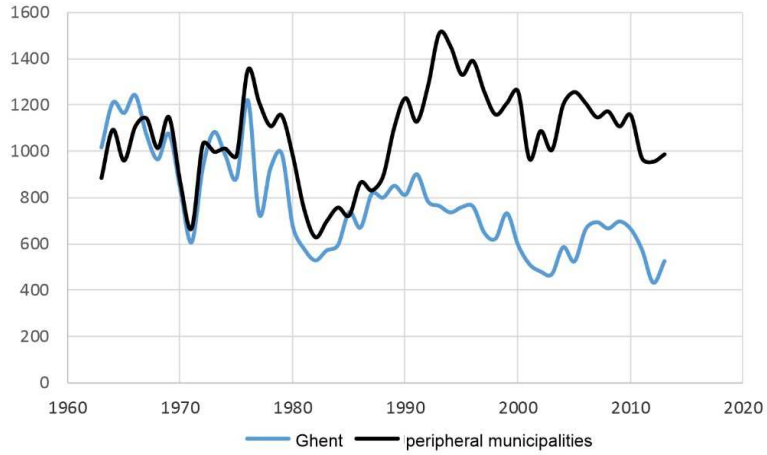

Fig. 2: Trend in new construction (all functions) in the urban region of Ghent in Belgium with a distinction between the city center of Ghent and its peripheral municipalities (Zelzate, Wachtebeke, Lochristi, Destelbergen, Melle, Merelbeke, De Pinte, Gavere, Nazareth, St-M-Latem, Nevele, Lovendegem and Evergem). Source: Licensing register (2015), own processing..

The first two periods, namely 1963-mid 1980 and the period mid-1980-mid-1990s, have a similar trend in the number of renovations between the city and its periphery. In Ghent, however, more is being renovated

than in the peripheral municipalities (more than twice as much). Since the 1990s, the number of renovations has increased both for the city and for the peripheral municipalities (Figure 3). This increase coincides with the decline of the new building during that period. The renovations then far exceed the number of new construction projects.

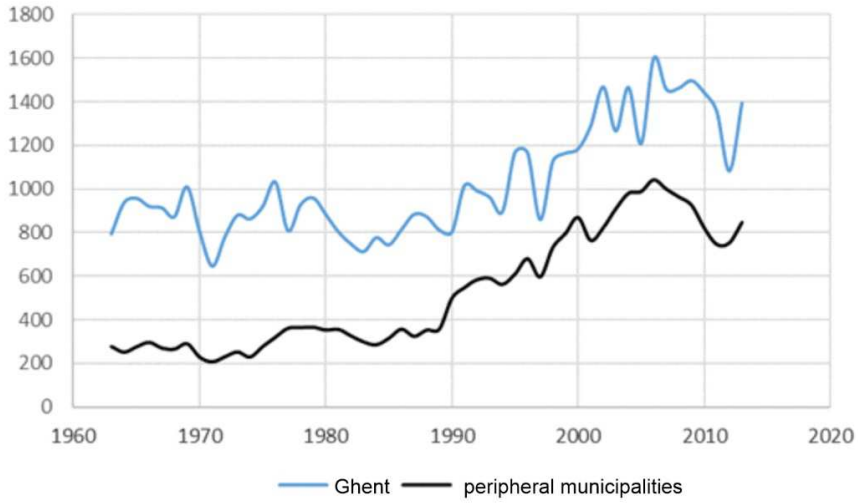

Fig. 3: Trend in renovations (all functions) in the urban region of Ghent in Belgium with a distinction between the center city of Ghent and its peripheral municipalities (Zelzate, Wachtebeke, Lochristi, Destelbergen, Melle, Merelbeke, De Pinte, Gavere, Nazareth, St-M-Latem, Nevele, Lovendegem and Evergem). Source: Licensing register (2015), own processing.

In addition to the quantity question, it is interesting to look at the real demand about the same three periods. This is done on the basis of the heat maps.

6.2 Trends in the neighborhoods

We have clearly seen two trends over the past 50 years: on the one hand the swarming of the buildings from the center of Ghent to the peripheral municipalities (suburbanization and densification) and on the other hand a more recent renovation wave in that center of Ghent and to a lesser extent in a first belt around Ghent (e.g. neighborhoods Wondelgem, Sint-Amandsberg, Gentbrugge) (Figure 4). These trends were started during the years 1980 to 1990 (Figure 5). Outside the city of Ghent and the first belt the start of the growth of the port villages (Zelzate and Ertvelde) occurs, and suburban villages such as Sint-Martens-Latem, De Pinte, Lovendegem, Evergem, Lochristi, and the villages in the Scheldt valley (Merelbeke, Schelderode, Melsen, Semmerzake, Gavere, ...). Also nearby villages are beginning to grow: Eke, Nazareth, Landegem. The Scheldt valley as well as the open spatial areas in Wachtebeke and Lochristi are coming under increasing pressure.

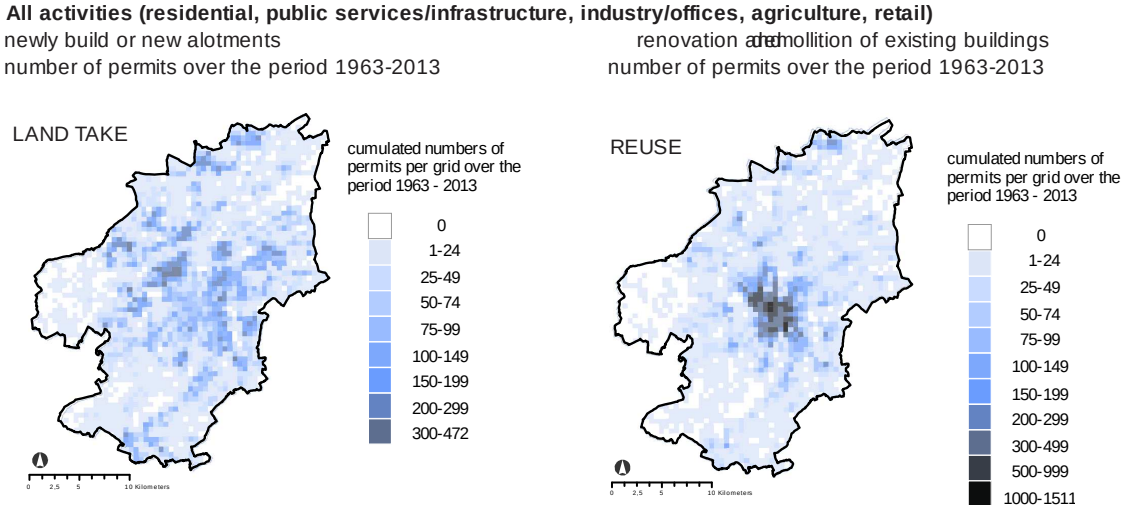

Fig. 4: Heatmap of the spatial pattern of the distribution of the number of building permits for new construction and for renovation over the period 1963-2013 in the urban district of Ghent. Source: own processing of data permits register (2015).

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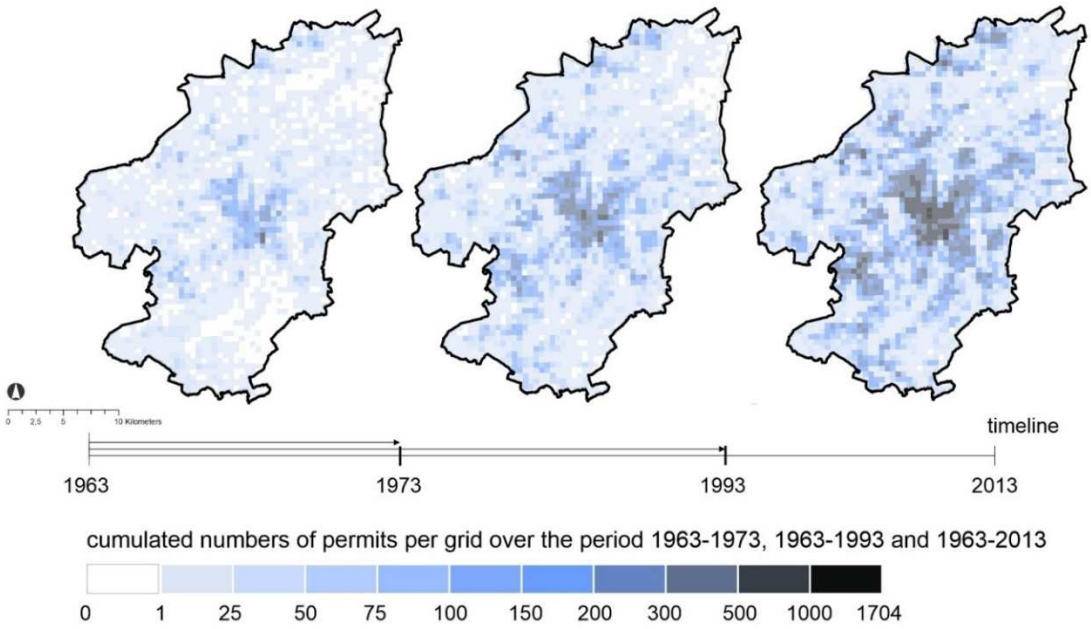

Fig. 5: Timeline of the spatial pattern of the distribution of the number of building permits (new construction and renovation) over the period 1963-2013 in the urban district of Ghent. Source: own elaboration.

6.3 Major driving forces behind transformations

Six driving forces are mapped: residential new construction, public services and infrastructure, industry and offices, agriculture, retail and deforestation, and new allotments. Both new construction and renovation and demolition are indicated on the maps (Figure 6).

In absolute numbers, the share of residential permits is the largest compared to the other functions. The number of permits for new construction and renovation is concentrated in the city center and in the villages around it, with the exception of the port villages that are growing due to the expansion of the port of Ghent. The new building is driven by land parcels and deforestation. This is very visible in Sint-Martens-Latem, Eke and Sint-Amandsberg, but has a dynamic all over the city region. This also puts more rural areas under pressure such as the municipality of Evergem. We also see the transformation of the rural area in Lochristi where greenhouse cultivation is being expanded. Finally, a concentration of public functions and infrastructure on the one hand is noticeable, and on the other hand of retail in the center of Ghent. Renovation coincides with this.

7 RESULTS AND DISCUSSION

7.1 Spatial transformations of the past 50 years

The post-war developments and Golden Sixties, with increasing car use and the Babyboom generation, led to optimism about the growth opportunities for Belgium. A consequence of the idea of progress was that in the later regional plans (i.e. zoning plans were drawn up for the entire territory in terms of housing, industry, recreation, nature, agriculture, etc.), a multitude of residential destinations were provided, based on optimistic population prognoses. The crises of the 1970s and 1980s will show that once again. Nevertheless, this large range of created building plots will reinforce later megatrends in the field of spatial planning. The accompanying economic policy and policy in the field of infrastructure have fueled the urbanization of Flanders (car oriented development).

Three major trends have been observed in the Ghent urban region since 1963: the growth of the urban region and the accompanying suburbanization, the densification of the growth centers and, finally, the renovation and transformation of the existing built-up tissue (Figure 7).

(1) Growth and suburbanization

Population growth and household growth are creating an increasing demand for building plots for mainly detached buildings, the dominant architectural style since the 1960s. The share of homeowners continues to increase. Suburbanization and ribbon development outside the village centers are typical for the Flemish

landscape and therefore also for the Ghent peripheral municipalities. The interpretation of the residential areas on the regional plans from the 1980s plays a role in this.

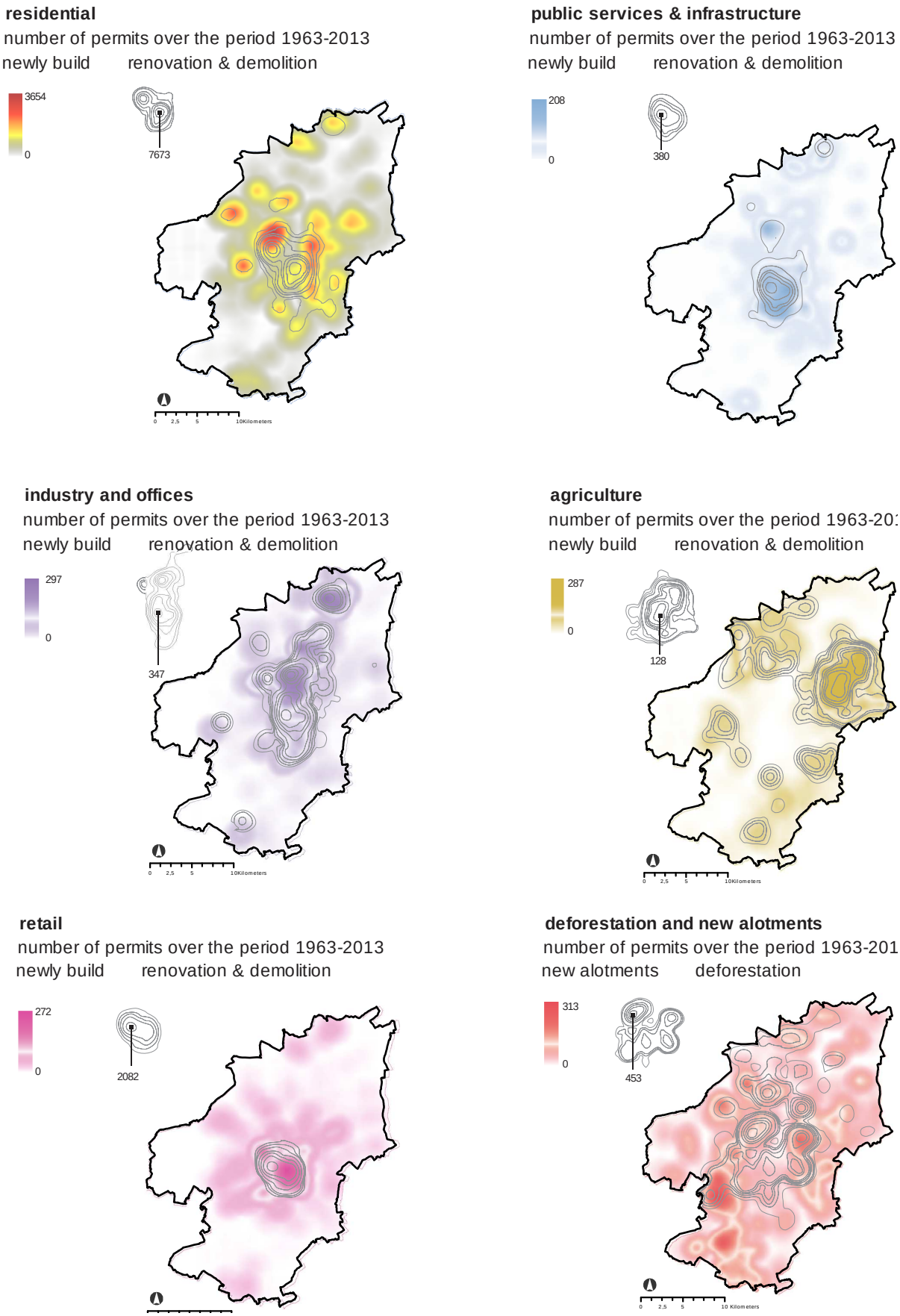

Fig. 6: Timeline of the spatial pattern of the distribution of the number of building permits (new construction and renovation) over the period 1963-2013 in the urban district of Ghent. Source: own elaboration.

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(2) Compaction in city and outskirts

The tissue of already spread villages and buildings is gradually being further densified. We see this process in the city center, the suburbs as well as in the peripheral municipalities.

(3) Transformation of the existing built-up tissue

Some change from expansion with new construction to renovation in the city center continues. In view of the supply of owner-occupied homes, owner-occupied apartments and building plots in the peripheral municipalities, the renovation and transformation of buildings may also be started here.

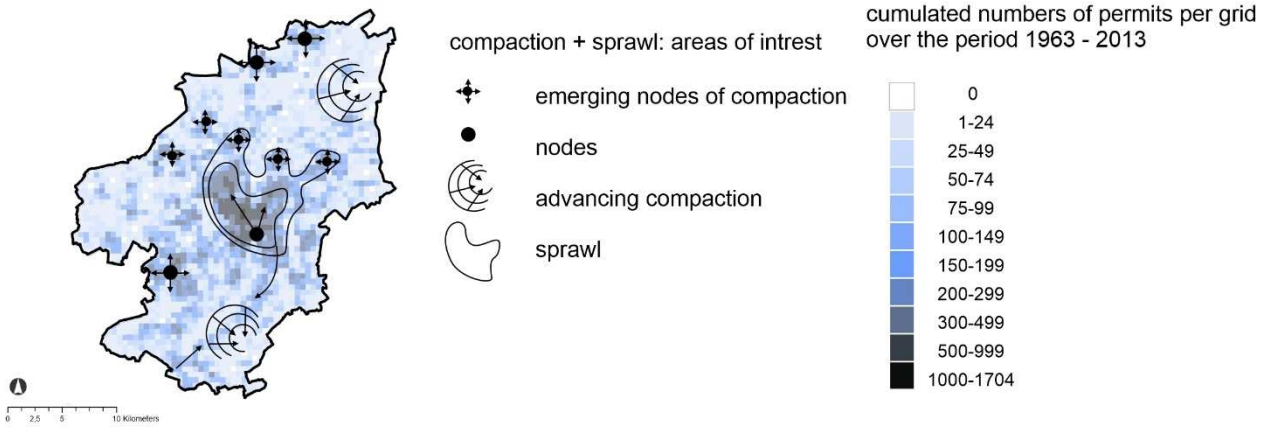

Fig. 7: Spatial trends of the number of building permits (new construction and renovation) over the period 1963-2013 in the urban district of Ghent. Source: own elaboration.

7.2 Where in the future?

7.2.1 Changes in the short term: what will happen in the next five years?

The bulk of what is for sale for houses, apartments and building plots (8,800) is located in the city of Ghent: approx. 5,800 buildings compared to the rest of the urban region (approx. 3,000 properties) (Figure 8a). The sold properties may be assumed that a part will be renovated, demolished and replaced, given up or given a different function. In the short term - given the aforementioned trends in demolition and separation, reuse etc. - the greatest dynamism can be expected in the city center of Ghent.

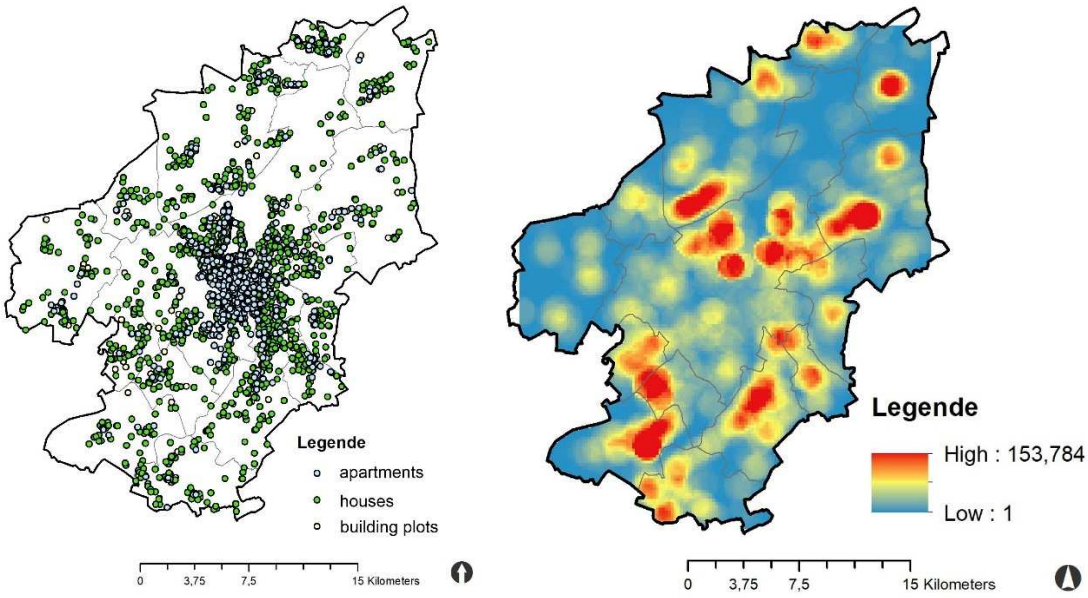

Fig. 8: (a) Real estate offer (for sale) in the urban district of Ghent. Source: own processing of real estate data (2014) and (b) heatmap of supply of vacant plots (whether or not for sale). Source: own processing of register vacant lots (2015).

7.2.2 Changes in the long term

In the longer term, it is more difficult to estimate where spatial dynamics will occur. The range of building possibilities on vacant plots shows just the opposite pattern of the supply on the existing buying market: approximately 29,000 of the approximately 109,400 plots in the urban region are located in Ghent, the remaining 80,400 in the peripheral municipalities (Figure 8b). The reserve in the periphery far exceeds the offered property. For example, the availability of new parcels can attract new residents. The potential for this is very great. Only later will they build and possibly renovate again later. Knowing migration patterns at the level of the urban region can play a role in this. Further research into links between these processes is recommended to fully understand the dynamics. The dynamics in the longer term could be greatest in the peripheral municipalities of the urban region if the wide range of services will be effectively addressed for housing or other functions.

Municipalities can counter transformations or give a boost through, among other things, the drafting of (re)zoning plans or through collective transformation by e.g. to encourage renovation. Via the latter, a scale leap can also be made: from building to street, or neighborhood. This can be useful e.g. to build energy-efficient neighborhoods. Steering on the supply of building plots seems necessary if one wants to maintain a dynamic in the existing built-up tissue that is situated mainly in the city of Ghent.

8 CONCLUSION

For the first time, data from three databases, i.e. the permit register, the register of vacant plots and real estate ads for sale on the internet, have been used to visualize the spatial transformations of the past 50 years in the Ghent urban region.

These transformations can be reduced to three processes: suburbanization (1963-1983), compaction (1984-1993) and renovation (> 1994). A repetition of this cycle can occur because in the short term property is mainly offered in Ghent and to a lesser extent in the peripheral municipalities, and in the longer term especially the wide range of building plots in those suburbs will lead to a new wave of land development if policy does not steer spatially.

The characteristics of the neighborhood can be a predictor of future transformations. Further research into the relationship between the size of the age group of starters in a neighborhood and the application for a renovation or new building permit can highlight this process.

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🏆 *reviewed paper*

Standort, Wettbewerb oder Persönlichkeit: Wer oder was entscheidet über die Adoption des Onlinehandels als Vertriebskanal?

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1 ABSTRACT

Der Onlinehandel ist ein mittlerweile fest etablierter Vertriebsweg, der insbesondere den inhabergeführten stationären Einzelhandel (ISEH) – und mit ihm die Innenstädte und andere Einkaufsstandorte – vor große Herausforderungen stellt. Gleichzeitig kann der Multi- bzw. Cross-Channel-Vertrieb auch eine Chance für den ISEH darstellen, was allerdings voraussetzt, dass diese (Prozess-)Innovation im Vertrieb überhaupt genutzt wird. Anhand von drei Angebotsstandorten in Karlsruhe (Innenstadt, Stadtteilzentren Mühlburg und Durlach) behandelt der vorliegende Beitrag zwei Kernfragen: 1) Welche Relevanz hat der Online-Vertriebsweg bei den stationären (inhabergeführten sowie filialisierten) Einzelhandelsbetrieben an den drei Standorten? 2) Welche Einflussfaktoren bedingen die Adoptionsentscheidung von Geschäftsinhaber/-innen, zusätzlich in den digitalen Vertrieb einzusteigen? Hierzu wurde in den Untersuchungsgebieten eine standardisierte, mündliche Anbieterbefragung durchgeführt und ausgewertet. Mit einem multivariaten Entscheidungsmodell wurde der Einfluss einzelner Faktoren (subjektive Einschätzung der Standortqualität und des Wettbewerbsdrucks, Unternehmer/-innenpersönlichkeit im Sinne der Marktphasentheorie) auf die Nutzung des Onlinevertriebs geprüft. Erwartungsgemäß zeigt sich, dass die Digitalisierung bei filialisierten Unternehmen wesentlich weiter fortgeschritten ist als im ISEH. Überraschenderweise stellen aber weder die subjektive Standortbewertung noch der empfundene Konkurrenzdruck durch den lokalen Handel Einflüsse im Hinblick auf die Adoption des Onlinehandels dar. Die Adoptionsentscheidung hängt aber in hohem Maße von der individuellen Persönlichkeit der Geschäftsinhaber/-innen sowie von deren subjektiver Einschätzung des Wettbewerbsdrucks durch den Onlinehandel ab. Diese Ergebnisse implizieren, dass Strategien zur Förderung der Online-Kompetenz von mittelständischen Einzelhändlern eine höhere Relevanz beigemessen werden sollte und hierdurch andere Komponenten der Standortförderung sinnvoll ergänzt werden können.

Keywords: Unternehmerpersönlichkeit, Standortevaluation, Adoption, Onlinehandel, Citymarketing

2 EINFÜHRUNG

Der Anteil des Onlinehandels am Gesamtumsatz des deutschen Einzelhandels für das Jahr 2018 (rd. 527 Mrd. EUR) liegt bei 10,1 %. Dieser Marktanteil ist seit 2000 (0,3 %) kontinuierlich gestiegen (2005: 1,5 %; 2010: 4,7 %; 2015: 8,3 %) und verzeichnet größere Wachstumsraten als der stationäre Handel. Besonders online-affine Branchen sind der Elektrofachhandel und der Modehandel mit Online-Marktanteilen von 31,0 % bzw. 27,7 % (HDE, 2019a). Da die Konsumausgaben der Privathaushalte im Einzelhandel stagnieren bzw. nur schwach wachsen, stellt der digitale Vertrieb einen Wettbewerbstreiber für den stationären Handel dar. Nach überwiegender Auffassung führen die Umsatzrückgänge im stationären Einzelhandel zu einer sinkenden Nachfrage der Handelsunternehmen nach Geschäftsflächen und somit zu Leerständen und Attraktivitätsverlusten in Innenstädten und anderen Standorten (Reink, 2014; Stepper, 2016).

Auch wenn Marktanteilsverlagerungen in Richtung des digitalen Vertriebsweges ein Faktum darstellen, ist jedoch die Vorstellung einer bipolaren Trennung zwischen den Vertriebskanälen nicht mit der (heutigen) Realität vereinbar. Waren in der Frühphase des Onlinehandels in den 2000er Jahren Offline- und Onlinehandel noch eindeutig getrennt, sind Multi- bzw. Cross-Channeling mittlerweile etablierte Vertriebsstrategien von Handelsunternehmen. Viele Filialunternehmen (z.B. H&M, Media Markt, IKEA) betreiben an die Filialen angeschlossene Onlineshops und generieren mittlerweile einen relevanten Anteil ihres Umsatzes über Onlinekäufe. Andererseits sind auch viele ehemalige “pure player” des Onlinehandels (z.B. Amazon, Zalando, notebooksbilliger) in den stationären Vertrieb eingestiegen (Rittinger et al., 2017). Auf der Konsumentenseite hat sich der Kaufprozess dahingehend ausdifferenziert, dass Cross-Channel-Einkäufe zunehmen: Nach einer Verbraucherumfrage von Boniversum (2018) haben rd. 60 % der befragten Personen zwischen 18 und 69 Jahren schon einmal per „click and collect“ (Bestellung online, Abholung in

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der Filiale) eingekauft; als besonders relevante Gründe hierfür zeigen sich u.a. die Einsparung von Versandkosten und die flexible Abholung der Bestellung im Geschäft. Eine besondere Bedeutung hat die parallele Nutzung mehrerer Informationskanäle in der Phase der Produktübersicht bzw. -information im Kaufprozess: Während die Einholung von Vorinformationen im Geschäft mit dem Ziel des späteren Online-Kaufs als „Showrooming“ oder „Beratungsklau“ diskutiert wird, findet das umgekehrte Muster (ROPO: „Research Online – Purchase Offline“) weit häufiger Anwendung. Für die Online-Vorinformation werden neben PCs vermehrt Smartphones genutzt, wobei location based services (LBS; z.B. Suchmaschinen, Kauf-Apps) eine besondere Rolle zukommt. LBS-Diensten wird daher tendenziell ein positiver Effekt für den stationären Handel zugesprochen (Heinemann, 2015; Schneider, 2019). Ähnlich werden (lokale) Online-Marktplätze als Strategie zur Förderung des Handels vor Ort diskutiert (Battermann/Neiberger, 2018).

Etwaige Vorteile der Digitalisierung für den stationären Handel und seine Standorträume setzen allerdings voraus, dass die betreffenden Betriebe online präsent sind. Während große Filialunternehmen regelmäßig im Multi- und Cross-Channeling aktiv sind, trifft dies nicht auf den inhabergeführten stationären Einzelhandel (ISEH) zu: Befragungen zeigen, dass der Großteil der kleinen und mittelständischen Einzelhandelsbetriebe weder über einen eigenen Onlineshop noch über eine Präsenz in Online-Marktplätzen verfügt (z.B. Buss, 2018; ECC Köln, 2014; Neiberger/Kubon, 2018; Rumscheidt, 2016). Vor dem Hintergrund, dass Multi-/Cross-Channeling eine Chance für den ISEH darstellen kann, ist dies eine große Diskrepanz; schließlich hat der nicht-filialisierte Fachhandel von allen Vertriebs- bzw. Organisationsformen im Zeitraum von 2000 bis 2018 den größten Marktanteilsverlust erlitten (HDE, 2019b). Es verwundert daher nicht, dass die Frage nach der Adoption des Onlinehandels als Vertriebskanal durch den ISEH in den letzten Jahren in den Fokus gerückt ist (z.B. Bollweg et al., 2016; Delpy/Neiberger, 2019). Auch in Anbetracht der Förderung des lokalen Handels im Rahmen der Städtebauförderung drängt sich die Frage auf, ob und, wenn ja, wie etwaige Online-Strategien die etablierten Formen der Standortförderung ergänzen können.

Anhand des regionalen Fallbeispiels von drei Angebotsstandorten in der Stadt Karlsruhe (Innenstadt sowie die Stadtteilzentren Mühlburg und Durlach) behandelt der vorliegende Beitrag zwei Kernfragen: 1) Welche Relevanz hat der Online-Vertriebsweg bei den stationären Einzelhandelsbetrieben? 2) Welche Einflussfaktoren bedingen die Adoptionsentscheidung von Geschäftsinhaber/-innen, zusätzlich in den digitalen Vertrieb einzusteigen? Hierzu wurde an den Untersuchungsstandorten eine standardisierte, mündliche Anbieterbefragung durchgeführt und entsprechend der Fragestellungen ausgewertet. In Bezug auf die zweite Kernfrage wurden drei Einflussfaktoren auf die Adoption des Onlinehandels herausgearbeitet (Standortqualität, Wettbewerbsdruck und Unternehmer/-innentyp), deren theoretische Überlegungen und methodische Operationalisierung im verwendeten Fragebogen im nachfolgenden Kapitel erläutert werden. Das darauf folgende Kapitel zeigt zunächst die Ergebnisse im Hinblick auf die Organisationsstrukturen der Betriebe an den Untersuchungsstandorten sowie Einzelauswertungen der (angenommenen) Einflussfaktoren. Die multivariate Analyse dieser Einflussgrößen erfolgt anhand eines Entscheidungsmodells bezüglich der Adoption des Onlinehandels als zusätzlichen Vertriebsweg. Der Beitrag schließt mit den aus den Ergebnissen abgeleiteten Schlussfolgerungen für einen möglichen Praxistransfer ab.

3 THEORETISCHE VORÜBERLEGUNGEN UND METHODISCHER ANSATZ

3.1 Einflussfaktoren der Adoption des Multi-/Cross-Channel-Vertriebs

3.1.1 Adoption des Onlinehandels als Kompensation der Standortqualität

Der erste hier identifizierte hypothetisch angenommene Einflussfaktor auf den Einstieg in den digitalen Vertrieb ist mit der Annahme verbunden, dass der betriebswirtschaftliche Erfolg im stationären Einzelhandel stark vom Standort der Verkaufsstelle geprägt ist. Hierüber besteht weitgehend Konsens, da der Standort eines Einzelhandelsbetriebes eng mit dem Einkaufsverhalten der Kunden zusammenhängt (Müller-Hagedorn et al., 2012; Zentes et al., 2017). In vielen Studien aus dem Bereich der Standortanalyse ist der Einfluss bestimmter (insb. „harter“) Standortfaktoren (z.B. Marktpotenzial, Konkurrenzsituation, Erreichbarkeit) auf den betrieblichen Erfolg empirisch nachgewiesen worden (Überblick z.B. bei Wieland, 2019). Diese decken sich im Wesentlichen mit der Bewertung ihrer Relevanz durch Gewerbetreibende im Einzelhandel (siehe z.B. Heinecke/Schöne, 2018). Allerdings sind Standortentscheidungen (z.B. Eröffnung, Verlagerung) i.d.R. langfristiger Natur (z.B. wegen hoher Anfangsinvestitionen und langer Mietverträge), so dass diesbezügliche Fehlentscheidungen nur schwer wieder korrigiert werden können (Müller-Hagedorn et al., 2012).

Sollte der Mikrostandort entweder auf einer ungünstigen Entscheidung beruhen oder sich langfristig aufgrund von Trading-down-Effekten spürbar verschlechtern, ist die Ausweitung des eigenen Vertriebs auf weitere Kanäle eine denkbare Möglichkeit, um die betriebliche Tragfähigkeit zu sichern bzw. die Umsätze wieder zu erhöhen. Ob allerdings die Standortqualität die Neigung zum Einstieg in den Onlinehandel beeinflusst, ist nicht gesichert und soll daher hier überprüft werden. Somit wird als erste Untersuchungshypothese formuliert: *Je ungünstiger der eigene Standort ausgeprägt ist, desto eher entscheiden sich Geschäftsinhaber/-innen zum Einstieg in den Onlinehandel als zusätzlichen Vertriebsweg*.

Hierbei wird nicht die objektive Ausprägung von Standortfaktoren betrachtet, sondern die subjektive Beurteilung des eigenen Standortes durch die Gewerbetreibenden in der Befragung erfasst. Die Messung der subjektiven Standortqualität erfolgt in Form eines Adequacy-Importance-Modells, einer Variante der multiattributiven Einstellungsmodelle (Cohen et al., 1972; Wochnowski, 1995). Die Gesamtbeurteilung des Objektes *j* (hier: Standort des Geschäftes *j*) anhand von *I* bewerteten Attributen (hier z.B. Passantenfrequenz), A_j, berechnet sich aus der Summe der Beurteilungen der Ausprägung des Attributes *i* (*i* = 1, …, *I*) von Objekt *j*, B_{ij}, gewichtet mit der subjektiv eingeschätzten Wichtigkeit des Attributs *i*, W_i:

$$A_j = \sum_{i=1}^{I} W_i B_{ij}$$

Nach diesem Muster wurden insgesamt zehn Standortfaktoren zur Bewertung (adequacy) bzw. Einschätzung der Relevanz (importance) vorgegeben, die sich in empirischen Studien als relevant für den Standorterfolg gezeigt haben bzw. als relevant angegeben wurden (siehe z.B. Heinecke/Schöne, 2018; Müller-Hagedorn et al., 1991; Themido et al., 1998; Weber, 1979; Wieland, 2019; Zhou et al., 2015). Folgende Standortfaktoren wurden abgefragt und im o.g. Sinne zum Indikator A_j aggregiert:

Standortfaktor		Adequacy-Skala B_{ij} (-2;2)	Importance-Skala W_i (-2;2)
1	Einwohnerzahl im Einzugsgebiet	sehr schlecht … sehr gut	völlig unwichtig … sehr wichtig
2	Erreichbarkeit für Kunden mit dem Auto		
3	Erreichbarkeit für Kunden mit dem ÖPNV (Straßenbahn, Bus)		
4	Passantenfrequenz vor dem Geschäft		
5	Sichtbarkeit meines Geschäftes		
6	Anbieter *anderer* Branchen in der Nähe meines Geschäftes		
7	Gestaltung des öffentlichen Raums in der direkten Umgebung		
8	Anbieter *derselben* Branche in der Nähe meines Geschäftes	trifft nicht zu … trifft nicht zu	geschäftsmindernd … geschäftsfördernd
9	Lage in einer Fußgängerzone oder in unmittelbarer Nähe einer Fußgängerzone		
10	Lage in unmittelbarer Nähe zu einer ÖPNV-Haltestelle		

Tabelle 1: Abgefragte Standortfaktoren im Adequacy-Importance-Modell.

3.1.2 Adoption des Onlinehandels in Abhängigkeit des wahrgenommenen Wettbewerbsdrucks

In ihrer Untersuchung zur Nutzung des digitalen Vertriebs im ISEH (*n* = 85) prüfen Bollweg et al. (2016) den Einfluss des wahrgenommenen Konkurrenzdrucks auf die Adoptionsentscheidung, wobei zwischen dem Wettbewerbsdruck durch den stationären Einzelhandel und dem Onlinehandel unterschieden wird. In beiden Fällen ergeben sich signifikant positive Einflüsse auf die aktuelle Nutzung des digitalen Vertriebsweges. In der von den Autoren vorgenommenen Literaturanalyse früherer Studien zeigt sich dasselbe Bild. In einer Sonderumfrage im Kontext des ifo-Konjukturtests (Rumscheidt, 2016) schrieben von den befragten stationären Einzelhändlern (*n* = 690) dem Onlinehandel 53 % einen geschäftsmindernden und weitere 12 % einen geschäftsgefährenden Einfluss zu. Diese Ergebnisse lassen auf ein deutliches Konkurrenzbewusstsein im ISEH schließen, wobei sich nahezu jeder stationäre Handelsbetrieb in einem Wettbewerbsverhältnis sowohl mit dem Onlinehandel als auch mit anderen stationären Anbietern in seinem Einzugsgebiet befindet.

In der aktuellen Befragung an drei Karlsruher Angebotsstandorten wurden daher beide Einflüsse überprüft, und zwar über zwei Aussagen-Items („Der … übt einen starken Konkurrenzdruck aus“), die auf einer

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fünfstufigen Likert-Skala („trifft nicht zu“: -2; „trifft voll zu“: 2) abgefragt wurden. Von der subjektiven Einschätzung des Wettbewerbsdrucks wird angenommen, dass sie die Wahrscheinlichkeit erhöht, in den Onlinevertrieb einzusteigen. Die empirisch zu prüfenden Hypothesen lauten daher: *Je stärker der wahrgenommene Wettbewerbsdruck durch den lokalen Einzelhandel, desto eher entscheiden sich Geschäftsinhaber/-innen zum Einstieg in den Onlinehandel als zusätzlichen Vertriebsweg* bzw. *Je stärker der wahrgenommene Wettbewerbsdruck durch den Onlinehandel, desto eher entscheiden sich Geschäftsinhaber/-innen zum Einstieg in den Onlinehandel als zusätzlichen Vertriebsweg*.

3.1.3 Einfluss des Unternehmer/-innentyps

Prinzipiell wird die Adoption des Onlinehandels als zusätzlichem Vertriebsweg häufig auch durch die wirtschafts- und sozialpsychologischen Eigenschaften der Entscheidungsperson – d.h. der/die Geschäftsinhaber/-in – erklärt. Bisher diskutiert und benutzt wurden diesbezüglich etwa Modelle zur Adoption von Innovationen und Technologien in kleinen und mittleren Unternehmen (KMU), auf die sich z.B. Bollweg et al. (2016) beziehen und daraus ihre Hypothesen ableiten, oder das Adoptionsmodell nach Rogers (1962), auf das sich z.B. die Untersuchung von Delpy/Neiberger (2019) begründet.

Eine andere Theorie, die ein explizites Gegengewicht zum neoklassischen Marktmodell darstellt und auch schon im Einzelhandelskontext angewendet wurde, ist die evolutionär-ökonomische Marktphasentheorie nach Heuss (1965). Deren Grundüberlegung ist, dass es vier verschiedene Unternehmer/-innentypen gibt, die sich primär im Hinblick auf ihren Gestaltungswillen und ihre Risikobereitschaft unterscheiden (siehe Abb. 1). An der „Spitze“ stehen *Pionierunternehmer/-innen*, die stets ein persönliches Interesse daran haben, ihr (Wettbewerbs-)Umfeld aktiv zu gestalten, Wegbereiter in Bezug auf neue Entwicklungen (Produkt- und Prozessinnovationen) zu sein und hierbei auch bereit sind, große unternehmerische Risiken einzugehen. Die spontan *imitierenden* Unternehmer/-innen vollbringen selber keine „Pionierleistungen“, sind aber in der Lage, die Pioniere gut nachzuahmen. Die *reagierenden* Unternehmer/-innen entsprechen am ehesten dem klassischen Marktmodell; dieser Typ handelt einzig und allein aufgrund des registrierten äußeren Wettbewerbsdrucks. Die vierte Gruppe der *immobilen* Unternehmer/-innen reagiert nicht einmal auf Marktentwicklungen, sondern beharrt in jeder Hinsicht auf dem bisherigen Geschäftsmodell.

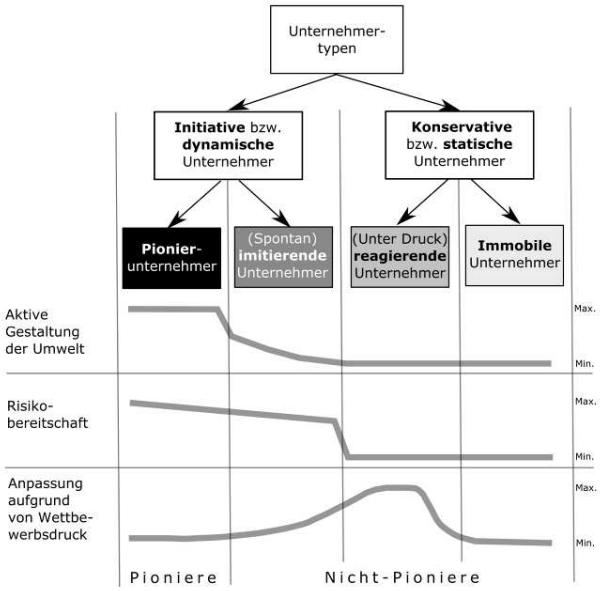

Abb. 1: Unternehmertypen in der Marktphasentheorie (eigene Darstellung in Anlehnung an Heuss 1965 und Körner/Proff 1998)

Die Marktphasentheorie ist bereits im Kontext der dynamischen Standorttheorie des Einzelhandels für die Erklärung der Diffusion von Betriebsformen angewendet worden (Lange, 1973); eine Übertragung auf Vertriebskanäle erscheint daher prinzipiell angebracht. Im vorliegenden Fall wurde dementsprechend davon ausgegangen, dass die Adoption des Onlinehandels auch vom Unternehmer/-innentyp beeinflusst wird bzw. dass insbesondere Pioniere und Imitatoren eher den Einstieg in den Onlinevertrieb vollziehen als reagierende und insbesondere immobilie Unternehmer/-innen; letztere müssten der Logik der Marktphasentheorie nach sogar vollständige „Onlineverweigerer“ sein. Jedoch existieren für diesen Zweck keine empirischen Erkenntnisse und/oder Itemkataloge, die als Vorlagen für die eigene Operationalisierung dieser Konstrukte

bzw. die Datenerfassung hätten zu Grunde gelegt werden können. Weiterhin erscheint es kaum möglich, die genannten Typen kategorisch zu identifizieren; vielmehr ist von einem Kontinuum auszugehen, dessen Pole (uneingeschränkter „Pionier“ vs. vollig „immobil“) in der Realität kaum anzutreffen sind.

Daher wurden für die vorliegende Befragung fünf Items formuliert, die die wichtigsten von Heuss (1965) genannten Eigenschaften dieser Unternehmer/-innentypen erfassen sollen (z.B. Risikobereitschaft, Bewusstsein über den eigenen Gestaltungsspielraum und dessen Ausschöpfung). Die Items sind in Form von Aussagen verfasst, wobei die befragten Geschäftsinhaber/-innen ihre persönliche Zustimmung auf einer fünfstufigen Likert-Skala („trifft nicht zu“: -2; „trifft voll zu“: 2) angeben konnten (siehe Tab. 2).

Aussage		Gewichtung g_j
S1	„Ich habe keinen eigenen Gestaltungsspielraum, sondern muss mich den Markt- und Wettbewerbsbedingungen anpassen“	-1
S2	„Ich möchte neue technische Möglichkeiten im Vertrieb am liebsten als allererster ausprobieren“	+1
S3	„Ich bin bereit, Risiken einzugehen, um neue technische Möglichkeiten im Vertrieb einzuführen, mit denen noch nicht viele Erfahrungswerte vorliegen“	+1
S4	„Ich folge meinen Konkurrenten nach, wenn sie neue technische Möglichkeiten im Vertrieb eingeführt haben“	+1
S5	„Ich möchte mich den Markt- und Wettbewerbsbedingungen nicht anpassen“	-1

Tabelle 2: Aussagen-Items zur Identifikation der Unternehmer/-innentypen und deren Gewichtung.

Die Aussagen S2 bis S4 stellen in der genannten Theorie wichtige Eigenschaften von initiativen Unternehmer/-innen (Pioniere oder zumindest Imitatoren) dar. Die Aussagen S1 und S5, die auf konservative bzw. immobile Unternehmer/-innen schließen lassen, wurden dementsprechend umgekehrt codiert, so dass die Summe aller Ausprägungen der fünf Items einen Score-Wert PS_j (-10;10) ergibt, der umso höher ist, je mehr die befragte Person von Geschäft *j* (Geschäftsinhaber/-in) einem „Pionier“ entspricht:

$$PS_j = \sum_{1}^{5} g_j \, S_j$$

Aus den o.g. Annahmen resultiert die diesbezügliche Hypothese: *Je stärker die Eigenschaft, ein/e Pionierunternehmer/-in zu sein, ausgeprägt ist, desto eher entscheiden sich Geschäftsinhaber/-innen zum Einstieg in den Onlinehandel als zusätzlichen Vertriebsweg*.

3.2 Ein Modell der Adoption des Onlinehandels als Vertriebskanal

Zur mikroökonometrischen Analyse der Entscheidung von Geschäftsinhaber/-innen, zusätzlich im Onlinevertrieb aktiv zu sein, wird ein binäres Logit-Modell verwendet (Die Darstellung der Modellstruktur im Folgenden basiert auf der Formalisierung in Cameron/Triverdi, 2005). Als empirische Eingangsgröße wird hierbei die Angabe der befragten Geschäftsinhaber/-innen zu ihrem Onlinevertrieb verwendet. Im vorliegenden Fall wird dabei bestehender und geplanter Onlinevertrieb summiert, d.h. die Adoption des Onlinehandels als Vertriebskanal ist vollzogen (OH=1), wenn die eigenen Waren aktuell neben dem stationären Vertrieb auch online vertrieben werden (eigener Onlineshop und/oder Online-Plattformen) *oder* die Einführung des Onlinevertriebs innerhalb der nächsten zwölf Monate geplant ist; wenn nichts von beidem zutrifft, besteht keine Adoption des Onlinehandels als Vertriebskanal (OH=0).

Die Zielgröße eines binären Logit-Modells ist die Wahrscheinlichkeit, dass der untersuchte Zustand (hier: Onlinevertrieb des Geschäftes *j*) zutrifft (Pr(OH_j=1)):

$$p_j = Pr\left[OH_j = 1 | \boldsymbol{x}'\right] = \frac{e^{\boldsymbol{x}'\beta}}{1 + e^{\boldsymbol{x}'\beta}}$$

Als erklärende Variablen werden der Scorewert der wahrgenommenen Standortqualität (A_j), der Pionierunternehmer/-innen-Score (PS_j) und die Items der beiden Aussagen zur Konkurrenzsituation (KL_j und KO_j) geprüft. Zusätzlich werden drei Kontrollvariablen berücksichtigt, nämlich die Anzahl der Mitarbeiter/-

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innen des Betriebs (ma_j), das Alter der befragten Person (al_j) sowie eine Dummy-Variable des Geschlechts der befragten Person (DG_j, weiblich=1). Die formale Verknüpfung der Variablen ist linear:

$$\boldsymbol{x}'\beta = \beta_0 + \beta_1 A_j + \beta_2 PS_j + \beta_3 KL_j + \beta_4 KO_j + \beta_5 ma_j + \beta_6 al_j + \beta_7 DG_j$$

Zur Interpretation des binären Logit-Modells ist zu sagen, dass diese entweder anhand exponierter Koeffizienten vorgenommen werden kann (e^{β} gibt an, um wieviel höher die Chance des Onlinevertriebs ist, wenn sich x um eine Einheit erhöht) oder der lineare Einfluss der Koeffizienten auf den Logit (d.h. das logarithmierte Wahrscheinlichkeitsverhältnis) betrachtet wird:

$$\frac{p_j}{1-p_j} = e^{\boldsymbol{x}'\beta} \quad \text{bzw.} \quad \ln\frac{p_j}{1-p_j} = \boldsymbol{x}'\beta$$

Die Maximum-Likelihood-Schätzung des Modells erfolgt mittels R (R Core Team, 2019) unter Nutzung des dort implementierten Standardverfahrens (IRLS; iteratively reweighted least squares).

3.3 Untersuchungsgebiete, Datenerhebung und Stichprobe

Als Untersuchungsgebiete wurden drei Angebotsstandorte in Karlsruhe ausgewählt, die von Seiten der Stadtverwaltung in der planungsinternen Zentrenhierarchie als A-Zentrum (Innenstadt) bzw. B-Zentren (Stadtteile Durlach und Mühlburg) klassifiziert werden (Stadt Karlsruhe – Amt für Stadtentwicklung, 2017). Diese Zentrenabgrenzung erfolgt allerdings anhand statistischer Stadtteilgrenzen, weshalb es keine offizielle Definition der eigentlichen Geschäftsbereiche gibt; diese wurden auf der Ebene von Baublöcken so vorgenommen, dass verkehrsintensive Querstraßen die äußeren Grenzen bilden und die Bereiche mit einem durchgehenden Geschäftsflächenbesatz integriert sind.

Um einerseits die Relevanz des Onlinehandels an den drei Karlsruher Standorten zu erfassen und, darauf aufbauend, die Einflussfaktoren für den Einstieg in den Onlinehandel zu analysieren, wurden eine Kartierung der Geschäftsflächennutzungen und eine mündliche Befragung vorgenommen. In der Kartierung wurden 730 Geschäftsflächen erfasst (siehe Tab. 3), hiervon 357 Einzelhandelsbetriebe, die im Zuge der späteren Anbieterbefragung kontaktiert wurden. Für die Befragung wurde ein standardisierter Fragebogen verwendet, in dem die in Kap. 3.1 vorgestellten Items zur Standortqualität, zur Wahrnehmung des Konkurrenzdrucks und zur Identifikation der „Pionier"-Einstellung sowie zur Intensität des eigenen Onlinevertriebs abgefragt wurden; der letztgenannte Fragenblock ist aus der Studie von Rumscheidt (2016) abgeleitet. An der Befragung haben 212 Betriebe teilgenommen, was einer Teilnahmequote von 59,38 % entspricht.

Standort-bereich	Geschäftsflächen						Befragte Einzelhandelsbetriebe		
	Anzahl	davon [%]:					Anzahl	davon [%]:	
		Einzel-handel	EH-nahe Dienst-leistungen	Gastro-nomie, Hotels	Sonsti-ges	Leer-stand		Rechtlich selbständige Geschäfte	Filialen
Innenstadt	466	52,15	13,52	20,17	7,51	6,65	140	48,57	51,43
Durlach	119	46,22	25,21	12,61	11,76	4,2	46	54,35	45,65
Mühlburg	145	40,69	22,07	13,79	17,24	6,21	26	50,00	50,00
Gesamt	730	48,90	17,12	17,67	10,14	6,16	212	50,00	50,00

Tabelle 3: Aussagen-Items zur Identifikation der Unternehmer/-innentypen und deren Gewichtung

4 ERGEBNISSE

4.1 Teilergebnisse: Standortqualität, Wettbewerbsdruck und Unternehmer/-innentyp

4.1.1 Wahrnehmung der Standortfaktoren und subjektive Standortqualität

Die Ergebnisse des Befragungsteils zur Standortqualität werden hier für alle befragten Einzelhandelsbetriebe (rechtlich selbständige Geschäfte und Filialen) und alle Gesprächspartner/-innen (Geschäftsinhaber/-innen und leitende Angestellte) dargestellt, um insbesondere die branchen- und standortspezifischen Unterschiede aufzuzeigen. Eine detaillierte Diskussion dieser Teilergebnisse ist hier nicht möglich, allerdings zeigt die Bewertung der Relevanz von Standortfaktoren (Abb. 2, links) zunächst ein zwischen den Branchen ähnliches

Muster: Typische Standortfaktoren, die sich auf das Einzugsgebiet und die Kundenerreichbarkeit beziehen, werden im Mittel als wichtig bzw. sehr wichtig eingeordnet. Unterschiede ergeben sich bei der räumlichen Nähe zu Anbietern derselben Branche: Insbesondere Branchen aus dem Bereich der Erfahrungsgüter bzw. des kurzfristigen Bedarfs (z.B. Apotheken) ordnen die Konkurrenznähe eher als geschäftsmindernd ein, während in eher „shopping-affinen" Branchen eben diese Agglomerationstendenz geschäftsfördernd wirkt.

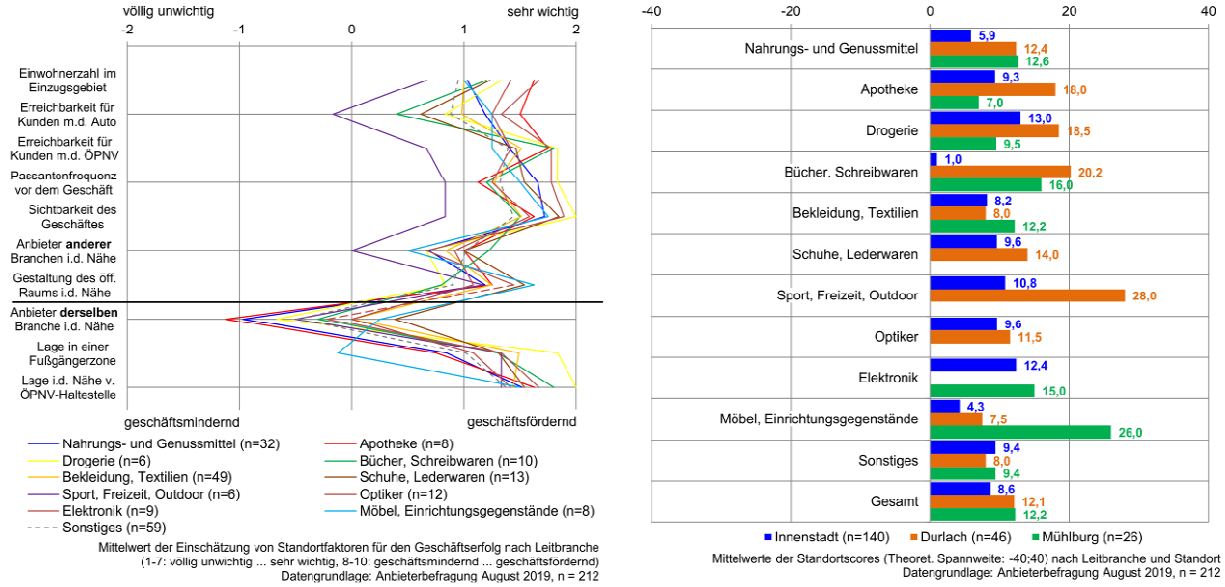

Abb. 2: Einschätzung der Standortfaktoren (links) und Standortscores (rechts) nach Branche.

Die Standortscores (Abb. 2, rechts) zeigen deutliche Bewertungsunterschiede zwischen Standorten und Branchen auf, wobei höhere Scores tendenziell in Branchen des mittel- und langfristigen Bedarfs erreicht werden. Auffällig sind die vergleichsweise ungünstigen Beurteilungen in der subjektiv empfundenen Standortqualität in der Innenstadt, die gleichzeitig den größten und relevantesten Angebotsstandort (A-Zentrum) darstellt. Dies ist jedoch auf die hohe Gewichtung von PKW- und ÖPNV-Erreichbarkeiten zurückzuführen: Der größte Teil des als „Innenstadt" definierten Gebietes ist eine Fußgängerzone, was die PKW-Erreichbarkeit naturgemäß einschränkt; auch die ÖPNV-Erreichbarkeit und die Passantenfrequenz sind – zumindest in der Zeit vor und während der Erhebung – durch umfangreiche Baumaßnahmen im Kontext der „Kombilösung" (Weiterentwicklung des Straßenbahnnetzes und Bau einer U-Bahn) geprägt.

4.1.2 Einstellungs-Items: Wahrnehmung des Wettbewerbsdrucks, Pionierunternehmer-Scores

Die branchenspezifische Einschätzung des Wettbewerbsdrucks und die Pionier-Scores sind in Abb. 3 dargestellt, wobei hier nur Geschäftsinhaber/-innen rechtlich selbständiger Betriebe (n = 67) berücksichtigt werden. Hierbei muss ferner auf die eingeschränkte Aussagekraft einiger Teilangaben hingewiesen werden, da in manchen Branchen nur eine oder wenige Geschäftsinhaber/-innen befragt wurden. Auffällig ist die Tendenz, den Konkurrenzdruck durch den lokalen Einzelhandel als eher gering einzuschätzen (Abb. 3, links). Die Wahrnehmung des Wettbewerbsdrucks durch den Onlinehandel ist dagegen unterschiedlich stark ausgeprägt, wobei die z.T. geringen Fallzahlen auch hier eine Interpretation schwierig gestalten.

Ein ähnliches Problem besteht hinsichtlich der branchenspezifischen Pionier-Scores (Abb. 3, rechts), wobei sich hier etwas anderes zeigt: Ausgehend von einer theoretischen Spannweite zwischen -10 und 10 Punkten ergeben sich relativ geringe Absolutwerte der Scores, wobei der theoretische Maximalwert nur einmal und der theoretische Minimalwert gar nicht erreicht wird ($\bar{x} \approx 0{,}851$; $s \approx 3{,}192$; $x_{min} = -5$; $x_{max} = 10$); die Scores von vier Fünfteln (79,1 %) der Gewerbetreibenden bewegen sich innerhalb von einer Standardabweichung. Dies weist zumindest auf eine Bestätigung der Annahme hin, dass eine eindeutige Kategorisierung schwierig ist und sich die ISEH-Inhaber/-innen i.d.R. auf einem Kontinuum der „Pionier"-Skala bewegen.

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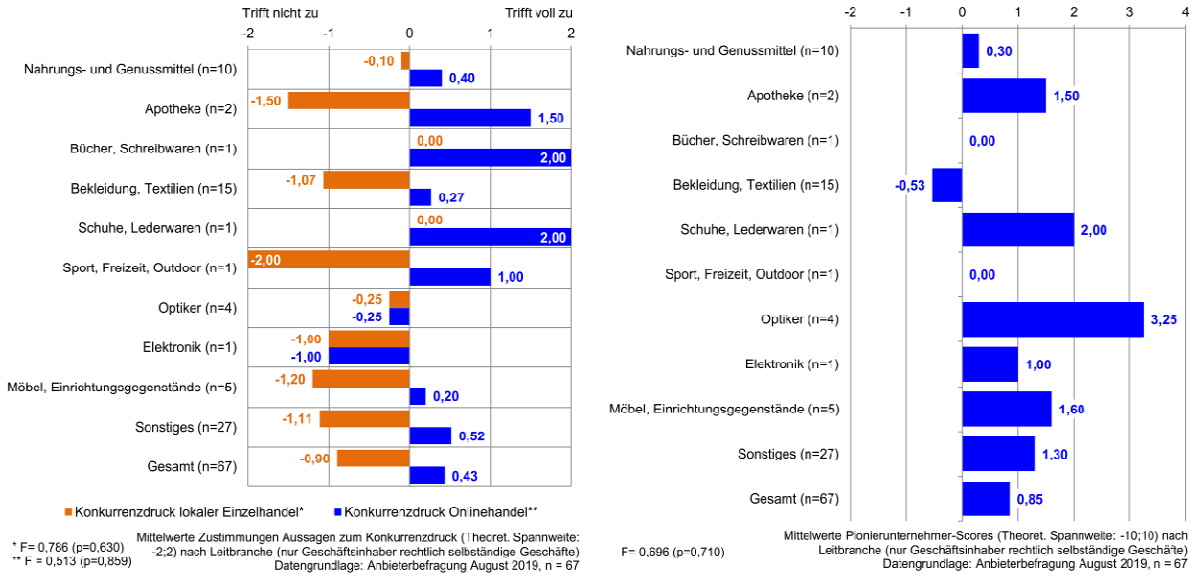

Abb. 3: Einschätzung des Wettbewerbsdrucks (links) und Pionier-Scores (rechts), jeweils nach Branche.

4.2 Online-Vertriebsaktivitäten der Einzelhandelsbetriebe an den Karlsruher Standorten

Ausgehend von allen Befragten (*n* = 212) sind 44,3 % der Einzelhandelsbetriebe auf zumindest einem Kanal (Online-Plattform oder eigener Onlineshop) im digitalen Vertrieb aktiv. Erwartungsgemäß bestehen aber große Unterschiede zwischen den Organisationsformen: Während die Filialen (*n* = 106) zu 63,2 % zu Unternehmen gehören, die ihre Waren auch online vertreiben, trifft dies nur auf 25,5 % der ISEH-Betriebe (*n* = 106) zu. Insgesamt nutzen 8,5 % der befragten Einzelhändler/-innen sowohl einen eigenen Onlineshop als auch Online-Verkaufsplattformen (siehe Abb. 4, links). Ein Vergleich mit bestehenden Ergebnissen ist nur eingeschränkt möglich, da dort nicht zwischen Filial- und eigenständigen Unternehmen differenziert wird; allerdings liegt der Anteil der Online-Nutzer in der selben Größenordnung wie in der Befragung von Rumscheidt (2016) (37 %). Unterschiede in der Vertriebsaktivität finden sich zwischen den Standorten: Der Anteil von Einzelhandelsbetrieben mit Onlinevertrieb ist in der Innenstadt am höchsten, was allerdings wiederum mit dem dortigen höheren Filialisierungsgrad (51,4 %) zusammenhängt (siehe Abb. 4, rechts).

Weiterhin abgefragt wurde die Nutzung von verschiedenen Optionen, die entweder einen Einstieg in den Onlinevertrieb begünstigen (z.B. eigene Homepage, Eintrag in sozialem Netzwerk) oder erst ermöglichen (z.B. software-gestütztes Warenwirtschaftssystem) oder zumindest damit in Verbindung stehen (z.B. Nutzung von location based services, Kunden-WLAN). Hier verwundert es in Anbetracht der Ergebnisse zum Onlinevertrieb nicht, dass die dementsprechenden Angebote bei Filialbetrieben deutlich häufiger vorzufinden sind als im ISEH (siehe Abb. 5, links). Besonders interessant ist die Nutzung eines softwaregestützten Warenwirtschaftssystemens (WWS), das faktisch eine Grundvoraussetzung für den Betrieb eines Onlineshops darstellt (z.B. um die Verfügbarkeit eines Produktes bzw. die verfügbaren Mengen automatisch anzeigen zu lassen): Dass im Großteil der befragten Filialbetriebe ein solches verwendet wird (82,4 %), ist wenig erstaunlich und zeigt den Unterschied in der Professionalisierung zwischen Filialisten und ISEH (43,3 %) auf.

Werden nur die Geschäfte mit zusätzlichem Onlinevertrieb (*n* = 94) betrachtet (Abb. 5, rechts), zeigt sich, dass deren Onlineauftritt überwiegend die typischen Aspekte der Informationsvermittlung beinhaltet: Neben dem Preis der angebotenen Produkte, dessen Anzeige der Regelfall ist, werden fast ebenso häufig weitere Produktinformationen dargeboten. Bei sehr dringlichen Käufen ist die Information über die aktuelle Verfügbarkeit des spezifischen Produktes im Laden für die Kundenentscheidung wichtig; diese Information bieten etwa zwei Drittel der Onlineshops. Im Hinblick auf die unterschiedlich ausgestalteten Kauf- und Rückgabeoptionen ist der einfache Online-Versand, bei dem keine Vertriebskanäle verbunden werden, der Regelfall; aber auch die Click-and-collect-Option wird von etwa drei Vierteln aller Anbieter ermöglicht. Auffällig ist, dass bezüglich der Servicefunktion des Onlineshops i.d.R. keine nennenswerten bzw. statistisch signifikanten Unterschiede zwischen Filialbetrieben und ISEH-Betrieben bestehen.

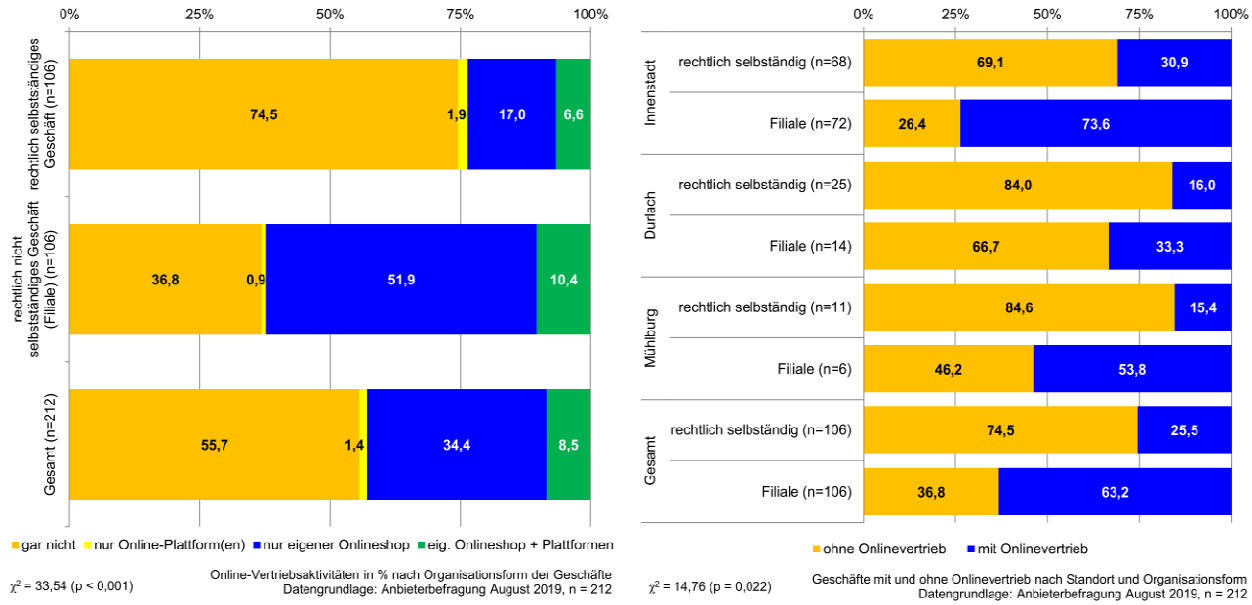

Abb. 4: Online-Vertriebsaktivitäten nach Organisationsform (links) und Standort (rechts) der Geschäfte.

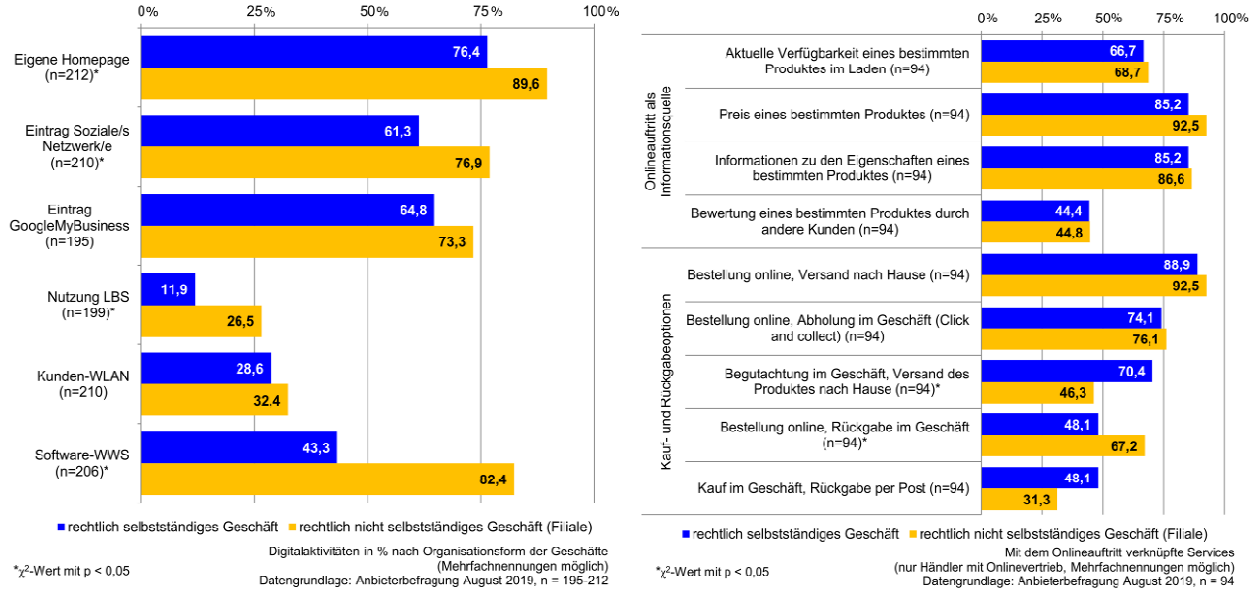

Abb. 5: Online-bezogene Angebote aller Geschäfte (links) und Online-Services der Händler mit Onlinevertrieb (rechts).

4.3 Modellergebnisse

Tabelle 4 zeigt die Ergebnisse des in Kap. 3.2 vorgestellten Logit-Modells zum aktuellen oder geplanten „zweiten Standbein“ im Onlinehandel. Zunächst fällt auf, dass die erste Modellvariable, der subjektive Standort-Score (A_j), zwar ein der Hypothese entsprechendes Vorzeichen aufweist, aber keinen signifikanten Einfluss auf die Entscheidung zum Einstieg in den Onlinehandel hat. Dies ist bei einer (in der Tabelle nicht dargestellten) Irrtumswahrscheinlichkeit von $p \approx 0{,}77$ auch kaum der geringen Größe der Fallzahl ($n = 67$) zuzuschreiben, sondern weist darauf hin, dass, zumindest im vorliegenden Fall, als ungünstig empfundene Standortbedingungen nicht durch den Ausbau der eigenen Vertriebswege kompensiert werden. Von den beiden Hypothesen zum wahrgenommenen Konkurrenzdruck wird nur die Wirkung des Onlinehandels als Wettbewerbstreiber (KO_j) bestätigt: Je mehr der Aussage, dass der Onlinehandel einen starken Konkurrenzdruck ausübt, zugestimmt wird, desto eher entscheiden sich Gewerbetreibende im ISEH für den zusätzlichen Onlinevertrieb. Der wahrgenommene Konkurrenzdruck durch den lokalen, stationären Einzelhandel (KL_j), der ohnehin nicht stark ausgeprägt ist (siehe Kap. 4.1.2), hat keine signifikante Wirkung.

Einen signifikanten und der Hypothese entsprechenden Einfluss auf die Adoption des Onlinehandels hat offensichtlich der Unternehmer/-innentyp: Je höher der hier entwickelte Pionierunternehmer/-innen-Score, desto höher die Wahrscheinlichkeit, dass Gewerbetreibende einen zum stationären Vertrieb zusätzlichen

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Onlinevertrieb aufbauen. Interessant ist vor diesem Hintergrund, dass die inkludierten Kontrollvariablen keine signifikanten Einflüsse aufweisen. Es wäre z.B. zu erwarten gewesen, dass mit der Betriebsgröße (Mitarbeiterzahl) auch die Wahrscheinlichkeit eines Online-Einstiegs steigt, da dieser Einstieg mit Kosten verbunden ist, die ein umso größeres Betriebsrisiko darstellen, je kleiner das Unternehmen ist ist.

Unabhängige Variablen:	Abhängige Variable: Onlinevertrieb aktuell/geplant (1=ja, 0=nein)	
	Koeffizienten (Std.-fehler)	Exp. Koeffizienten
Subjektive Standortbewertung (A_j)	-0,012 (0,041)	0,988
Pionier-Score (PS_j)	0,282** (0,129)	1,325
Bewertung Konkurrenzdruck Lokaler Handel (KL_j)	-0,522 (0,333)	0,593
Bewertung Konkurrenzdruck Onlinehandel (KO_j)	0,484* (0,263)	1,623
Anzahl Mitarbeiter/-innen (ma_j)	0,030 (0,041)	1,030
Alter Geschäftsinhaber/-in (al_j)	0,011 (0,039)	1,011
Geschlecht Geschäftsinhaber/-in (1=w) (DG_j)	0,475 (0,707)	1,609
Konstante	-3,140 (2,041)	0,043
Anzahl Beobachtungen	64	
Log-Likelihood	-28,506	
AIC	73,012	
		*p < 0,1; **p < 0,05; ***p < 0,01

Tabelle 4: Modellergebnisse Adoption des Onlinehandels als zusätzlicher Vertriebskanal.

Bei der Interpretation ist weiterhin zu bedenken, dass die Fallzahl, die, bezogen auf die Größe der Untersuchungsstandorte und die hohe Teilnahmequote, zwar vergleichsweise groß ausfällt, dieser Umstand jedoch für die statistische Signifikanzprüfung keine Rolle spielt. Hier kann nur eine größer angelegte Befragung (z.B. in mehreren Untersuchungsstädten) diesbezügliche Abhilfe schaffen.

5 SCHLUSSFOLGERUNGEN

Die häufig angeführte Verschmelzung zwischen stationärem und Onlinehandel bestätigt sich im Wesentlichen auch in der Innenstadt und den zwei größten Stadtteilzentren Karlsruhes. Allerdings besteht eine große Diskrepanz zwischen Filialunternehmen und ISEH-Betrieben, wobei sich auch in dieser Untersuchung zeigt, dass der überwiegende Teil dieser Geschäfte bisher nicht online aktiv sind. Offensichtlich ist der Ausbau der eigenen Vertriebswege stark von der Unternehmer/-innenpersönlichkeit abhängig. Zwar ist die technische Möglichkeit eines Onlinevertriebs nicht “neu” – die ersten Onlineshops eröffneten in den 1990er Jahren –, jedoch ist insbesondere für ISEH-Inhaber/-innen eine Offenheit den “neuen” Vertriebswegen gegenüber und eine – nicht zuletzt finanzielle – Risikobereitschaft notwendig, um in den Multi-/Cross-Channel-Vertrieb einzusteigen. Zu dieser Innovation sind “Pioniere” eher bereit als reagierende bzw. immobile Gewerbetreibende. Weiterhin ist ein Bewusstsein für den Konkurrenzdruck durch den Onlinehandel – der nahezu alle Branchen betrifft – maßgeblich für die Adoptionsentscheidung.

Verschiedene Programme der deutschen Städtebauförderung zielen explizit auf die Förderung von lokalen Handelsbetrieben ab, um bestehende Innenstädte und/oder Stadtteilzentren zu stärken (z.B. innerhalb der Förderprogramme “Soziale Stadt” und insbesondere “Aktive Stadt- und Ortsteilzentren”) (Jakubowski/Koch, 2009). Verschiedene daraus finanzierte Einzelmaßnahmen beinhalten z.B. die Aufwertung des öffentlichen Raumes, Gebäudesanierungen oder Investitionsbeihilfen für Gewerbetreibende. Diese Förderkulisse wird seit 2020 in veränderter Form weitergeführt (Bundesministerium des Innern, für Bau und Heimat, 2019). Alle

diese Maßnahmen fokussieren letztendlich die Verbesserung der Standortqualität. Wenn aber davon ausgegangen wird, dass die Schaffung eines Onlinevertriebs, die Click-and-collect-Option oder die Präsenz in location based services für bisher rein stationär agierende Betriebe tendenziell förderlich ist, lässt dies den Schluss zu, dass eine Förderung des lokalen stationären Einzelhandels (auch) darin bestehen sollte, sowohl das Bewusstsein für den Online-Vertriebskanal als auch die Online-Kompetenz bei kleinen und mittelständischen Gewerbetreibenden zu stärken. Im Umkehrschluss bedeutet dies nämlich, dass, wenn nicht zumindest eine Anpassung an den zeitgemäßen "Marktstandard" erfolgt, viele inhabergeführte Geschäfte – insbesondere in "gewachsenen" Standorträumen wie Innenstädten oder Stadtteilzentren – keine Zukunftsperspektive mehr besitzen – unabhängig von der *baulichen* Entwicklung dieser Standorte.

Einen Hinweis in diese Richtung gibt etwa die Förderinitiative „Mittelstand 4.0 – Kompetenzzentrum Handel", in der die Kompetenzentwicklung insbesondere von kleinen und mittelständischen stationären Händlern hinsichtlich der Digitalisierung im Fokus steht (HDE, 2020). Denkbar sind weiterhin derartige Angebote im Rahmen des Citymanagements/Citymarketings, sofern hierfür Mittel und Personal zur Verfügung stehen. Natürlich hängt der Erfolg solcher Maßnahmen stets von der Akzeptanz seitens der Zielpersonen – ISEH-Unternehmer/-innen – ab, denn ein Förderprogramm kann kaum eine Veränderung der Persönlichkeit von Unternehmer/-innen herbeiführen.

6 FÖRDERUNGSHINWEIS UND DANKSAGUNG

Das Forschungsprojekt „Zur Raumwirksamkeit des Onlinehandels" (Antragsteller: Dr. Thomas Wieland) wird durch die Deutsche Forschungsgemeinschaft (DFG) gefördert (Projektnummer 402130768). Der DFG sei für die finanzielle Förderung des Projekts gedankt. Die Datenerhebungen zu diesem Beitrag entstanden im Projektseminar „Einkaufen zwischen City und Smartphone – Braucht der Handel die Städte noch?" am KIT, Institut für Geographie und Geoökologie (Seminarleitung: Prof. Dr. Caroline Kramer, Angelika Hoppe, unter Mitwirkung von Dr. Thomas Wieland). Den Teilnehmerinnen und Teilnehmern sei für ihre aktive und konstruktive Mitarbeit gedankt.

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STEMPICOM – Geodatenkonzept für gemeinschaftsbasierte Lieferdienste in ländlichen Regionen

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1 ABSTRACT

Die strukturellen Probleme in ländlichen Räumen sind hinreichend beschrieben und umfassen eine Vielzahl unterschiedlicher Themenbereiche. Eines davon ist der fortdauernde Strukturwandel im lokalen Einzelhandel und seine Konsequenzen auf die Versorgung der dort lebenden Bevölkerung mit Gütern des täglichen Bedarfs. In Folge von Ladenschließungen mangels lokaler Kaufkraft, kommt es mancherorts bereits zu strukturellen Versorgungslücken, die insbesondere für die alternde und damit immobilere Bevölkerung spürbar sind. Die Wegestrecken zum nächsten Nahversorger bedeuten für die dort lebenden Bewohner ein wachsendes Zeit- und Mobilitätserfordernis.[1]

Darüber hinaus gibt es kaum Kenntnisse darüber, ob das veränderte (digitale) Konsumverhalten und der daraus folgende, immer populärer werdende Onlinehandel, diese Entwicklungen in ländlichen Regionen eher verschärfen oder potenziell entgegenwirken können. Logistisch betrachtet, wird die spezielle Situation des ländlichen Raums besonders an der sogenannten „letzten Meile“ deutlich. Das durch den Onlinehandel entstehende Paketaufkommen wird größtenteils von Kurier-Express-Paket-(KEP)-Dienstleistern abgewickelt, die den Transport und die Wegestrecken der Waren vom Händler oder Distributionslager bis zur Haustür jedes Kunden übernehmen. Das letzte Wegestück der Transportkette ist in der Regel das teuerste, da die Zahl der verschiedenen Ablieferungsorte, zu denen immer kleinere Warenmengen geliefert werden, wächst.[2] Auch aus einer Zukunftsstudie (2016) vom Fraunhofer IML geht hervor, dass ein zunehmender Zeit- und Kostendruck auf der letzten Meile entsteht. Im ländlichen Raum ist dies vor allem in der Überwindung großer Distanzen sowie unterdurchschnittlich wachsenden Gütermengen begründet.[3]

Dennoch bestehen, laut Fraunhofer Institut IML, große Chancen für Einzelhandelsversorger im ländlichen Raum durch die Potenziale einer digitalen Vernetzung.[4] Gerade neue und innovative Zustellkonzepte, zu denen beispielsweise eigeninitiative oder gemeinschaftsbasierte Lieferdienste, wie das Projekt „Digitale Dörfer“ des Fraunhofer IESE zählen,[5] können sich einerseits positiv auf das Wachstum bzw. das Bestehen der regionalen Erzeuger, andererseits auf eine Verbesserung der Nahversorgungssituation der Bewohner ländlicher Gebiete auswirken.[6] Analysiert man die genannten Logistikprozesse etwas detaillierter, lassen sich im Wesentlichen drei relevante Akteursgruppen identifizieren: Nachfrager, Lieferanten und Anbieter.

Der Forschungsschwerpunkt ‚nextPlace‘ der Technischen Hochschule Ostwestfalen-Lippe untersuchte im Rahmen einer vom Bundesministerium für Verkehr und digitale Infrastruktur (BMVI) geförderten mFUND1-Vorstudie das Zusammenwirken dieser Akteursgruppen und deren technische Optimierungsmöglichkeiten in Form geodatenbasierter Konzepte und qualitativer, raumplanerischer Umfragen. Die Online-Befragung der Akteursgruppen stellt aktuell nur eine Stichprobe dar und ist bislang nicht repräsentativ. Aber aus den ersten Rückläufen zeichnet sich ab, dass auf Seiten der Nachfrager besonders in Klein- und großen Mittelstädten tendenziell ein hohes Maß an Offenheit gegenüber einem gemeinschaftsbasierten Dienst besteht. Allerdings ist den demographischen Merkmalen zu entnehmen, dass die Nachfrage insgesamt mit steigendem Alter abnimmt. Aus technologischer Perspektive ergaben die Experteninterviews mit bestehenden Lebensmittel-Lieferservices, dass außer einer üblichen Smartphone-

[1] Vgl. Kuhlicke; Petschow (2005): Vom schleichenden Ende der Nahversorgung.
[2] Vgl. Wegner; Wegner (2017): Einführung in das Logistik-Management, S. 266.
[3] Vgl. Fraunhofer IML (2016): Zukunftsstudie 2016.
[4] Vgl. Willinger und Wojtech (2018): Digitalisierung im ländlichen Raum: Status Quo u. Chancen für Gemeinden, S. 10.
[5] Vgl. Wegner (2019): Potenziale der Digitalisierung für die letzte Meile in der Logistik, S. 289.
[6] Vgl. Willinger und Wojtech (2018): Digitalisierung im ländlichen Raum: Status Quo u. Chancen für Gemeinden, S. 10.

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Navigation, aktuell kein spezieller Routing-Algorithmus und folglich bislang auch keine Echtzeitdaten zum Einsatz kommen.

Im Ergebnis lässt dies darauf schließen, dass Erfolg und Akzeptanz eines digitalen, gemeinschaftsbasierten Dienstes sehr stark von der Optimierung einzelner, konkreter Probleme und deren ausführlicher Erläuterung abhängt und nicht unbedingt automatisch von einer „Digital ist besser"-Disruption ausgegangen werden kann. Für das nun zu beantragende mFUND-Hauptprojekt hat dies zur Folge, dass, neben einer noch stärkeren Zielgruppenausrichtung, insbesondere auch das individuelle Mobilitätsverhalten jeder Nutzergruppe und die unterschiedlichen Abhängigkeiten ihrer einzelner Wegeketten zu berücksichtigen sind.

Keywords: Logistik, Ländliche Räume, Geodateninfrastrukturen, Gemeinschaftsdienste, Routing

2 RAUM-ZEITLICHE BETRACHTUNGEN

2.1 Die letzte Meile im ländlichen Raum

Die letzte Meile ist nur ein Teilaspekt der gesamten Lieferkette. Der KEP-Dienstleister startet von seiner regionalen Zustellbasis mit dem Auftrag Pakete auf einer bestimmten Route auszufahren. Leider kommt es häufig vor, dass der Empfänger das Paket nicht entgegennehmen kann, was eine weitere Handlung des Zustellers nötig macht. Er kann das Paket bei einem Nachbarn abgeben, sofern dort jemand erreichbar ist. Er könnte das Paket in einer Packstation überbringen und der Empfänger holt das Paket dann selbst ab. Hierzu ist zu sagen, dass die nächste Packstation von einem Bewohner im ländlichen Raum durchaus sehr weit weg sein kann. Eine weitere Möglichkeit wäre ein erneuter Zustellungsversuch am nächsten Tag, der eine Mitnahme der Ware zufolge hat.

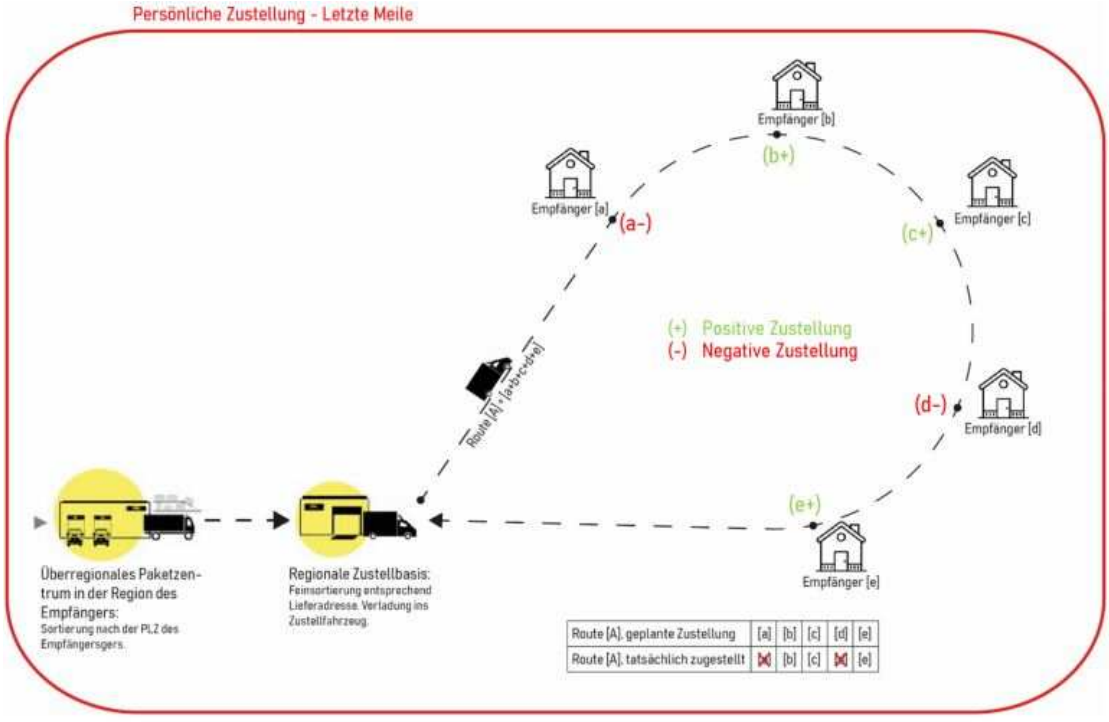

Abbildung1: Persönliche Zustellung auf der letzten Meile

Durch die Darstellung in Abbildung1 wird deutlich, wie viele Auslieferungsoptionen mit einem Liefervorgang einhergehen. Dafür wird der Auslieferungsvorgang auf den Maßstab eines Gebäudes skaliert. Die Paketzustellung erfolgt ausschließlich innerhalb des Gebäudes. In diesem Beispiel hat der Dienstleister bei nur zwei Paketen in einem Haus eine Vielzahl von Auslieferungsmöglichkeiten. Die zufällige und freiwillige Annahme und Weiterleitung einer Sendung durch den Nachbarn ist für den Dienstleister und Logistiker ein nicht berechenbarer und auch nicht kalkulierbarer Faktor. Es ist also festzustellen, dass der Prozess der Paketzustellung mit einem Aufwand verbunden ist, der zeitlich nicht planbar ist.

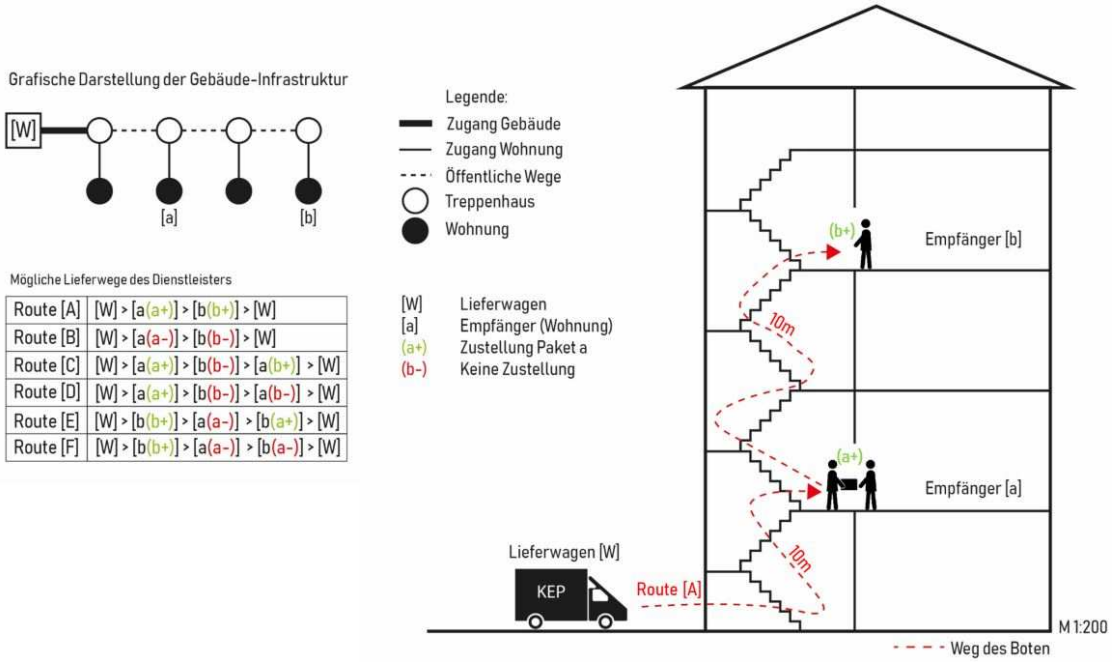

Abbildung 2: Paketzustellung

Im Vergleich wird schnell klar, dass die Paketzustellung bei einer Skalierung des Liefergebietes vom Gebäude auf ein Dorf, das aus mehreren Gebäuden besteht, ein deutlich höherer Zeitaufwand für den KEP-Dienstleister bedeutet. Ein Zurückfahren zu einem vorherigen Empfänger erzeugt gleichzeitig einen sehr hohen Zeit- und Streckenaufwand. Die alternative Auslieferung an einen Nachbarn, der in diesem Beispiel in über vier Kilometer Entfernung wohnt, ist somit keine realistische Option für die erfolgreiche wirtschaftliche Zustellung. Multiple Anfahrten lassen sich bei einem Nicht-Antreffen des Kunden also nicht vermeiden.

Eine wesentliche Problematik der letzten Meile in der Logistik ist somit das Match zwischen Lieferanten und Besteller. Zahlen belegen, dass ein Großteil aller Pakete nicht beim ersten Versuch zugestellt werden können: „Von den ca. 7,5 Mio. B2C-Paketen pro Tag können gerade einmal 60 % im ersten Versuch zugestellt werden.“[7] Das bedeutet, dass für 40 % der Pakete ein zusätzlicher Transport zum Nachbarn (30 %) oder in einen Paketshop bzw. eine Paketstation (10 %) erforderlich ist.[8] Die heutige logistische Infrastruktur ist nicht mehr in der Lage, diese Herausforderungen, insbesondere unter der Prognose einer Verdopplung der Pakete im B2C-Bereich innerhalb der nächsten sieben Jahre, zu bewältigen.[9] Folglich sind Lösungen gefordert, um einerseits die Logistik zu bewältigen, andererseits den ländlichen Raum lebenswert zu erhalten, sodass eine Nahversorgung für die Bewohner weiterhin möglich ist.

Letzte-Meile-Lösungen, die sich auf organisatorische Konzepte beziehen, können laut Wegner in zwei Ansätze unterteilt werden: Das Holprinzip und das Bringprinzip. Während Letzteres eine Zustellung an der Haustür fokussiert, werden für Lösungen, die dem Holprinzip zugeordnet werden, alternative Zustellorte genutzt, sodass der Kunde seine Ware am jeweiligen Standort selbst abholt (z.B. Boxensystem, Personalisierte Übergabestellen).[10] Die Idee eines gemeinschaftsbasierten Lieferdienstes, der auf dem Bringprinzip beruht, wurde bereits in verschiedenen Regionen umgesetzt. In der Literatur wird diese besondere Art des Lieferdienstes auch dem Konzept des Crowdshippings oder der Crowd-Logistik zugeordnet. Das Prinzip beruht auf Privatpersonen, die über freie Kapazitäten verfügen und für andere Personen den nachgefragten Transport von Waren übernehmen. Über eine Online-Plattform werden die Kunden bzw. ihre Bestellung und der Zusteller miteinander vernetzt.[11]

[7] SESAM (2019): Pakete in Mehrfamilienhäusern - Das Weißbuch für Wohnungsbaugesellschaften, S. 9.
[8] Vgl. ebd.
[9] Vgl. ebd.
[10] Vgl. Wegner (2019): Potenziale der Digitalisierung für die letzte Meile in der Logistik, S. 288.
[11] Vgl. Rai et al. (2017): Crowd logistics: an opportunity for more sustainable urban freight transport, S. 2.

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2.2 Raumwiderstand

Die beiden nachfolgenden Punkte wurden bereits als die wesentlichen Probleme der letzten Meile im ländlichen Raum identifiziert:

- Zeit/Wege (Überbrückung großer Distanzen)
- Zustellung (Persönliche Übergabe der Ware)

Eine Lösung für diese Probleme liegt nicht allein im Ausbau der Kapazitäten von KEP-Dienstleistern, da diese bereits an ihre Grenzen kommen. Vielmehr muss die Daseinsvorsorge in ländlichen Räumen als gesamtgesellschaftliche Aufgabe verstanden und bewerkstelligt werden. Demnach bezieht sich der Fokus dieser Arbeit auf die Organisation von raum/zeitlichen Matches bei der Belieferung durch gemeinschaftsbasierte Dienste zwischen Nahversorgern und Nachfragern.

Das logistische Problem der großen Distanzen im ländlichen Raum kann auch als Raumwiderstand bezeichnet werden. Ein Attribut, das zwar erfasst werden kann, aber sich physikalisch nicht verändern lässt. Was hier verändert werden kann, ist die Möglichkeit die Wege effektiver abzufahren. Es besteht ein großes Potenzial durch die Kapazitäten im Personen-Individualverkehr. Eine Vielzahl von Personen ist zum Selbstzweck unterwegs obwohl in ihren Fahrzeugen noch Kapazitäten (für Waren oder Mitfahrer) frei wären. Das Einbinden dieser Fahrzeuge, die ohnehin unterwegs sind, in gemeinschaftliche Bedarfe erzeugt eine Lösung, wie eine Warenauslieferung trotz Raumwidertand erfolgen kann.

Bei der Zustellung auf der letzten Meile ist die zeitliche Komponente am schwierigsten zu koordinieren. Bei traditionellen Lieferdiensten ist der Nachfrager abhängig von der Lieferroute und der damit im Zusammenhang stehenden Zustellzeit durch den Lieferanten (die er in den meisten Fällen nicht weiß). Für eine erfolgreiche Zustellung zwischen Lieferanten und Nachfragern, müsste sich der Lieferant zukünftig an den Tagesrhythmus des Kunden orientieren, wenn er eine erfolgreiche und gleichzeitig wirtschaftliche Auslieferung anstrebt.

2.3 Übergabepunkte

Das spätere Ziel des Projektes ist die Entwicklung eines Softwarekonzeptes, welches interoperable, räumliche Datenmodelle erzeugt und Abfrageverfahren für zukünftige Microservices in metropolfernen Räumen möglich macht. Diese Software-as-a-Service Dienstleistung soll gemeinschaftsbasierten Lieferdiensten in der Optimierung derer Prozessabläufe dienen, um somit Lieferungen effizienter zu gestalten. Um größere Distanzen oder auch Warenlieferungen auf Teilstrecken der Gesamtlieferstrecke zu ermöglichen, gilt es relevante Übergabepunkte im Straßennetz zu identifizieren, welche als Lagerstandorte dienen könnten. Ein Ort also, an dem sich häufig genutzte Wege überlagern, kreuzen oder trennen.“[12] Dieser Punkt, im Folgenden „Bruchpunkt“ genannt, ist somit immer an Kreuzungen vorzufinden, wo im Vergleich zu umliegenden Kreuzungen, von einem maximalen Verkehrsaufkommen gesprochen werden kann. Dies ermöglicht, auch Warenmitnahme auf Teilstrecken zu realisieren.

Im Rahmen dieser Vorstudie und der darin integrierten Bachelorthesis wurde ein graphentheoretischer Algorithmus entwickelt, der aus einem OpenStreetMap-basierten Straßennetz und amtlichen Pendlerdaten am Beispiel des Regierungsbezirks Detmold derartige Kreuzungspunkte ausgibt. Auf Basis einer relationalen Datenbankstruktur des OSM-Straßennetzes wurden mittels verschiedener Python-Skripte zunächst die Kanten, Knoten und Stützpunkte des Graphennetzes extrahiert und später ein A*-Algorithmus als euklidische Routing-Funktion implementiert. Zur Ermittlung der Bruchpunkte läuft das Python-Skript nachfolgende Schritte ab:

- Ermittlung aller kürzesten Wege w im betrachtenden Gebiet G aus einer Liste mit Start- und Zielpunkten R
- Gewichtung aller kürzesten Wege mit Pendlerdaten P
- Übertragung der Gewichtung der Wege auf alle Kanten e jedes Weges w
- Summierung der Gewichtung jeder Kante e

[12] Vgl. Pöttker (2019): Konzeption eines Algorithmus zur Identifikation von Bruchpunkten in nutzungsgewichteten Straßengraphen, S.1.

- Übertragung der Gewichtung auf Startknoten u und Zielknoten v jeder Kante e
- Summierung der Gewichtung jedes Knoten v
- Prüfe in der Liste der gewichteten Kanten E, ob es für die Gewichtung des Zielknotens v einer Kante e eine Änderung im Vergleich zum Startknoten u gibt
- Wenn Änderung vorhanden -> Bruchpunkt!

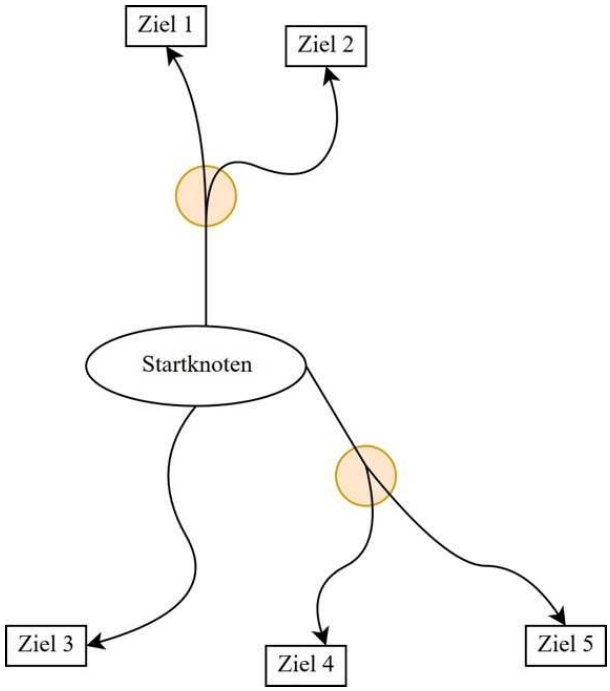

Abbildung 3: Schematische Darstellung des graphentheoretischen Routing-Algorithmus

Mittels einfacher GIS-Abfragen wurden die Bruchpunkte zur Standortüberprüfung gefiltert und in die Kategorien innerorts und außerorts eingeteilt. Da nur Bruchpunkte von Interesse sind, die sich nicht in Reichweite eines Supermarktes befnden, wurden die in den OSM-Daten enthaltenen POIs nach dem Tag shop = supermarket selektiert und mit einem 1km Radius geclipt. Weiterhin wurden die Bruchpunkte anhand des Tags residential = landuse und einem 50km-Puffer in innerorts und außerorts eingeteilt. Neben diesen ersten, einfachen, exemplarischen Abfragen können zukünftig noch eine Reihe weiterer Standortüberprüfungen vorgenommen werden, um die Eignung als Lagerstandort geauer zu klassifizieren.

Um die vorgestellten Skripte zur Identifizierung der Bruchpunkte im Rahmen eines Realisierungsprojekts sinnvoll zu nutzen, müssen Daten zur Straßennutzung zukünftig in einem kleineren Maßstab für die entsprechenden Gebiete vorliegen. Diese Daten könnten durch Umfragen oder bereits vorhandene Nutzungsprofile generiert werden. Weiterhin müssen die Gewichtungen der Kanten des Straßengraphes detaillierter angepasst werden. Es müssen weitere Faktoren, wie vor allem die Verkehrsdichte in Abhängigkeit von Uhrzeit und Wochentag, mit erfasst oder aus weiteren Datenquellen hinzugezogen werden, um die zeiteffizientesten Wege in Abhängigkeit dieser Werte zu ermitteln. Diese Bruchpunkte sollten weiterhin aggregiert werden, um Dopplungen und Überlagerungen auszuschließen. Standortanalysen können sowohl mit den vorhandenen, frei verfügbaren Informationen aus den OpenStreetMap-Daten als auch mit Daten aus den amtlichen Katastern durchgeführt werden.

Prinzipiell sind zwei verschiedene Möglichkeiten des Einbindens der Übergabepunkte in die Auslieferungsszenarien denkbar. Zum einen wäre es vorstellbar, dass eine Warenbestellung von einem KEP-Dienstleister bis zu einem Übergabepunkt geliefert wird und im weiteren Prozess von einem Fahrtendienstleister aus der Gemeinschaft zur angeforderten Zeit zum Zielort geliefert wird. Dabei wird die letzte Meile-Logistik vom KEP-Dienstleister auf die Gemeinschaft übertragen. Zum anderen wäre es möglich, dass die Übergabepunkte für Teilstrecken des Gesamtlieferweges von der Gemeinschaft selbst verwendet werden können. Dadurch kann das Potenzial eines Fahrtendienstleisters genutzt werden, dessen Strecke sich mit dem Gesamtlieferweg in Teilen überschneidet. Befindet er sich in der Nähe eines Nahversorgers, bei dem eine Bestellung vorliegt, so könnte er das Paket bis zu einem Übergabepunkt

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transportieren, welcher dem eigentlichen Zielort am nächsten ist. Der restliche Lieferweg erfolgt dann durch einen weiteren Fahrtendienstleister aus der Gemeinschaft. Folgende Vorteile sind hier zu erwähnen:

- Überregionale Geschäfte könnten in die Prozesskette integriert werden.
- Größere Distanzen im ländlichen Raum können überbrückt werden.

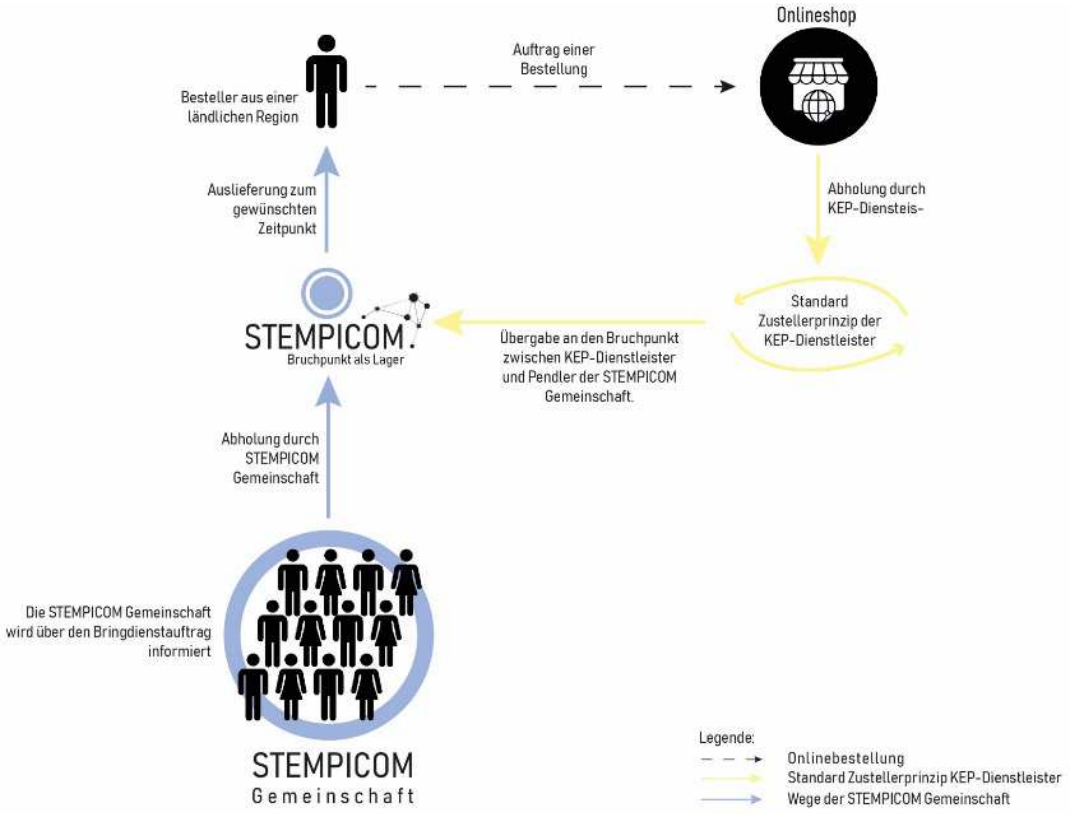

Abbildung 4: Zustellung über einen Übergabepunkt als Lagerstandort

2.4 Softwarearchitektur

Im folgenden Abschnitt wird das Konzept der technischen Infrastruktur für die Umsetzung von STEMPICOM beschrieben und erläutert. Zu Beginn ist darauf hinzuweisen, dass sich die Softwarearchitektur aus mehreren orchestrierten Anwendungen zusammensetzt, um somit eine breite Palette von Abfragefunktionen zu ermöglichen. Durch diese technische Herangehensweise wird die Verwendung für diverse Webanwendungen möglich gemacht und die Interoperabilität gewährleistet. Anwendungsprogramme (a) können neben OGC-Diensten und/oder auf Apache Spark[13] zurückgreifen, um Daten in Informationen umzuwandeln. OGC-Dienste ermöglichen nur einfache Abfragen, wohingegen Spark (d) ein Programmiergerüst verwendet, welches auf Cluster Computing basiert und demnach verteilte und optimierte Abfrageoperationen auf Grund eines Rechenverbundes durchführen kann. Geomesa ermöglicht die Abfrage der im Zusammenhang stehenden räumlichen Geodaten. Der GeoServer (e) fungiert als zentrale Komponente, indem Geodaten und Analysefunktionen der untergeordneten Systeme veröffentlicht werden. Zu den untergeordneten Systemen gehören PostgreSQL[14] sowie Geomesa- Accumulo und Kafka. Das objektrelationale Datenbankmanagementsystem (ORDBMS) PostgreSQL (f) mit PostGIS[15] als räumliche Erweiterung dient zur einfachen Abfrage von Daten und ist direkt an den Geoserver angeschlossen. Geomesa (g)- Accumulo sowie Kafka erweitert den Geoserver mit der Möglichkeit auch größere und komplexere Datenmengen auszuwerten bzw. zu verarbeiten. Accumulo (h) ist ein verteiltes System zum Speichern und Abfragen von Schlüssel-Werte-Datenbanken.[16] Kafka (i) ist eine verteilte Streaming Platform und dient

[13] Apache Spark ist ein Entwicklungsframework welches ein Programmiergerüst für das Cluster Computing bietet, um Rechenkapazitäten sowie die Verfügbarkeit bei Abfrageoperationen zu erhöhen.
[14] PostgreSQL ist ein objektrelationales Datenbankmanagementsystem.
[15] PostGIS ist eine Erweiterung für PostgreSQL und dient mit geografischen Objekten und Funktionen.
[16] Schlüssel-Werte-Datenbank (Key Value Database) dient zur elektronischen Datenverwaltung in Computersystemen und basiert auf dem Schlüssel-Werte-Datenmodell, um assoziative Datenfelder zu speichern.

insbesondere der Speicherung sowie Verarbeitung von Datenströmen und stellt eine Schnittstelle zum laden und exportieren von Datenströmen zu Drittsystemen bereit.

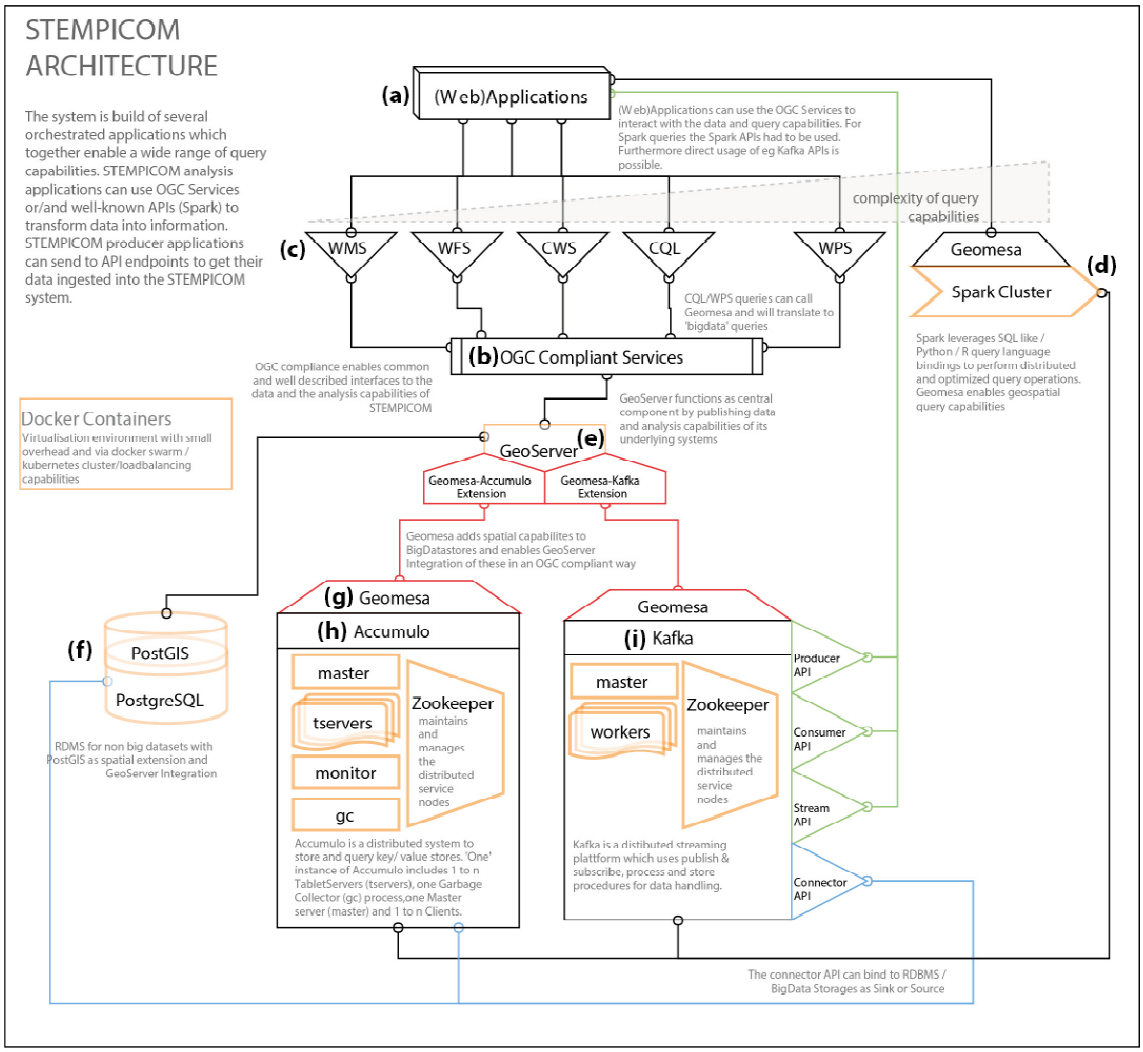

Abbildung 5: STEMPICOM – Softwarearchitektur

Über die vorgestellten Schnittstellen kann ein möglicher STEMPICOM Dienst somit zukünftigen Community-Services zur Verfügung gestellt werden, um die eigene Service-Dienstleistung möglichst effizient umsetzen und anbieten zu können. Um das STEMPICOM Routing zu ermöglichen, werden Daten von Standorten, Livedaten von Autobewegungen und zeitliche Angaben benötigt. Hinsichtlich des Aufbaus der Datentabellen wird hier zwischen den eingangs erwähnten Akteuren unterschieden. Neben einer möglichen Einbettung öffentlicher (z.B. mCLOUD) und/oder zusätzlicher proprietärer Daten sind die wichtigsten Daten prinzipiell die, welche von den Akteuren bei der Verwendung selbst eingegeben und erzeugt werden.

3 QUALITATIVE UNTERSUCHUNGEN ZUR AKTEURSSTRUKTUR

Um herauszufinden, welche Bevölkerungsgruppen einen gemeinschaftlich organisierten Lieferdienst nutzen würden und unter welchen Bedingungen dies möglich wäre, wurde im Rahmen des Arbeitspakets Marktforschung eine Online-Umfrage durchgeführt. Der Abruflink war über einen Zeitraum von 25 Tagen frei zugänglich (12.09.-06.10.2019). Weitergeleitet wurde er zum einen über verschiedene Emailverteiler der Technischen Hochschule Ostwestfalen-Lippe, sowie über Emailverteiler der Projektpartner. Des Weiteren konnten einige Teilnehmer über die Verbreitung des Umfragelinks auf sozialen Netzwerken erreicht werden. Die durch die Umfrage generierte Stichprobe umfasst 170 Personen, davon haben 145 Personen alle Fragen vollständig beantwortet. Im Folgenden wird zunächst auf die allgemeinen Ergebnisse, die sich auf die gesamte Stichprobe beziehen, eingegangen. Danach folgt die differenzierte Auswertung für die Gruppe der potenziellen Nachfrager, sowie die Gruppe der potenziellen Fahrtendienstleister.

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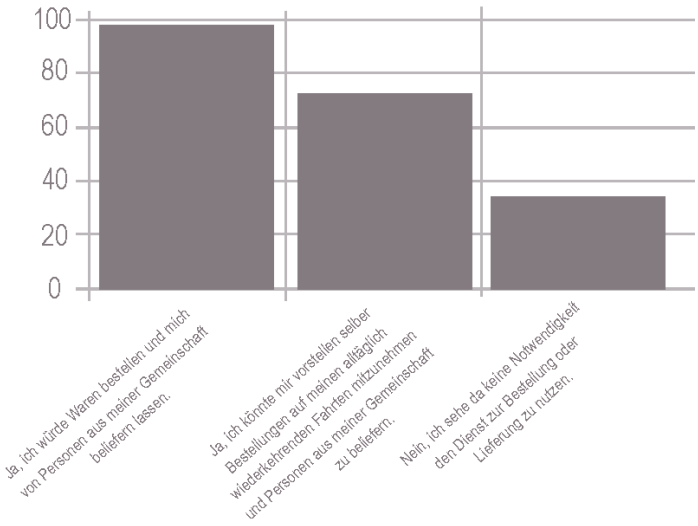

Abbildung 5: Antwortverteilung (Mehrfachnennung möglich) auf Basis der Grafiken des LimeSurvey-Tools (2019): Statistiken – einfacher Modus, unter: https://survey.nextplacelab.org/index.php/admin/authentication/sa/login (abgerufen am 09.10.2019).

Bei der Frage „Könnten Sie sich vorstellen einen gemeinschaftsbasierten Lieferdienst zu nutzen, wenn die für Sie relevanten Einzelhändler eine Online-Bestellmöglichkeit anbieten würden?“, bei der ebenfalls eine Mehrfachauswahl möglich war, fällt auf, dass die meisten Teilnehmer (rund 100 Personen) Waren bestellen und sich von Personen aus der eigenen Gemeinschaft beliefern lassen würden. Etwas weniger Personen (ungefähr 70), die an der Umfrage teilgenommen haben, können sich vorstellen, Bestellungen auf den eigenen alltäglich wiederkehrenden Fahrten mitzunehmen und entsprechend abzuliefern. Für rund 40 Teilnehmer kommt eine Nutzung des Dienstes nicht in Frage. Die Bereitschaft einen gemeinschaftlich organisierten Lieferdienst als Nachfrager zu nutzen, ist deutlich höher, als die Option den Dienst als Fahrtendienstleister in Anspruch zu nehmen. Von 145 befragten Personen, stimmten 66,90 % (97 Personen) der Aussage „Ja, ich würde Waren bestellen und mich von Personen aus meiner Gemeinschaft beliefern lassen“ zu. Dadurch wird das Potenzial eines solchen Dienstes, als zusätzliche Option zu den bisherigen Einkaufsmöglichkeiten, Waren online zu bestellen und sie per Lieferung zu erhalten, deutlich. Zudem bringt die Quote zum Ausdruck, dass über die Hälfte der Personen bereit ist, sich auf etwas Neues einzulassen und es auszuprobieren. Somit besteht eine grundsätzliche Offenheit der Mehrheit der Befragten gegenüber einem solchen Dienst.

In Bezug auf die räumliche Kategorie der Wohnorte der Befragten kombiniert mit der sozialen Nähe (vgl. Abbildung 6) ist auffällig, dass die Bereitschaft der Nutzung als Nachfrager bei Bewohnern von Kleinstädten mit 87,50 % am höchsten ist. Es folgt der Anteil der Bewohner von großen Mittelstädten mit 80,56 % aller befragten. Am geringsten ist der Bedarf in kleinen Mittelstädten, hier zeigen lediglich 53,33 % Interesse. Interessant ist das Ergebnis für die Kategorie Landstadt und Großstadt. Die Ergebnisse fallen mit einem Anteil von 62,50 % (Landstadt) und 63,79 % (Großstadt) sehr ähnlich aus.

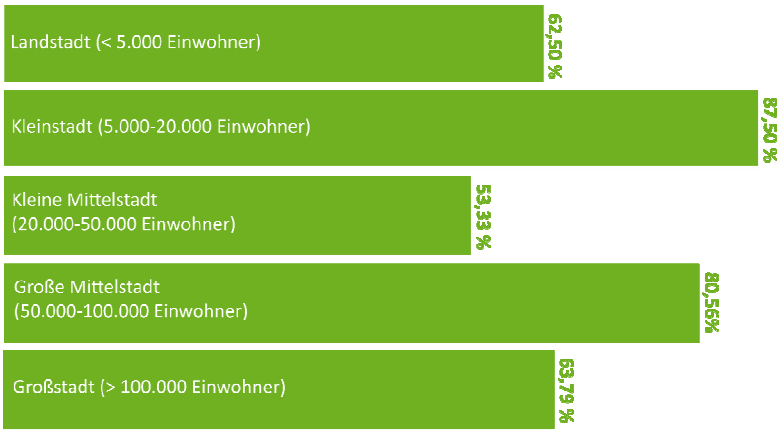

Abbildung 6: Prozentualer Anteil der potenziellen Nachfrager nach Raumkategorien

Befragungen zur sozialen Nähe machen deutlich, dass die Akzeptanz des Nachfragers zur Beanspruchung eines Fahrtendienstleister mit der persönlichen Bekanntschaft zusammenhängt. So würden sich 90,72 % der Personen, die den Lieferdienst als Nachfrager nutzen würden, von Bekannten oder Freunden beliefern lassen. Personen, die durch Freizeitaktivitäten bekannt sind, wie beispielsweise eine Vereinsgemeinschaft, kommen für 79,38 % in Frage. Deutlich geringer ist der Anteil bei Personen, die lediglich in derselben Gemeinde leben: 65,98 % stimmen einer Belieferung durch diese Personengruppe zu. Geht es um die Belieferung durch fremde Personen, so ist der Anteil mit 34,02 % von allen Kategorien am geringsten. Von einer persönlichen Warenannahme sehen 27,84 % der Befragten ab, da sie die Ware gerne an einem Schließfach abholen würden.

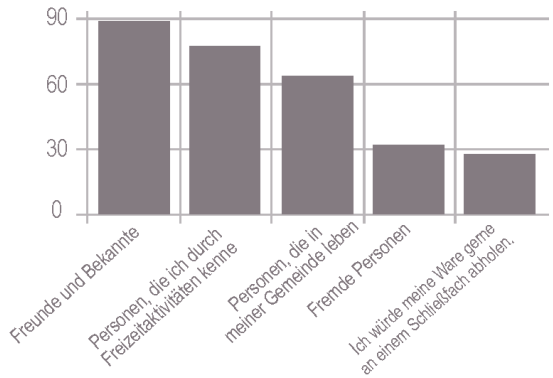

Abbildung 7: „Welche Personengruppe kommt für Sie persönlich als Lieferant in Frage, wenn Sie eine Lieferung erwarten?“

Die Angabe des Alters der Befragten ermöglicht es, hinsichtlich potenzieller Nachfrager Aussagen zu demographischen Unterschieden zu generieren. Während in der ersten Altersgruppe (20-35 Jahre) 71,76 % angeben, dass sie den Dienst als Nachfrager nutzen würden, sinkt der Anteil mit zunehmendem Alter der Befragten. In der zweiten Altersgruppe (36-50 Jahre) liegt der Anteil bei insgesamt 68,00 %, wohingegen er in der dritten Altersgruppe (51-65) mit 60,00 % nochmal geringer ist. Die letzte Altersgruppe (66-80 Jahre) bildet mit 50,00 % die anteilig schwächste Nutzergruppe als Nachfrager.

Aus Perspektive der Lieferanten wurde ermittelt, welche persönliche Nähe zu den Nachfragern, die die Ware bestellen und entgegennehmen, von den Fahrtendienstleistern gewünscht ist. Für die deutliche Mehrheit aller Personen (70,83 %) ist es egal, welche Person sie beliefern. Als Kriterium wurde vorausgesetzt, dass der zeitliche Aufwand für den Fahrtendienstleister angemessen ist. Lediglich 30,56 % der Befragten geben an, dass sie ausschließlich Personen aus dem persönlichen Umfeld beliefern würden.

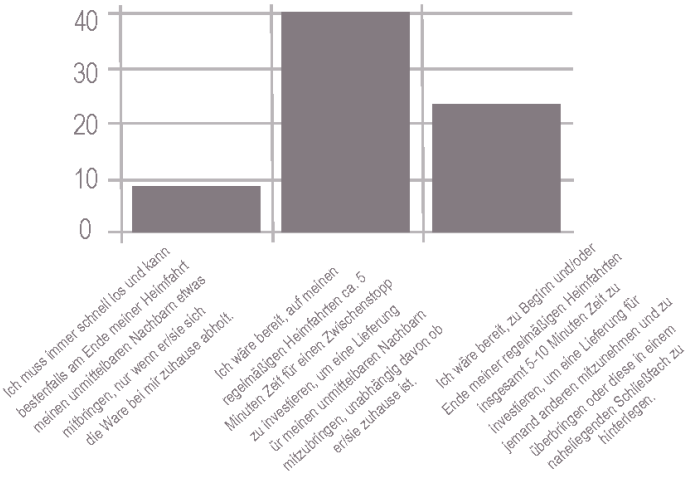

Abbildung 8: Bereitschaft zum zeitlichen Mehraufwand (Mehrfachnennung möglich)

Im Rahmen der Onlineumfrage wurden die potenziellen Fahrtendienstleister ebenfalls nach ihrem möglichen Zeitkontingent für die Lieferung befragt. Über die Hälfte aller Befragten (55,56 %) gibt an, dass ein Umweg von fünf Minuten ihrem möglichen Zeitaufwand entspricht. Die größtmögliche Zeitinvestition, die bei insgesamt fünf bis zehn Minuten liegt und zu Beginn und bzw. oder der Heimfahrt getätigt wird, kommt für

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31,94 % aller potenziellen Fahrtendienstleister in Frage. Die Antwort, die mit dem geringsten zeitlichen Aufwand verbunden ist und eine Abholung der Ware durch den Nachbarn vorsieht, wird lediglich von 11,11 % gewählt. Entsprechend positiv sind die vorherigen Ergebnisse zu werten, aus denen hervorgeht, dass ein zeitlicher Mehraufwand der Möglichkeit die Waren nur zu fahren, sie aber nicht auszuliefern, für den überwiegenden Teil aller Befragten annehmbar ist.

4 CONCLUSION

Das Projekt STEMPICOM stellt ein Vorkonzept dar, wie eine raum-zeitliche Intelligenz für einen gemeinschaftsbasierte Lieferdienst nutzbringend umgesetzt werden kann. Es wurden die potenziellen Akteure identifiziert und Probleme der traditionellen Routing- und Zustellprozesse analysiert. Auf Basis dieser Ergebnisse wurde die Umsetzung eines neuen Routing- und Zustellkonzepts entwickelt. Das in diesem Projekt vorgestellte Routing-Konzept könnte im Wesentlichen als eine Programmerweiterung für sogenannte letzte Meile Apps verwendet werden. Zur prototypischen Umsetzung dieser Geodateninfrastruktur wird aktuell eine Antragstellung für die zweite Phase der mFUND-Förderlinie in Erwägung gezogen. Darüber hinaus erarbeitet der Forschungsschwerpunkt nextPlace eine Projektskizze im Rahmen der BMVI-Förderrichtlinie „Städtische Logistik“ in Kooperation mit dem Fraunhofer Institut IOSB-INA, Lemgo und dem Fraunhofer Innovationslabor „LemgoDigital“ zur Implementierung des Routings in eine städtische Liefer-Infrastruktur. Aus den bisherigen Voruntersuchungen wurde deutlich, dass sich gerade in ländlichen Räumen digitale, app-basierte Geschäftsmodelle nicht in gleicher Selbstverständlichkeit umsetzen lassen, wie man es ggf. aus Metropolräumen gewohnt ist. Vielmehr spielen alltägliche, raum-zeitliche Rahmenbedingungen eine wesentliche Rolle, die es bei der technologischen Entwicklung und unternehmerischen Vermarktung zu berücksichtigen gilt.

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Straße der Zukunft

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1 ABSTRACT

Urbane Straßen erfüllen neben der bedeutsamen und offensichtlichen verkehrstechnischen Verbindungs- und Erschließungsfunktion weitere wichtige Funktionen für die Stadt: Sie sind Wirtschaftsraum, soziokultureller Aktionsraum und ökologischer Puffer für den Temperatur-, Wasser- und Schadstoffhaushalt. Aufgrund dieser vielfältigen Bedeutung wirken sich aktuelle Trends und Entwicklungen in den unterschiedlichen Bereichen maßgeblich auf den Straßenraum aus und fordern neue Konzepte hinsichtlich Planung, Umsetzung und Instandhaltung. Wie die Entwicklung von zukunftsfähigen Straßen mit Blick auf gegebene Herausforderungen gestaltet werden kann und wie dabei Technologieinnovationen Eingang finden können, wird im Rahmen des BMBF-geförderten Projekts „Straße der Zukunft“ durch die beiden Fraunhofer-Institute IAO und IGB gemeinsam mit dem Praxispartner Drees & Sommer Infra Consult und den Kommunen Ludwigsburg und Erlangen erforscht. Im Projekt werden zwei Musterstraßen in den Partnerkommunen baulich umgesetzt. Dabei fließen wissenschaftliche Erkenntnisse aus dem Projekt in den Prozess ein, um vor Ort den Einsatz innovativer Lösungen zu erproben.

In diesem Beitrag wird zunächst ein Überblick über die Entwicklung und Bedeutung der vielschichtigen Dimensionen der Straße gegeben. Neben einer historischen Einordnung werden dafür die Funktionen beleuchtet, die Straßen im Stadtgefüge erfüllen sowie aktuelle Trends diskutiert, die auf die Straße der Zukunft einwirken. Abschließend werden zwei im Forschungsprojekt erarbeitete Extremszenarien für den Straßenraum 2030 „Highway of Data“ und „Grüne Lunge“ vorgestellt und ein Ausblick für deren Integration gegeben. Das übergeordnete Forschungsinteresse für den weiteren Projektverlauf ist es zu verstehen wie Digitalisierung und Nachhaltigkeit in einer gemeinsamen Planungsperspektive integriert werden können.

Keywords: Raumplanung, Straßenplanung, Ressourceneffizienz, Digitalisierung, Szenario

2 EINLEITUNG

Dieses einleitende Kapitel widmet sich den Fragen: Wie hat sich der Straßenbau historisch entwickelt? Welche unterschiedlichen Funktionen vereint der Straßenraum? Welche sich abzeichnenden Trends mit Blick auf technische Innovationen, Mobilitätsverhalten und Ressourceneffizienz prägen die Zukunft der Straße und ihre Entwicklung?

2.1 Historische Innovationsphasen im Straßenbau

Über Jahrtausende waren Straßen in Form von Wasserwegen oder Landverbindungen für Menschen das bedeutendste Kommunikationsmittel. Sie dienten dem Güter- und Warenaustausch, als Heerwege oder in Form von Prozessionsstraßen auch religiösen Zwecken (Grewe 2003, Köpp 2012). Dennoch schritt ihre Entwicklung nicht kontinuierlich voran, sodass auf eine Phase des Fortschritts meist ein Bedeutungsverlust folgte.

In Mitteleuropa erfuhr der Straßenbau einen immensen Fortschritt im Zeitalter des Römischen Reichs, indem das größte Verkehrsnetz der Antike mit einer Länge von 80.000 Kilometern entstand. Die Verkehrswege dienten dazu militärischen Truppen zu verlagern sowie Nachrichten und darüber hinaus die römische Kultur, Religion, Werte, Ideologie und Lebensweisen zu verbreiten. In friedlichen Zeiten bildeten Straßen die Basis für den (über-)regionalen Handel (Andrikopoulou 2012). Die hohe Ingenieurskunst des römischen Straßenbaus verdeutlicht beispielsweise die Berücksichtigung von Entwässerung durch Quergräben, die durch Gewölbebautechnik optimierten Brücken und die Verwendung eines eigenen Betons für die oberste Fahrbahnschicht, den Opus Caementitium (Chevallier 1972, Füsser 1997, Grimm 2014). Mit dem Untergang des Römischen Reichs verfiel der Großteil des überregionalen Straßennetzes aufgrund fehlender Wartung und mangelndem straßenbaulichem Wissen. Im Mittelalter verlor es zusätzlich an Bedeutung, da Europa in zahlreiche Ländereien aufgeteilt war. Die Handelswege bestanden zu diesem Zeitpunkt vorrangig aus unbefestigten naturbelassenen Erdwegen, die abschnittsweise mit quer- und längsgelegten Hölzern

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ausgebessert wurden (Kappel 2016). Eine systematische Optimierung der Straßen mit Holz, Sand und Steinpflasterungen begann erst im 13. Jahrhundert (Szabó 2007).

Bis hin zum Spätmittelalter waren die meisten innerstädtischen Straßen gepflastert. Besserungen und Wartungen beschränkten sich auf urbane Zentren und das unmittelbare städtische Umfeld (vgl. ebd). Der qualitativ schlechte Zustand der Verkehrswege sowie die begrenzte Kapazität und Reichweite der Verkehrsmittel Fuß und Fuhrwerk hemmten das Städtewachstum zu diesem Zeitpunkt (Füsser 1997).

Mit dem Beginn der Postbeförderung im 16. und 17. Jahrhundert wuchs erneut die Wichtigkeit von überregionalen Straßenverbindungen (vgl. ebd). Auch die stabilen politischen Bedingungen im 18. Jahrhundert waren förderlich für den Straßenbau. Begünstigt durch die Gründung der französischen „École Nationale des Ponts et Chaussées“ im Jahr 1760 erarbeiteten Ingenieure aktuellere und bessere Methoden, um die Wirtschaftlichkeit und Stabilität der Straßen zu steigern. Seitdem wurde der Straßenbau in Europa wieder systematisch weiterentwickelt (Kappel 2016).

Die Entwicklung pausierte Mitte des 19. Jahrhunderts aufgrund des starken Ausbaus des Schienennetzes. Passenderweise wurde die damalige “Straße der Zukunft” auf der Pariser Weltausstellung im Jahr 1900 als rollender Fußweg erbaut, der die Besucher auf einer 3,5 km langen Strecke durch die Stadt beförderte.

Ab den 1920er Jahren veränderte sich der Straßenbau durch das Automobil zu Ungunsten des Schienenverkehrs. Mit dem steigenden motorisierten Fahrzeugbestand kristallisierten sich die Nachteile der Schotterstraßen heraus. Die oberste Schotterschicht wurde durch den von den Autos erzeugten Unterdruck aufgewirbelt und folglich erodierte das Fahrdeckenmaterial wodurch es zu einer starken Staubentwicklung kam. Die Vermischung der Schotterschicht mit dem Bindemittel Teer entstaubte die Straßen und es etablierte sich ein neuer Straßendeckentyp - der Vorläufer der gegenwärtig überwiegenden Asphaltstraßen. Seit den 1970er Jahren werden diese statt mit Teer mit aus Erdöl gewonnenem Bitumen gebunden (vgl. Grimm 2014). Der Einsatz von Beton gewann im 20. Jahrhundert vor allem beim Bau von Straßen mit starker Verkehrsbelastung, wie Autobahnen, wieder eine größere Bedeutung (vgl. ebd). Auf die Ausbreitung des Automobils reagierte die Verkehrsplanung mit breiteren Straßen und schnellerer Linienführung, um ein fließendes Vorankommen zu ermöglichen. Dafür wurden ab Mitte der 50er Jahre Straßenbahnlinien und Radwege sowie Baubestand abgerissen. Aufgrund der veränderten Prioritäten der Verkehrsplanung und der höheren Geschwindigkeit des Automobils im Vergleich zu vorherhigen Transportmitteln, dehnten sich Städte räumlich weiter aus und rückten funktional näher zusammen, da größere Distanzen nun in kürzerer Zeit zurückgelegt werden konnten.

Die Spürbarkeit der durch den Verkehr entstandenen Umweltbelastungen schärfte in den 70er Jahren das Umweltbewusstsein der Menschen. Hauptgegenstand der wachsenden Kritik an der autogerechten Stadt waren die ungenügende städtebauliche Integration der Straßenräume, die mangelhafte Rücksichtnahme auf nicht-motorisierte Bevölkerungsgruppen und soziale Aspekte im Straßenraum (Füsser 1997). Der in England veröffentlichte Buchanan-Report schlussfolgerte, den Verkehr auf Hauptachsen zu konzentrieren und aus beruhigenden Stadtquartieren möglichst zurückzuhalten. Interdisziplinäre Planungsansätze und die Bereitschaft in fachübergreifenden Expertengruppen Planungskonzepte zu erarbeiten, bildeten die Grundlage, um neue Interessen umzusetzen. Die Besinnung von der vorwiegend monofunktional-technischen Planung der Straßenräume auf interdisziplinäre Planung veranschaulicht der stattgefundene Fokuswechsel hin zu integrierten multifunktional-städtebaulichen Regelwerken (Haller & Stieger 2019).

Diese Regelwerke sollen der Funktionsvielfalt der Straße gerecht werden. Denn im Gegensatz zu Autobahnen oder Landstraßen sind Straßen in urbanen Räumen als Bestandteile jeder Stadt, in der Menschen arbeiten, leben, sich fortbewegen, Handel betreiben und interagieren alles andere als monofunktional (Ross 2018): Neben dem Transport von Menschen und Gütern dienen sie als Orte vielfältigen Nutzungs- und Funktionsmustern. Dennoch ist die Realität vieler Städte heute weiterhin dominiert von den Auswirkungen autogerechter Stadt- und Verkehrsplanung der Vergangenheit. Schließlich sind die Lebens- und Entwicklungszyklen der Straßeninfrastruktur äußerst lang. Vor dem Hintergrund von sich abzeichnenden Trends, die Anforderungen hinsichtlich erhöhter innerstädtischer Aufenthaltsqualität, Teilhabe, Digitalisierung, dem Einsatz neuer technischer Lösungen, Ressourceneffizienz und Klimawandelanpassungen stellen, steht ein neuer Entwicklungszyklus in Straßenbau und Verkehrsplanung an, der unsere heutigen Verkehrswege zukunftsfähig machen soll, indem den Funktionen neben der verkehrlichen Nutzung der Straße eine wichtigere Bedeutung zukommt.

2.2 Verkehrstechnische Funktion der Straße

Die wohl offensichtlichste Funktion des öffentlichen Straßenraums ist die Nutzung als Verkehrsweg. Die gute Erreichbarkeit verschiedener Ziele mittels eines flächendeckenden Wegenetzes (Verbindungsfunktion) mit möglichst geringem Zeitaufwand gehört dabei zu den Hauptanforderungen an eine Straße. Da diese Anforderung für alle Fortbewegungsformen gleichermaßen gilt, entstehen naturgemäß Konflikte zwischen den Straßennutzungen – sowohl hinsichtlich der Priorisierung im Straßenverkehr als auch der Flächenverteilung. Die autogerechte Stadt ist in dieser Hinsicht für den Autoverkehr optimiert und ermöglicht eine kontinuierliche schnelle Fortbewegung für den MIV. Mancherorts birgt das rasche Durchschleusen von Fahrzeugen Vorteile, weil dadurch die lokale Lärm- und Abgasbelastung für das direkte Straßenumfeld reduziert werden. Werden jedoch Ziele hinsichtlich eines nachhaltigeren Modal Split angestrebt, d.h. weniger Pkw-Verkehr, müssen die anderen Fortbewegungsformen attraktiver werden. Vorrangschaltung bei Ampeln, ebenerdige Fußgängerquerungen, ausreichende Fahrbahnbreiten beispielsweise für den zweispurigen Radverkehr, Sicherheitsvorkehrungen wie freie Sichtbeziehungen, Vorfahrt für den ÖV auf öffentlichen Straßen etc. können beispielhaft als Anreize genannt werden, die auf Bestandsstraßen meist nur auf Kosten des Autofahrens umgesetzt werden können. Auch Planungsmodelle wie „Livable Streets“, „Shared Space“ oder „Complete Streets“, welche gleichwertigen Zugang für alle Nutzer des Straßenraums fordern und versuchen gleiche Rechte herzustellen (Randelhoff 2017), stellen den lange Zeit bevorteilten Pkw-Nutzer schlechter als bisher.

Nicht zu vernachlässigen ist bei der Diskussion der verkehrstechnischen Funktion der Straße der ruhende Verkehr. Seine Bedeutung liegt in der Erreichbarkeit von Zielen im Sinne der Erschließungsfunktion. Gleichzeitig bilden Parkflächen eine wichtige Ressource zur Neugestaltung des Straßenraums, denn in vielen Städten werden Fahrradwege, neue Aufenthaltsbereiche oder Lieferzonen nur aufgrund der Flächenreduktion der Kfz-Stellplätze möglich. Dies birgt großes Konfliktpotenzial, wie die öffentliche Diskussion um die temporär in Stuttgart installierten Parklets im Rahmen des Reallabors für nachhaltige Mobilitätskultur zeigte (RNM 2018). Doch eine modernisierte Flächenverteilung verspricht Vorteile wie eine positivere Gesamtwahrnehmung des Straßenraums (Umweltbundesamt 2017), eine menschenorientierte Flächennutzung (Braun et al. 2019, Acatech 2018), die bessere Berücksichtigung von Barrierefreiheit, eine Verbesserung von Nachbarschaftsverhältnissen (Sauter & Hüttenmoser 2006) und einen nachhaltigeren Modal Split. Schließlich sind Menschen motiviert zu Fuß zu gehen, wenn sie ein attraktives Umfeld mit kurzen und direkten Wegen, breiten Gehflächen und guten Querungsmöglichkeiten vorfinden (Verkehrsclub Österreich 2015). Ergänzend wird seit geraumer Zeit die 3D-Mobilität diskutiert, d.h. die Verlagerung des Verkehrs in die vertikale Dimension, um der knappen Ressource Raum in urbanen Regionen gerecht zu werden. Vernetzte, automatisierte und elektrische Fluggeräte stehen dabei zentral in der Forschung und Entwicklung. Die Anwendungsfelder sind vielfältig und reichen von persönlichen Flugautos über On-Demand-Flugtaxis und Krankentransporte bis hin zu Pannenservice, Müllentsorgung, landwirtschaftlicher Überwachung und Instandhaltung großflächiger Anlagen wie Solarparks aus der Luft (Werner et al. 2019).

Im weiteren Sinne umfasst diese Funktion der Straße auch den Austausch von Daten und Informationen, Messungen von Luftwerten oder die Bereitstellung von Verkehrsinformationen und die Kommunikation von Infrastruktur Verkehrsträgern. Daher ist die Straße der Zukunft auch von absehbaren Trends in diesen benachbarten Feldern tangiert.

Eine Balance zwischen den Mobilitätsbedürfnissen der Individuen und den gesamtgesellschaftlichen Zielen zu finden, stellt die zuvor genannten Anforderungen an den Straßenraum hinsichtlich einer hohen Fahrgeschwindigkeit, der Direktheit der Wege und der Erreichbarkeit von Zielen in ein neues Licht. Dies fordert kommunale Strategien hinsichtlich der Flächenverteilung und Priorisierung – nicht nur mit Bezug zu unterschiedlichen Fortbewegungsarten im Straßenverkehr, sondern auch zu den anderen Funktionen der Straße und ihren Bedarfen – bei gleichzeitiger Berücksichtigung der individuellen lokalen Gegebenheiten.

2.3 Wirtschaftliche Funktion der Straße

Wie in der Einleitung skizziert besitzen Straßen seit jeher ebenfalls wirtschaftliche Funktionen. Dabei handelt es sich vorrangig um die Erreichbarkeit von Zielen. Die wirtschaftliche Funktion der Straße kann in vier Bereiche unterteilt werden: Erstens sind Straßen Transitraum, d.h. Güter und Waren werden auf ihnen von A nach B transportiert. Dabei ist ein fließender Verkehr zentral für die Wirtschaft. Regelmäßig errechnet

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INRIX die wirtschaftlichen Einbußen durch im Stau festsitzende Waren und bieten beeindruckende Zahlen (INRIX 2016).

Zweitens dienen Straßen und Zuwege der Anlieferung bzw. Abholung von Gütern. Be- und Entladeflächen v.a. für größere Fahrzeuge und regelmäßige Lieferungen müssen je nach Standort zur Verfügung gestellt werden und Kommunen definieren Regeln für die Belieferung, um Lärmbelästigung und Barrieren für andere Nutzungen durch Lkw und Transporter zu vermeiden. Während derartige Flächen an Wirtschaftsstandorten meist Berücksichtigung finden, werden neue Logistikkonzepte für Paket- und Warenzustellungen zunehmend auch für Wohngebiete benötigt – ausschlaggebend ist der wachsende Online-Handel. Mit Blick auf die Ressourcenschonung, der eine Dematerialisierung, also die merkliche Reduktion von Stoffströmen, zugrunde liegt (FutureManagementGroup AG 2016), sollen urbane Güterströme zukünftig restrukturiert werden. Die Entlastung der Städte soll mithilfe von Logistik-Hubs in Außenbereichen, gebündelten Auslieferungen und einem Anbieter als Zusteller auf der letzten Meile (Acatech 2018), autonomen Lieferfahrzeugen, hauseigene Packstationen in Wohngebäuden, Kofferraumlieferung und Drohnenanlieferung erreicht werden (Heß & Polst 2017).

Drittens nutzen die Menschen Straßen, um einerseits ihren Arbeitsplatz zu erreichen und dadurch wirtschaftlich aktiv zu werden, und andererseits, um Geschäfte und Dienstleistungsanbieter zu erreichen. Viertens werden Straßenflächen unmittelbar als Wirtschaftsraum genutzt, beispielsweise gastronomische Außenbereiche von Restaurants. Insbesondere die beiden zuletzt genannten Aspekte bauen eine Brücke zur soziokulturellen Funktion der Straße. Anschauliche Beispiele bieten zum einen die Terrasse eines Cafés als sozialer Aufenthaltsraum in welchem Menschen sitzen und das Treiben auf der Straße beobachten und zum anderen die sozialen Interaktionen auf einem Wochenmarkt. Soziokulturelle und wirtschaftliche Funktionen des Straßenraums sind damit eng verzweigt und dienen einander. So stimulierte die Flächenkonversation einer Autostraße in San Franscisco zu Fußgänger- und Fahrradnutzung die Verkäufe des ansässigen Einzelhandels um 60% (National Complete Streets Coalition, o.J.).

2.4 Soziokulturelle Funktion der Straße

Kaum ein Raum ist so handlungsreich und heterogen wie die Straße. Als öffentlicher Raum ist sie für jeden zugänglich und wird somit auf vielfältige Weise beeinflusst und mitgestaltet. Sie ist kultureller Aktionsraum in dem komplexe, teilweise konfliktreiche Raumaushandlungs- und Aneignungsprozesse stattfinden. Die Straße kann zudem als Bildungs- und Lernraum verstanden werden, da vielerlei Tätigkeiten der Menschen auf der Straße vollzogen und beobachtet werden können. Als die minimale Form des sozialen Austauschs auf der Straße kann wohl der Sichtkontakt mit einem Fremden im Vorbeigehen genannt werden. Sich aus dem Weg zu gehen, um einen Zusammenstoß zu vermeiden, ist ein Beispiel für einen alltäglichen Aushandlungsprozess. Auch die Kommunikation mithilfe von Gesten im Straßenverkehr ist eine Art der sozialen Interaktion. So wird bspw. mittels Handbewegung signalisiert, wenn Vorfahrt gewährt wird. Auch durch Lichtzeichen oder die Betägigung von Hupe und Fahrradklingel kann die Aufmerksamkeit anderer Verkehrsteilnehmer erzeugt werden. Je schneller die Fortbewegung der Menschen auf der Straße, desto weniger soziale Interaktion kann erwartet werden und desto anonymer wird die wenige Interaktion. Demnach geschieht die bedeutsamste Form des sozialen Austauschs auf dem Bürgersteig sowie verbindenden Elementen wie Plätzen. Jacobs (1963) bezeichnet Bürgersteige und Straßen sogar als wichtigste öffentliche Orte eines urbanen Raums.

Insgesamt sind die soziokulturellen Funktionen des Straßenraums bestimmt durch die Begegnungs- und Aufenthaltsqualität, das Maß an Identität, die Orientierung und das Sicherheitsgefühl. Durch diese Variablen wird deutlich, dass öffentlicher Raum „nicht die Restfläche zwischen den Gebäuden [ist], sondern […] als Gestaltungsaufgabe verstanden werden“ muss (Lee 2012). Für die Gestaltung der Straße als öffentlicher Raum ist es wichtig, ihre Qualitäten und Potentiale sowie die prägende Kraft dahinter einzuschätzen und zu nutzen (Geschke 2009). Die soziokulturelle Funktion spielt eine zentrale Rolle darin, wie eine Straße erlebt wird: als vielfältig, bunt, langweilig, laut, sicher, einladend oder abweisend.

Doch lebhafte Straßenzüge lassen sich nicht nur top-down planen und umsetzen. Stattdessen entstehen sie durch eine enge Symbiose aus gebauten Anreizen für vielfältige Nutzungsmöglichkeiten und Freiräumen für die bottom-up Mitgestaltung der Flächen. Eine unbewusste Form der Mitgestaltung manifestiert sich im Raum bspw. durch Trampelpfade abseits der vorgesehenen Fußwege auf Grünflächen während „Verschönerungsaktionen“ durch Graffiti oder andere Do-It-Yourself Kunstwerke bewusst im öffentlichen

Raum durchgeführt werden. Doch die demokratischen Qualitäten des öffentlichen Raumes gehen über die Grenzen der Straße hinaus: Seit jeher dient der Straßenraum als Demonstrations- oder Protestfläche, aktuell beispielsweise für Versammlungen wie „Critical Mass“ und „Fridays for Future“. Die Kritik an bestehenden Machtverhältnissen erstreckt sich dabei über nahezu alle Lebensbereiche und betrifft selbstverständlich auch die Straße als öffentlichen Raum selbst.

Mobilität, das heißt die grundsätzliche Fähigkeit mobil zu sein, ist seit jeher auch ein Ausdruck von Status. Die Verkehrsmittelnutzung, das heißt die gewählten Mobilitätsdienstleistungen, Fahrzeugtypen und -marken, dienen der Statusmanifestierung. In Zukunft wird erwartet, dass die Nachfrage nach Dienstleistungen und Produktion immer individueller und von einem zunehmenden Umweltbewusstsein geprägt sein wird (Ahrens et al. 2011). Dies zeigt sich auch in der soziokulturellen Funktion der Straße, die den steigenden Ansprüchen der Nutzer gerecht werden muss: Sie fordern mehr Mobilität, mehr Flexibilität und vielfältige Mobilitätsformen (ADAC 2017). Gleichzeitig sollen sich aufgrund eines größeren ökologischen Verantwortungsbewusstseins Konsumwünsche und Verhaltensweisen dem Nachhaltigkeitsprinzip anpassen, wodurch vermehrt alternative Mobilitätsangebote nachgefragt werden (Rammler 2014). Neben einer starken Sharing Economy werden der erweiterten Angebotsauswahl des ÖPNV, dem vermehrten Einsatz von aus regenerativen Energien betriebenen e-Autos und der Mikromobilität (Heß & Polst 2017) zukünftig große Bedeutung zugeschrieben. Mobilitätsvermeidung ist ein Ansatz, jedoch gilt die Entwicklung und der Einsatz sauberer Technik auf Unternehmensseite als vielversprechender (Hertelendy et al. 2016), wie beispielsweise die nächste Generation von Biofuels (Phelps et al. 2015).

Neben der Gesundheit des Planeten steht auch die menschliche auf dem Spiel: So priorisieren vor dem Hintergrund aktueller Volkskrankheiten wie Übergewicht, Bluthochdruck und Herz-Kreislauf-Erkrankungen die durch Bewegungsmangel entstehen, Planungsansätze wie “Healthy Streets” in London bereits heute gesundheitsfördernde Bewegungsformen wie Gehen, Fahrradfahren und ÖPNV-Nutzung (Saunders 2017). Darüber hinaus weisen mehrere Studien auf einen statistischen Zusammenhang zwischen Depression und Selbstmordraten sowie Luftverschmutzung hin (Braithwaite et al. 2019).

2.5 Ökologische Funktion der Straße

Ökologische Aspekte haben einen direkten Einfluss auf die Lebensqualität der unmittelbaren Anwohner, die Aufenthaltsqualitäten für temporäre Straßennutzer, auf das Stadtklima sowie den lokalen Wasserhaushalt und die Biodiversität vor Ort. Die Qualitäten des Straßenraums werden beispielsweise durch Verkehrsemissionen in Form von Lärm, Abgasen und Feinstaub herabgesetzt. Auch die auf die monofunktionale verkehrliche Nutzung ausgelegte Versiegelung und dabei die Verwendung bestimmter Materialien schaden der Aufenthaltsqualität von Straßenräumen: Das Hitzeinsel-Phänomen und die Folgen für den lokalen Wasserhaushalt bzw. die Grundwasserneubildung durch geringe Verdunstungsraten, den oberflächlichen Abfluss von Regenwasser und die in diesem Zuge verursachten Schäden bei Starkregenereignissen werden im Zuge der Klimawandelmitigation immer häufiger diskutiert. Die aktive Nutzung des Straßenraums als Puffer für unterschiedlichste ökologische Vorgänge gewinnt in diesem Zusammenhang zunehmend an Relevanz: Einen wesentlichen Beitrag zu einem angenehmeren Stadtklima leistet beispielsweise das Konzept der „Green Streets“, das die Begrünung des Straßenraums vorsieht. Das strategische und schematische Pflanzen von Bäumen, krautartigen Pflanzen, Gras und die Begrünung von Fassaden bedingen die Akkumulation von atmosphärischen Partikeln. Es wird zum einen die Schadstoffausbreitung minimiert, zum anderen werden Versickerung und Verdunstung von Niederschlägen begünstigt. Ebenso werden „Green Streets“ oft mit der äußerlichen Aufwertung des Raums in Verbindung gebracht und folglich mit der Verbesserung der Aufenthaltsqualität (Shaneyfelt et al. 2017). Des Weiteren wird durch schattenspendende Elemente, wie beispielsweise Bäume, der Hitzeinseleffekt in Städten reduziert (Napoli et al. 2016). Ebenso positiv im Sinne von abkühlend wirkt sich die Transpiration der Blätter auf das urbane Mikroklima aus (Kotzen 2018). Nicht zuletzt soll durch die Auswahl geeigneter Pflanzen die Artenvielfalt von Flora und Fauna in unseren Städten gefördert werden. Darüber hinaus transportiert die Straße Energie, Wasser- und Abwasser, für die unterhalb der für den Verkehr genutzten Straßenoberfläche Leitungen verlegt sind und die bei Bau und Instandhaltung Berücksichtigung finden müssen.

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2.6 Zukünftige Funktion: Die Energieproduzierende Straße

Ein aktueller internationaler Forschungszweig lässt zukünftig eine völlig neue Funktion für den Straßenraum vermuten: Die Energiegewinnung aus der Straße.

Die Gewinnung thermaler Energie durch die Sonnenwärme hat einerseits die lokale Erzeugung erneuerbarer Energie zum Vorteil und andererseits die Verstärkung der plastischen Resistenz des Asphalts (Kisgyörgy & Plesz 2014). Denn im Sommer erreichen die Oberflächentemperaturen von Asphaltbelägen bis zu 65 Grad Celsius, was zur plastischen Deformation, beispielsweise in Form von Spurrillen, führen kann. Bei der Umsetzung solarer Energie in thermale Energie werden thermale Kollektoren in die Straßenoberfläche eingebettet. Forschungen von De Bondt und Jansen (2006) stellen beispielsweise ein solares Kollektorsystem für den Asphalt vor, welches die Vorteile der wärmeabsorbierenden Eigenschaften nutzt und die Fahrbahndecke und andere Infrastrukturen kühlen und erhitzen kann. Die Wärme kann darüber hinaus beispielsweise zur Beheizung von umliegenden Schwimmbädern genutzt werden.

Bei der Umsetzung von kinetischer in elektrische Energie gilt es, die durch die Bewegung von Menschen oder Fahrzeugen freigesetzte kinetische Energie im Untergrund in elektrische Energie zu konvertieren. Piezoelektrische Platten der Firma Pavegen werden bspw. genutzt, um die kinetische Energie von Fußtritten der Menschen festzuhalten und in elektrische Energie umzusetzen, indem eine geringe Verlagerung in der vertikalen Achse (bis zu 5mm) registriert wird. Die Platten können in hoch frequentierten urbanen Gebieten, wie Fußgängerzonen, angebracht werden, um bspw. die Energie für die Straßenbeleuchtung vor Ort zu erzeugen. Prototypen werden aktuell an verschiedenen Standorten und unter unterschiedlichen Wetterbedingungen getestet (Duarte et al. 2013).

Um elektrische Energie aus solarer Energie zu gewinnen wird Photovoltaik bereits heute auf einem Radweg in Erftstadt als Fahrbahnbelag eingesetzt. Das beteiligte Start-up Unternehmen Solmove plant auf versiegelten Flächen wie Straßen horizontale Photovoltaik Module anzubringen, die aus großen Glasfliesenteppichen mit integrierten Solarzellen bestehen und miteinander vernetzt sind. Ein Vorteil besteht darin, dass die Straßen bei der Anbringung nicht aufgerissen werden müssen. Ziel ist es, nach den erfolgreichen Tests auf Geh- und Radwegen, die Module auch auf von Pkw befahrene Straßen zu übertragen. Weiterführend soll auch die e-Mobilität gefördert werden, wenn die Glasfliesen als Fahrbahnuntergrund dienen. Denn der erzeugte Strom könnte induktiv an die Fahrzeuge während der Fahrt übertragen werden. Weitere Vorteile sind die Nutzung der Energie für die Beheizung der Straße im Winter oder auch für ihre Beleuchtung (Schmidt 2017).

2.7 Technologieinnovationen für drei zentrale Herausforderungen

2.7.1 Digitalisierung der Straße

Sämtliche Studien zur Zukunft der Mobilität sind sich einig: Die Digitalisierung unserer Lebensumwelt ist eine unumgängliche Entwicklung mit zentraler Bedeutung auch für den zukünftigen Straßenbau. Grundsätzlich wird eine digitale Straße als eine mit Sensoren ausgestattete Straße bezeichnet, die Daten sammelt, diese drahtlos mit einem Kommunikationsnetzwerk teilt, sodass sie anschließend in aussagekräftige Informationen umgewandelt werden, um idealerweise ad-hoc und automatisiert angepasste Maßnahmen zu treffen. Derartige Sensoren können zudem in den Fahrbahnbelag integriert werden und müssen nicht manuell angebracht werden. Zu den erfassten Daten zählen unter anderem lokale Verkehrscharakteristika, wie Fahrzeugtypen, Intensität oder Dichte, aber auch meteorologische Merkmale, wie Temperatur, Nebel, Geräusche oder Niederschlagswerte. Weiterhin können einzelne Verkehrsteilnehmer gezählt, Emissionen erfasst, Hindernisse bestimmt, die Parkraumverfügbarkeit geprüft, der Straßenzustand gemessen und die Instandsetzung durch Predictive Maintenance kosteneffizient verwirklicht werden (Bundesanstalt für Straßenwesen 2016). Straßenlaternen stellen bis dato ein geeignetes Trainingselement für die Ausstattung des Straßenraums mit Sensoren dar (Jehle 2017). Neben der bedarfsgerechten Straßenbeleuchtung gibt es Lösungen zum Laden von Elektrofahrzeugen an Straßenlaternen, der Nutzung als WLAN-Hotspot oder der Anbringung von Umwelt- und weiteren Sensoren. In Karlsruhe wurde in diesem Zusammenhang gemeinsam mit EnBW eine Straßenlaterne technisch so aufgerüstet, dass Stauwarnungen automatisch generiert werden können. Dafür ist die Messung des Verkehrsaufkommens, ein Stromanschluss und eine Anbindung an die städtische Datenpattform notwendig.

Von digitalen, vernetzten Systemen und der Nutzung der Daten in Echtzeit profitiert im Straßenraum hauptsächlich der Mobilitätssektor. Die Staureduktion durch Routenplanung in Echtzeit (Van Audenhove et al. 2018) sowie telematische Verkehrsflussoptimierung (Rammler 2014) sind beispielhaft zu nennen. Ebenso sind individuellere und flexiblere Angebote, digital dynamische Verkehrsbeschilderung oder On-Demand Haltestellen, die für die Vernetzung von Mobilitätsangeboten und damit Seamless Mobility eine Rolle spielen, nur durch die digitale Vernetzung möglich (Acatech 2018, Blanck et al. 2017, Rammler 2014).

Auch für die Verwirklichung des autonomen Fahrens ist die Kommunikation zwischen Fahrzeug und Infrastruktur ausschlaggebend (FutureManagementGroup 2016, Hertelendy et al. 2016, Přibyl & Přibyl 2015). Hierzu dient bspw. die A9 in Bayern als Testfeld, deren Brücken und Masten mit Radarsensoren ausgestattet sind. Spezielle Landmarkenschilder auf der Teststrecke dienen der selbstständigen exakten Standortbestimmung des vernetzten, automatisierten Fahrzeuges (Bundesministerium für Verkehr und digitale Infrastruktur 2016). Durch vernetztes autonomes Fahren vor Allem im nicht-MIV-Verkehr und die digitale Integration aller Mobilitätsangebote, entstehen Mobilitätsketten (Heß & Polst 2017), d.h. die Multimodalität wird gefördert, innerhalb derer situativ, ad hoc und gepoolt Mobilität abgerufen werden kann. Verkehrsmittel konkurrieren nicht länger untereinander, sondern vereinigen sich zu integrierten Mobilitätskonzepten (ADAC 2017). Die Digitalisierung verspricht neben Prozessen im eigenen Zuhause auch jene aus der Arbeitswelt zu erleichtern, was in einem gewissen Rahmen Ortsunabhängigkeit schafft und Wege reduziert.

2.7.2 Ressourcenschonung im Straßenbau

Ein Ziel im Rahmen der Ressourcenschonung ist die Verbesserung der Langlebigkeit von Straßenbelägen, um Instandsetzungsmaßnahmen zu reduzieren und dadurch auch baustellenbedingte Staus zu verringern. Insbesondere Schäden durch extreme Wettereignisse und veränderte Klimabedingungen stellen die Straßeninfrastruktur und den Verkehr heute und zukünftig vor Herausforderungen. Annehmbar ist, dass die Häufigkeit hitzebedingter Schäden deutlich zunehmen wird und die Infrastrukturelemente je nach Zustand, Alter, Verkehrsbelastung und Bauweise unterschiedlich stark in Mitleidenschaft gezogen werden (Korn et al. 2017). Während Beton wenig von Klimaveränderungen beeinflusst wird, zeigt sich bei Asphaltbefestigungen ein nicht unerhebliches Verbesserungspotenzial durch gezielte thermophysikalische Mischgutoptimierung (Wellner et al. 2017). Innovationen bezüglich der Ressourcenschonung betreffen u.a. das Kühlen und Heizen des Straßenbelags durch Erdwärme. Die Bundesanstalt für Straßenwesen erprobt im Testgebiet „duraBASt“ im Autobahnkreuz Köln-Ost eine Form der geothermischen Straßenheizung bzw. -kühlung und deren Auswirkungen auf den Straßenbelag. Erdwarmes Wasser wird aus der Tiefe hochgepumpt und in Röhren geleitet, die unter dem Asphalt verlegt sind. Die Temperatur des Belages soll damit im Winter nicht unter fünf Grad Celsius fallen und im Sommer nicht über 35 Grad Celsius ansteigen. Die Straßen sollen nicht flächendeckend, sondern erstmal innerhalb gefährdeter Bereiche, wie Steigungsabschnitte, Brücken oder Tunnelportale, temperiert werden (Seher 2019, Trialog Publishers Verlagsgesellschaft 2017).

Außerdem soll polymermodifiziertes Bitumen den hohen Anforderungen an die Langlebigkeit gerecht werden. Während traditionelle Bindemittel oft an ihre Leistungsgrenzen stoßen, optimiert der Einsatz von Polymeren Eigenschaften wie die Verformungsbeständigkeit, Lärmabsorption, Risswiderstand und geringe Sprühfahnenbildung des Fahrbahnbelags. Allerdings sind die Herstellung teurer und anspruchsvoller als herkömmliche Verfahren (Styrelf 2010).

Ein weiterer Schwerpunkt der Ressourcenschonung liegt auf der Wiederverwertung der verwendeten Materialien im Straßenbau. Aufgrund der begrenzten Anzahl an Recyclingzyklen des Asphalts, beschäftigen sich aktuelle Forschungen damit bisherige Recyclingquote von 83% weiter zu steigern (Bundesanstalt für Straßenwesen 2016). Extrahiertes Bitumen wird dabei mit Rejuvenatoren (Verjüngungsmitteln) versetzt und die Eigenschaften des alten Bindemittels werden verbessert. Eine Art von Rejuvenatoren sind Öl-Wachs-Gemische, die eine Steigerung der Recyclingquote auf 99% bei schichtweise gefrästen Belägen ermöglichen soll. Begleitend zu Asphaltuntersuchungen wird eine Prüfungsmethode aus den Resultaten aus allen chemischen und physikalischen Bindemitteluntersuchungen entwickelt, die regelmäßig die Qualität des Asphalts kontrolliert und den Alterungsgrad des Bindemittels ableiten kann (Nytus 2018).

Ein anderer Ansatz betrifft den Einsatz von Recyclingplastik im Straßenbau, wobei Plastik als Bindemittel das teuere aus Erdöl gewonnene Bitumens ersetzen soll. Die niederländische Straßenbaufirma KWS mit ihrem Projekt ‘Plastic Road’ testet mit dem 30 Meter langen errichteten „Plastikradweg“ in Zolle und

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Giethoorn, die Beständigkeit und Effizienz. Der Wegabschnitt soll so viel Plastik enthalten wie 500.000 Plastikschraubdeckel. Kritik an der Idee einer „Plastikstraße“ äußert sich in der möglichen Einschränkung der Wiederverwertbarkeit aufgrund des Plastikanteils im Bitumen, den unterschiedlichen Qualitätsmerkmalen des Plastiks und in der Belastbarkeit der Straße durch Schwerverkehr (Mau 2019). Auch Lignin, das in Holz, Stroh oder Pflanzen enthalten und eines der am häufigsten vorkommenden natürlichen Polymere ist, wurde bereits erfolgreich als Ersatz für Bitumen eingesetzt (Pérez et al 2019; Van Vliet et al. 2016). Eine weitere Innovation stellt Bio-Asphalt dar: Speisereste werden, durch beispielsweise Hinzugabe von Flugasche, als Abfallprodukt aus Kohlekraftwerken, in eine Art Bitumen-Bindemittel für den Asphalt umgewandelt (You et al. 2011). Eine Vielzahl von Studien beschäftigt sich nun mit der Frage, wie Bio-Asphalt langlebiger und weiter optimiert werden kann (Hill et al., 2018; Zhang, et al. 2017).

2.7.3 Emissionsreduzierende Fahrbahnbeläge

Neben der bereits erwähnten Begrünung von Straßenzügen zur Verbesserung der lokalen Luftqualität, werden photokatalytische Oberflächen in Straßen eingebaut, um Stickoxidanteile (NOx) zu mindern. Herkömmlich wird hierfür Titandioxid mit in die Straßenoberfläche verarbeitet oder an unterschiedliche Straßenbauwerke angebracht. Die Stadt Kiel setzt seit geraumer Zeit auf mit Titandioxid vermischten Asphalt, um die EU-Grenzwerte der Luftreinhaltung einzuhalten. Bei der Photokatalyse kommt es durch Lichteinwirkung zu einer Beschleunigung des chemischen Oxidationsprozesses und somit werden Stickoxide schneller zersetzt. Während des Prozesses wird das Titandioxid nicht verbraucht und die Reaktion ist beliebig wiederholbar (Wang et al. 2014). Die Wirksamkeit konnte nicht nur im Labor, sondern auch in Verkehrsnähe belegt werden (Bundesanstalt für Straßenwesen 2016).

Ein weiterer Forschungsschwerpunkt liegt in der Weiterentwicklung des offenporigem Dränasphalt (OPA) zum Flüsterasphalt. Als Flüsterasphalt soll der herkömmlich zur Wasserabführung eingesetzte OPA anhand des Hohlraumgehalts und der Teilabsorption und Verschiebung der Frequenzen, eine Lärmminderung um 4 Dezibel erzielen (Gary 2004).

3 ZWEI SZENARIEN IM JAHR 2030

Während das Kapitel 2 das Untersuchungsfeld Straße thematisiert hat, werden in diesem Kapitel zwei Zukunftsszenarien für die Straße im Jahr 2030 vorgestellt. Sie entstammen dem BMBF-geförderten Projekt „Straße der Zukunft“ und wurden mittels Szenariotechnik entwickelt. Die Wissenschafts- und Praxispartner des Projekts beschlossen, zwei Extremszenarien auf Basis der beiden dringlichsten Herausforderungen für den Straßenbau zu erstellen: Die Anforderungen hinsichtlich Digitalisierung und Nachhaltigkeit in Planung und Umsetzung weitestgehend zu berücksichtigen. Im weiteren Projektverlauf gilt es, die beiden Extreme in einem Synthese-Szenario zusammenzuführen und die teilweise konträren Anforderungen zu integrieren. Die Extremszenarien „Highway of data“ und „Grüne Lunge“ werden mit Berücksichtigung von Funktionserfüllung, Auswirkungen auf die verfügbare Fläche und möglicher Konflikte verschiedener Nutzergruppen sowie der Befriedriegung der Nutzeransprüche nachfolgend präsentiert.

3.1 Szenario 1: “Highway of Data”

Die Mobilitätssysteme im Szenario „Highway of Data“ sind digitalisiert, vernetzt, und elektrisch. Ein Betrachtungsschwerpunkt liegt auf dem technologischen Fortschritt in den Bereichen Digitalisierung, Automatisierung, Vernetzung, cyberphysische Systeme, Open Data und Datenverfügbarkeit. Abbildung 1 visualisiert beispielhaft eine Stadtszene aus dem Szenario. Es ist ersichtlich, dass der Erfüllung der verkehrlichen Funktion des Straßenraums größte Priorität zukommt. Die gute Erreichbarkeit von Zielen für alle Menschen ist gegeben und kann mit wenig Zeitaufwand erfüllt werden. Die Flächenverteilung fällt zugunsten des Verkehrs aus. Automatisierte Fahrzeuge, Mikromobile, 3D-Mobilität und der Fußverkehr finden dabei Berücksichtigung. Der Straßenraum ist vorrangig effizienter Transitraum auf technologisch neuestem Stand mit viel Komfort für die mobilen Menschen. Vorteile für die Stadtgesellschaft ergeben sich durch die Reduktion von Lärm-, Abgas- und Feinstaubemissionen aufgrund von technologischen Maßnahmen auf Fahrzeugseite. Auch die Zeiteffizienz mit der die Fortbewegung inkl. Reiseplanung und Zugang zu den Angeboten verwirklicht wird, bietet einen Mehrwert für die Menschen. Nutzerbedürfnisse wie beispielsweise Individualität, Schnelligkeit und Flexibilität sind durch die vernetzten Angebote und die situative Auswahl gestillt.

Abbildung 1: Szenario im Jahr 2030: Die Straßenraum ist vernetzt, digitalisiert und der Verkehr nathlos und intermodal.

Die Transportmittel sind aufgrund des rasanten technologischen Fortschritts zu Mehrheit vollautomatisiert und fahrerlos. Gleichzeitig wird durch die Integration unterschiedlicher Mobilitätssysteme, ein gut ausgebautes Netz (5G) und die Nutzung digitaler Echtzeitdaten das Mobilitätssystem hochaktuell abgebildet und es werden vielfältige bedarfsgerechte Mobilitätsoptionen angeboten. Zentral für diese Zukunftsvision sind daher dezentrale Hubs, über welche Angebote gebündelt abgerufen werden können. Durch einheitliche Datenstandards, die hohe Datenverfügbarkeit, die Nutzung dynamischer Informationen und die intelligente Vernetzung unterschiedlicher Datenquellen verzeichnen die Menschen einen Zugewinn an Komfort, wenn beispielsweise bei der individuellen Reiseplanung das Wetter, die Einkaufsliste oder den Trainingsplan berücksichtigt werden. Durch derartige Vorteile sind die Nutzer neuen Technologien gegenüber grundsätzlich positiv eingestellt, was sich auch in ihrem Mobilitätsverhalten äußert. Die Nachhaltigkeitsverantwortung wird großenteils in die Hände der Anbieter gelegt; es wird auf technologische Lösungen gesetzt. Durch die vermehrte Nutzung alternativer, v.a. geteilter Mobilitätsangebote, reduziert sich anteilig der Pkw-Besitz. Der private Fahrzeugbestand auf den Straßen verringert sich. Sowohl durch die geteilte Mobilität als auch das autonome Fahren werden Park- und Stellplatzflächen in geringerem Umfang benötigt als bisher. Im Szenario werden Parkierungsflächen durch Mobilitätshubs sowie Drop-Off- bzw. Pick-Up-Stationen ersetzt. Zugleich perfektioniert die Vernetzung der Fahrzeuge den Verkehrsfluss. Attraktive Verkehrsmodelle und ein verbessertes Informationsangebot durch die Nutzung dynamischer Informationen stärken die Multimodalität. Alle Verkehrselemente vernetzt, sodass die Nutzer ein optimales Erleben der Mobilität über den gesamten Weg von Tür zu Tür haben.

Mit den genannten Entwicklungen geht die Verlagerung von Dienstleistungen und Aktivitäten auf die Straße einher. Die Nutzung des automatisierten Fahrzeugs als Third Place verändert die räumliche Struktur von menschlicher Aktivität und Interaktion.

Eine Flächenreduktion beim fahrenden Verkehr wird erzielt, indem die dritte Dimension des Stadtraums im Jahr 2030 bereits teilweise erschlossen ist. Die Mobilität von Personen und Gütern findet immer mehr Anwendungsfälle im urbanen Luftraum. Während Drohnen bereits zum Transport von Gütern und der Auslieferung von Paketen durch Roboter auch in Deutschland schon seit einigen Jahren genutzt werden, fliegen in vereinzelten Metropolen weltweit bereits autonome Taxis durch die Lüfte. Durch die breite Akzeptanz von Mobility as a Service (MaaS) erhalten auch Flugtaxis einen Aufschwung. Diese on-demand Drohnen bieten Kapazitäten für ein bis zwei Personen mit Handgepäck und operieren zwischen

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Landepunkten in einem Radius von 15 bis 50 km. Zusätzlich haben sich in manchen Städten bereits Drohnen als Shuttles zwischen Knotenpunkten wie Flughäfen für maximal vier Personen und einer Streckenabdeckung bis zu 50 km etabliert. Drohnen verkehren zwischen Städten in bis zu 250 km Entfernung, die nicht vom regulären Flugbetrieb abgedeckt werden mit einer maximalen Kapazität von ebenfalls vier Personen inklusive Gepäck. Durch die 3D-Mobilität und die gute Erschließung des urbanen Raums wird vor Allem die ökonomische Funktion im Szenario „Highway of Data“ erfüllt.

Die soziokulturelle sowie die ökologische Funktion der Straße ist in diesem Szenario unterrepräsentiert. Zwar werden durch technische Innovationen Emissionen durch den Verkehr gemindert, doch die vorrangige Flächenzuteilung zu verkehrlichen Zwecken und die aus diesem Grund gewählten infrastrukturellen Ausprägungen der Straße sind nicht förderlich für ein gutes Stadtklima. Fehlende Versickerungs- und Verdunstungsflächen hindern eine natürliche Temperaturregulierung und Extremwetterereignisse haben große Auswirkungen auf den Stadtraum. Fehlt beispielsweise Beschattung, macht es den Aufenthalt an heißen Tagen für einige Bevölkerungsgruppen unangenehm bis unmöglich. Starke Regenfälle werden in der Konstruktion der Straße zwar berücksichtigt, doch der Verkehr wird durch den oberflächlichen Abfluss zeitweise eingeschränkt. Vor diesem Hintergrund fällt die Aufenthaltsqualität im öffentlichen Raum gering aus. Selbst wenn ehemalige Verkehrsflächen umgewidmet werden zum Beispiel in gastronomische Außenbereiche oder Flächen für kulturelle Veranstaltungen, lässt die Aufenthaltsqualität zu wünschen übrig. Dies birgt Nutzungskonflikte, denn der Bedarf nach öffentlichen Begegnungs- und Aufenthaltsflächen sowie Orten des sozialen Austauschs sind unverändert hoch. Ebenso mindert der geringe Grünflächenanteil die Ästhetik des Raums.

3.2 Szenario 2: “Grüne Lunge”

Das Szenario “Grüne Lunge” stellt ein umweltbewusstes Nachfrageverhalten nach ressourcenschonenden Fortbewegungsmitteln auf individueller Ebene und eine hohe Aufenthaltsqualität im öffentlichen Raum in den Vordergrund. Ein Fokus im Straßenbau liegt auf der Klimawandeladaption. Öffentlicher Raum bedeutet Raum für Biodiversität. Prägend für den Mobilitätssektor sind eine starke Sharing Economy und die Implementierung alternativer Mobilitätskonzepte nach dem MaaS-Prinzip, ein Schwerpunkt auf Mikromobilität sowie die Etablierung eines leistungsstarken, kostengünstigen und vielseitigen ÖPNV. Dies fördert Multimodalität und führt dazu, dass der MIV-Anteil am Modal Split im Szenario deutlich sinkt. Die vorgesehene Fläche für den Autoverkehr wird demnach zugunsten von ÖV-, Fahrrad-, Fuß- und Aufenthaltsflächen reduziert. Abbildung 2 stellt eine mögliche visuelle Variante des Szenarios dar. Auffällig ist dabei der hohe Grünanteil im Straßenraum und der Einsatz verschiedener Oberflächenmaterialien. Außenflächen werden im Szenario 2 dahingehend gestaltet, dass sie nicht nur das Stadtklima positiv bedingen, sondern auch Aufenthaltsqualitäten bieten und dadurch den sozialen Austausch im öffentlichen Raum fördern. Nutzerbedürfnisse wie Individualität, Flexibilität und eine ressourcenschonende Fortbewegung werden im Szenario “Grüne Lunge” durch die vernetzten, energieeffizienten und kostengünstigen Angebote des ÖV und der Mikromobilität adressiert.

Die verkehrstechnische Funktion wird erfüllt, indem v.a. Mikromobilität und Sharing-Angebote Berücksichtigung finden. Durch den geringen Platzbedarf für diese Angebote und den reduzierten MIV-Anteil im Straßenraum verringert sich die Verkehrsfläche im Allgemeinen. Die Mobilitätsangebote des ÖV sind ausgebaut, vollständig in das Netz integriert und an die heterogenen Bedürfnisse der Nutzer angepasst. Durch die Implementierung alternativer Mobilitätskonzepte und die Entstehung von Mobilitätsketten, ist die Mobilität kostengünstig und energieeffizient. Der Verkehr ist zwar vernetzt, doch entschleunigt und aufgrund der Straßengestaltung mit Ausrichtung auf aktive Mobilität wird das Szenario von Nutzergruppen als „Wohlfühlraum“ wahrgenommen – ob sie unterwegs sind oder sich auf öffentlichen Plätzen aufhalten. Auch blaue Stadtelemente wie Teiche und Wasserläufe finden sich häufiger wieder. Es steigt nicht nur die Umweltqualität, sondern auch das Sicherheitsgefühl. All diese Aspekte führen dazu, dass trotz eines diversifizierten Nachfrageverhaltens und heterogenen Nutzerbedarfen die Entschleunigung und die saubere Luft als Gewinn für die Lebensqualität verstanden werden. Ein Konfliktrisiko besteht, falls die vorhandenen Mobilitätsangebote der hohen Nachfrage nicht gerecht werden und größere Distanzen mit Fortbewegungsmitteln der Mikromobilität nicht zu meistern sind. Hier ist die nahtlose Integration aller vorhandenen Angebote zentral für die Befriedigung der Nutzerbedarfe.

Abbildung 2: Szenario im Jahr 2030: Kultivierte Biodiversität und blaugrüne Straßen dienen als „grüne Lungen“ der Städte

Die wirtschaftliche Funktion ist in diesem Szenario in Teilen berücksichtigt. Auch Güter und Waren werden im Innenstadtbereich vorrangig mittels Fahrzeugen der Mikromobilität transportiert. Die Anlieferung bzw. der Abtransport mit großen Fahrzeugen geschieht auf vereinzelten Routen, an deren Endpunkten strategisch günstig gelegene Verteilhubs eingerichtet sind. Aufgrund des geringeren Flächenbedarfs für den Verkehr dienen zugewonnene Flächen der Gastronomie oder kulturellen Veranstaltungen im öffentlichen Raum. Die Gestaltung der Flächen für eine vielfältige Nutzung ist ausschlaggebend für deren Attraktivität. Grundsätzlich verbessern Verdunstungs- und Versickerungsflächen sowie schattenspendende Elemente die Luftqualität bzw. generell die messbare Umweltqualität. Diese sind nicht auf Freiflächen reduziert, sondern erstrecken sich in die vertikale Dimension, beispielsweise an Hauswänden, und über den gesamten öffentlichen Raum. So werden auch beim Straßenbau Bodenmaterialien eingesetzt, die die Durchlässigkeit von Wasser priorisieren und damit eine Pufferfunktion übernehmen. Auch die Vielfältigkeit der verwendeten Materialien nimmt zu, sodass der Raum durch deren Verwendung strukturiert und ästhetisch wirkt und zu einer Bandbreite an Nutzungen einlädt. So kann farbiger Asphalt für Radwege, piezoelektrische Platten zur Energiegewinnung auf Fußwegen, Holzbohlen in Aufenthaltsbereichen und Kopfsteinpflaster in den Übergängen zwischen Grünflächen und Verkehrs- bzw. Aufenthaltsflächen verwendet werden.

Hinsichtlich der ökologischen Funktionen, deckt das Szenario durch die hohe Umweltqualität anhand der Begrünung und der vielen Versickerungs- und Verdunstungsflächen und der Nutzung alternativer Mobilität, die insgesamt ein positives urbanes Mikroklima verursachen, alle Kriterien ab.

Soziokulturell gesehen, existieren ausreichend soziale Begegnungsräume im öffentlichen Raum, die einladend sind und rege genutzt werden. In diesem Szenario spielt sich daher das Leben im öffentlichen Raum ab, dieser wirkt belebt und in vielerlei Hinsicht vertraut.

4 AUSBLICK

Vor dem Hintergrund von Klimawandel, Digitalisierung und Partizipationsforderungen von Bürgern bei der Stadtentwicklung, verändert sich die Straße der Zukunft in ihrer Planung, Umsetzung, Nutzung und Instandhaltung, d.h. über den gesamten Lebenszyklus hinweg. Die Trends für den Straßenbau bedeuten gleichermaßen Herausforderungen; so soll der Straßenraum in der Zukunft gleichermaßen ressourcenschonend, klimaneutral, digital und nutzerfreundlich zu sein. Ob dies schon bis zum Jahr 2030 gelingen kann ist nur in geringen Maße vorhersehbar. Wie den Herausforderungen im Rahmen bestehender

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Planungs- und Umsetzungsprozesse umfänglich zu begegnen ist, wird im Projekt „Straße der Zukunft“ thematisiert. Hierbei werden die drei Aspekte Technologieinnovationen, Ressourceneffizienz und die Erfüllung von Mobilitätsbedarfen besonders herausgestellt. Um potenzielle Entwicklungspfade für die Straße der Zukunft in diesem neuen Entwicklungszyklus aufzuzeigen, wurden zwei Extremszenarien erarbeitet, welche die zwei zentralen Herausforderungen Digitalisierung und Nachhaltigkeit im Straßenbau behandeln. Die Vergangenheit hat allerdings gezeigt, dass die monofunktionale Ausrichtung im Straßenbau nicht sinnvoll ist. Deshalb gilt es, die Erkenntnisse aus den beiden vorgestellten Extremszenarien für das Jahr 2030 zu vereinen. Ein Syntheseszenario „klimagerecht-&-digital“ greift die Stärken beider vorgestellten Szenarien auf und reduziert mögliche Risiken. So wird sichergestellt, dass alle Funktionen der Straße zukünftig gleichwertig Berücksichtigung finden können bei der Flächenverteilung aber auch bei der Auswahl, welche Anforderungen jeweils in Planung und Umsetzung priorisiert werden.

Einige erste Erkenntnisse für die Zusammenführung können bereits angerissen werden: Das Szenario „Highway of Data“ zeigt bspw. den enormen Flächenverbrauch für Mobilitätshubs auf und regt zur Weiterentwicklung des Ansatzes an, die einen Fokus auf free-floating Angebote legen könnte, für die das Abstellen entlang des gesamten Platzes als home-zone ermöglicht wird. Außerdem könnten die Verwendung verschiedenster Materialien und die Fassadenbegrünung als Anreize aus dem Szenario „Grüne Lunge“ übernommen werden, um die Aufenthaltsqualität und die Ästhetik des Raumes im Digitalszenario zu verbessern. Gleichzeitig helfen Aspekte der 3D-Mobilität, die wirtschaftliche Funktion im Szenario „Grüne Lunge“ besser zu erfüllen. Beide Szenarien zeigen zudem auf, dass die Vernetzung von Angeboten ausschlaggebend für ein erfolgreiches Mobilitätserlebnis ist – für die Verwirklichung eines leistungsfähigen Verkehrssystems mit einem geringen MIV-Anteil aber insbesondere. Das bedeutet, das Szenario 2 wird ohne Digitalisierung nicht möglich sein.

Wie die konkrete Ausgestaltung der urbanen Räume in den Partnerkommunen ausfällt, ist abhängig von den standortspezifischen Gegebenheiten und Bedürfnissen, die sich in einen gesamtstädtischen Kontext einfügen. Die vorgestellten Szenarien sollen Anreize im Projekt schaffen, die Musterstraßen mit Blick auf alle Straßenfunktionen und unter Berücksichtigung der jeweils in den Extremszenarien vorgestellten Mehrwerte und Risiken zu entwickeln und umzusetzen.

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The Case of Smart City Istanbul: How to Evaluate the City Region and its Benchmarks with Participatory and Negotiation Processes?

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1 ABSTRACT

Since the 1990s, the Greater Municipality of Istanbul has been investing in intelligent, digital services and supporting infrastructures, while at the same time Istanbul has started to become an important centre for ICT technologies. Recently, the efforts of the municipality and the private stakeholders are significantly up-scaled as the city has become an important international business, transportation and digital hub. One of the most recent efforts to tackle the city's management challenges is the "Smart City Istanbul Program" which covers a range of activities from developing a Smart City benchmark model to the assessment of the metropolitan city with a specific Maturity Model.

The Greater Municipality has recently developed an assessment and monitoring model for Istanbul's development as an international financial sector. The development of other models focusing on particular issues is also on the agenda. In a way, the municipality is trying to establish an information-rich intelligence base that focuses on strategic priority areas. These efforts may contribute to the adaptation of the global and national metropolitan agenda that pushes metropolitan governments to establish evidence-based policies and integrated management supported by indicator systems that allow benchmarking city-regions.

The development of such intelligence capabilities poses significant challenges. Meticulous encouragement of participatory processes by the Greater Municipality of Istanbul itself within its own activities should facilitate the diffusion of its emerging knowledge assets to other stakeholders, thereby creating a dynamic and complex environment of urban intelligence building. Enhancing the quality of participatory processes is thus very important.

The paper provides information on the participatory methodological approach used in the establishment of the Smart City Assessment and Monitoring Model, developed by the authors in collaboration with the Greater Municipality of Istanbul and its affiliate ISBAK. It also discusses the benefits and challenges associated with the Smart City Assessment Models based on a rich literature survey. The approach employed is particularly aimed at avoiding empty signifier problems, feeding participatory processes with rich information, establishing trust among stakeholders, avoiding fuzziness and indecisiveness, and enabling the production of a small set of mutually agreed and selected benchmark indicators which can later successfully inform maturity models.

Lessons learned are: the involvement of specialised practitioners in the Smart City domain in disseminating local information into the process; the use of a layered participatory process to enable evaluation and agreement on a large set of indicators in a relatively short time; and the co-presence of these two processes to help avoid empty signifier problems. The paper suggests that it is possible to tackle the unique challenges associated with Smart City development activities. Enabling repetitive benchmarking processes makes it possible to challenge rapid technological change and achieve convergence. Layered participatory processes work better when practitioner teams also see potentials in collaboration. Also third, feedback mechanisms should be provided at different layers of participatory processes as they enhance decision-making processes.

Keywords: grey relational analysis, participatory process, smart city, benchmark, Istanbul

2 INTRODUCTION

Smart cities are seen as a panacea to achieve sustainable development. They are also expected to create a market as large as $300 billion by the year 2030.[1] Though the Smart City concept is not new, in recent years there has been a rush by cities of all sizes to adopt strategy making associated with the smart city concept. Now a large number of city governments experience challenges of strategy making associated with this dynamic paradigm.

This paper discusses the challenges of smart city associated spatial strategy making in large city-regions. It focuses on the specific topic of building locally informed benchmarking models to evaluate the city's position with respect to its "smart" peers. The paper employs Healey's spatial strategy-making framework (Healey, 2009b) and explores the unique issues relevant to the Smart City Paradigm through the lense of participatory processes, management of knowledge (Liew, 2013) and technological change. After discussing special issues about benchmarking, the paper discusses the relevance of the Delphi Method and the Gray Relational Analysis for facilitating and speeding up participatory processes. Finally, the paper presents the experiences obtained during the recent experience of Istanbul, Turkey in this context (Şeker et al., 2019) and concludes by a discussion on the lessons learned.

3 CHALLENGES IN SMART CITY STRATEGY BUILDING AND THE ROLE OF BENCHMARKING

The origins of the Smart City concept dates back to 1830s, but only after the year 2000 has it become a key global interest though the discourses of sustainable development and smart growth (Albino et al., 2014; Eger, 2009; Susanti et al., 2016) "Smart City" is seen as a vision aiming to constitute the 21st century's efficient, technologically advanced, green, and socially inclusive city (Vanolo, 2014; Yigitcanlar & Kamruzzaman, 2018).

In general, smart cities have a high share of knowledge-based businesses and professionals, accommodate creative and innovative activities, sustain a higher quality of life with competitive costs, use efficient and effective resource technologies and green infrastructures, and have output-oriented planning systems and participatory governance procedures (Anthopoulos, 2015; Fernandez-Anez et al., 2018; Nam & Pardo, 2011; Neirotti et al., 2014; Paskaleva, 2011).

The Smart City Paradigm is also supported by technology companies that promote the smart city agenda, through publications, events and benchmarking studies. The New Urban Agenda of Habitat III has played a role in connecting the smart city concept with Sustainable Development Goals, as it is heavily based on indicators and urban data (Caprotti et al., 2017). Many cities and citizens perceive Smart City applications to be beneficial. Large city-regions where half of the global economic production takes place[2] have also become the playground of Smart City applications.

There are now a substantial number of international smart city benchmarking models, which are mostly being prepared by global private enterprises. While they provide the opportunity of quick assessment for planners, they have certain setbacks like opaqueness, selection bias of indicators and year on year variation of rankings. These issues decrease the validity and legitimacy of such benchmarks. Hence scholars and planners face increased demands from local governments to develop tailor-made smart city benchmarking models to be utilised in Smart City-associated spatial strategy making.

3.1 Challenges associated with spatial strategy making and smart city agenda

The processes that generate the making of spatial strategies are complex and delicate (Healey, 2009b, 2009a). In general, spatial strategy-making processes involve understanding and seeking opportunities to be involved in higher hierarchical structures, connecting to other spatial locations, improving the relative position of cities among different socio-spatial contexts and networks and improving internal relations and components in a city. Each city has to find its own way ((Healey, 2006) p.267). The essential steps of spatial

[1] Future Cities Special Interest Group, Accessed at 31st Jan.2020. https://connect.innovateuk.org/web/future-cities-special-interest-group/definition

[2] Global MetroMonitor 2012: Slowdown, Recovery, and Interdependence" by Emilia Istrate and Carey Anne Nadeau, The Brookings Institution – 30th November, 2012. https://www.brookings.edu/wp-content/uploads/2016/06/30-global-monitor.pdf

strategy-making aim to move away from current positions by discovering new opportunities, integrating and gearing up different aspects, leading to the opening up of new possibilities and setting directions (Healey, 2009b). From this perspective, "the smart city associated spatial strategy making" has a similar nature but poses unique challenges.

There are many examples where interventions under the pretext of Smart City discourses have faced strong criticism. Smart city strategies are criticised to be empirically and conceptually shallow and accused of leading to the outsourcing of democratic and environmental resilience to the global technology sector (Viitanen & Kingston, 2014). In accordance, there is limited empirical evidence on smart cities' ability to form green and inclusive urban environments, or on their ability in dealing with carbon dioxide emissions (Yigitcanlar & Kamruzzaman, 2018), or yielding significant sustainability outcomes (Yigitcanlar & Lee, 2014). In fact, unintended consequences of smart city applications carry the risk of further increases in environmental, social or economic problems (Federico Cugurullo, 2013; Shwayri, 2013), due to the pervasive use of rapidly changing ICT systems and products (Hilty & Aebischer, 2015; Li et al., 2013).

Both (Caragliu & Del Bo, 2012) and (Pancholi et al., 2017) suggest that the incorporation of local communities and actors might help in better addressing and dealing with space-specific societal, economic and environmental challenges. Hollands (2008) suggests that city governments should focus first on people for progressive, sustainable and smart cities, rather than solely focus on economic competitiveness and pervasive use of ICT. A large and varied body of knowledge is embedded in various stakeholders in global city-regions which has strategic value for smart-city associated spatial strategy making. Many stakeholders have their own connections to other spatialities and have the ability to alter the internal structure and functioning of the host city-region. In many aspects, these stakeholders also provide efficient channels to connect to various higher hierarchy structures. So the deployment of such embedded knowledge at the very beginning of analytical processes could be important in shaping the understanding and hence strategy building processes that might serve for the attainment of Sustainable Development Goals.

Therefore smart city spatial strategy makers have to utilise suitable approaches and methods that would effectively extract, relate and utilise the embedded knowledge of stakeholders with factual data, without introducing problems of over-dependence on subjectivity, representation, legitimacy, and consensus-building. Put together with rapid technological change, the complexity of global city-regions and their ever-changing connections to other spatialities, Smart City associated strategy making becomes a huge challenge.

Facing these challenges, spatial strategy makers need to adopt agile approaches that are capable of capturing, processing and representing diverse and immense information in a meaningful, productive and legitimate way in very short time intervals.

Making use of existing smart city indices or benchmarks developed by international organisations might enable fast assessment of cities, but they are inferior tools in establishing power balances. Topics covered could be wide or narrow and irrelevant for a particular city-region's own assessment. In addition, there is no guarantee that these benchmarks would continue their existence in the near future. Thus, there is a need to establish local benchmarking capabilities that quickly, legitimately and effectively utilise locally embedded knowledge relevant to the connectivity, position, and internal components of the specific city-region.

3.2 Challenges of local development of benchmark models

Planning is a political process of power that acts to build a consensus between conflicting interests (Savini, 2013) It is impossible to deliberately describe and analyse the situation in multiple contexts, while also understanding local capabilities and their interrelationships with regional goals. given the pressing time limits and rapidly changing agendas. However, this gap has to be bridged anyway through a decision-making process which utilises strategic tools (Frenkel & Porat, 2017). Strategic tools enable quick utiliaation of vast amounts of information regarding indeterminate urban systems, and the conflicting agendas as well as different images, visions and capabilities of stakeholders (AlAwadhi & Scholl, 2013; Fernandez-Anez et al., 2018; Santis et al., 2014). They improve punctuality in making decisions regarding building complex and highly valid intelligence.

(Borsekova et al., 2018) focus on the functionality between the size and indicators of smart cities presuming that there is an association between the selection of indicators and city sizes. Their findings on 158 European cities suggest that some indicators (such as ecological awareness) are more important for larger smart cities.

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They also find that larger cities enjoy better sustainable resource management, but they are not as open-minded or innovative as medium-sized cities, concluding that one-size-fits-all type of smart city strategies would be inefficient and ineffective, and positive or negative prejudices on larger cities should be avoided by planners and strategy developers.

From this point of view, using a smart city benchmark model that is based on factual data on global cities but which also takes into account local priorities and concerns becomes an attractive option as it could perform better;

- in the identification of more relevant issues with the subject city and its technology level,
- in framing and focusing on a more relevant set of cities, regions, or networks,
- establishing a familiar conceptual framework but avoiding ubiquitous strategic decision-making processes,
- covering a suitable range of issues on the potential organisational capacity of that particular locality,
- establishing faster and easier consensus on the perceived position of the city within a variety of contexts that are more relevant to the local agenda.

Despite these potential benefits, the development and continued use of a local smart city benchmarking model are challenging. First of all, better performance is conditional on the ability of the benchmarking model to capture relevant locally embedded knowledge and transfer it quickly into the design of the benchmarking model before it is degraded. Second, the method should allow for some flexibility in shaping subsequent versions of the model due to changing contexts. Third, the methods employed should be able to economically include multiple stakeholders for subsequent versions, and thus should not impose high time costs. Otherwise, this may lead to the abandonment of the use of such locally informed benchmarks. As a result, actions and organisational changes may move in incompatible directions and yield irreversible results, which contradicts the inherent aims of strategic spatial planning in general (Albrechts, 2010; Kotter, 1996).

3.3 Participatory Planning Processes and their use in benchmark studies

As Batty(et al. (2012) suggest, smart cities are both automated routine functions serving individual persons, buildings and traffic systems, as well as ways that enable us to monitor, understand, analyse and plan the city to improve the efficiency, equity and quality of life for its citizens in real-time.

It is crucial to distinguish between the data-driven tactical planning approach of smart cities versus the making of spatial strategies for smart cities. Although both are used in successful smart cities, they play different roles. The former implies that decision-making and implementation at tactical or operational levels including day to day planning and servicing of public services and infrastructure. Big data and data automation systems may improve the speed of tactical or operational planning and improve services reliant on them, such as demand management (Jindal et al., 2018).

Spatial strategy making, on the other hand, requires complex social processes to bring out meaningful and relevant knowledge, to establish trust and legitimacy, and to set common agendas, all of which form the basis of strategic intelligence that would carry the city forward in competitive and risky environments as a smart city. Spatial strategy making also monitors the outcomes of the data-driven tactical planning mentioned above, makes use of them as tactical assets for maximising or minimising social, economic, political or other goals. Thus, spatial strategy-making requires different and unique resources and capabilities which are not confined to the responsible authority. Bringing together relevant experts or stakeholders within very narrow timeframes provides the opportunity to create higher-level knowledge. They are key soft ingredients of building intelligence, establishing trust and initiating actions that would serve for success, competitiveness, resilience and perseverance.

Interestingly, the literature suggests that envisionment of smart cities often takes into account an insufficient amount of social and political questions (Calzada & Cobo, 2015; Cowley et al., 2018; Hollands, 2015; Katz, 2000; Söderström et al., 2014) while the smart city needs to navigate the complexities of multi-faceted urban complexities (Pettit et al., 2018). The inclusion of locally embedded knowledge in the design process of locally informed benchmarking models for smart cities may thus help overcome these issues.

Participatory research design and planning approaches provide important opportunities in the inclusion of locally embedded knowledge in smart city strategy-making processes, particularly in benchmarking efforts. These are:

(1) Better assessment of major issues that are relevant for the subject city's hierarchical networks, position, connectivity, and internal components (as suggested by (Healey, 2009b)).

(2) Quick and legitimate selection of a manageable number of smart city features that can be easily incorporated into the mission statements of associated or partnering stakeholders.

(3) Wiser selection of a set of benchmark cities that not only represent smart city features but are as well important sources for learning from best practices, or are potential partners for building strategic coalitions.

(4) Building consensus on strategic priorities relevant to smart cities that might create competitiveness, and enhance sustainability or resilience.

(5) Information economies of scope and scale for successful strategy development.

Yet there are certain issues that have to be taken into account with decision-making methods. Even large participatory planning events often include an inadequate number of experts, while a large number of decisions have to be made, rendering most statistical methods unsuitable. Non-numerical methods should involve time-consuming iterations as issues discussed are complex and reaching consensus at the first attempt is unlikely. Lastly, locally embedded knowledge is quickly degradable against multi-faceted urban complexities.

3.3.1 The Delphi Method

One of the most commonly used participatory methods is the Delphi Method, used for qualitative evaluation and consensus-building. The underlying principle of the Delphi method is that group-based forecasts are considered to be more accurate compared to individual forecasts. Delphi survey is capable of gathering information from a relatively large number of subjects, accumulating it, and preparing it to support objective decision making. Since the responses of the participants are anonymous, individual panellists don't have to worry about repercussions for their opinions. Consensus can be reached over time as opinions are swayed, making the method very effective. The Delphi method is used extensively in smart city-related works. They can be used directly for the assessment of smart city domains or in capability maturity model works relevant to smart cities (De Bruin et al., o. J.; Lee et al., 2013).

As a relevant example, Anthopoulos & Reddick (2016) wanted to explore existing frameworks and theories of e-government with regard to smart cities and confirm these findings with experts' opinions using a Delphi study spanning multiple years while only involving 16 experts from across the globe. While successful, the long time span raises concerns, as the subject studied is dependent on rapidly changing technologies and political contexts.

The use of the Delphi method is a time-consuming fashion, also not suitable for making repeated benchmarks as it might not be possible to bring a satisfactory number of participants into participation repeatedly. The benefit of agility in benchmarking stems from quickly understanding important priorities and dimensions and taking relevant actions with stakeholders, which provides benefits to the subject city-region similar to an early innovator. Thus, focused and limited use of the Delphi method may be more suitable in Smart City associated spatial strategy-making processes.

3.3.2 Grey Relational Analysis

The Gray Relational Analysis Method is used for numerical evaluation in participatory processes. The GRA Method is part of the Gray System Theory proposed by J.L. Deng in 1982 (Kuo et al., 2008). It is a multi-criteria decision-making model, which is utilised in ranking, categorisation, and decision-making. GRA is known to perform well with small samples, and the calculation process is simple and easy, which makes it an ideal method for the highly challenging Smart City strategy-making processes. As provided below, it allows selection of maximisation, minimisation or idealisation objectives.

A single value is calculated for each alternative decision according to the values attributed to each benchmark indicator (criterion) taken into account during the decision making process. This allows the reduction of the multi-criteria structure into a single and simple Gray relational value.

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A five-step calculation process is utilised to obtain this value: Data preparation, the establishment of a reference series, normalisation of the data set, calculation of the Gray relational quotient and assessment of the Gray relational rank (Wu, 2002). These are demonstrated by x,y,z,e,f,g below.

GRA alternatives xi and the criteria xi (k) are computed as in equation 1 and equation 2:

$$x_i = \left(x_i(1),\ x_i(2),\ x_i(3), \dots, x_i(k)\right) \qquad (1)$$

$$k = 1,2,3, \dots, n \ \ ve \ \ i = 1,2,3, \dots, m \qquad (2)$$

In the next step, an X matrix is established for alternatives to be assessed in the multi-criteria decision-making problem as in equation 3.

$$\boldsymbol{X} = \begin{bmatrix} x_1(1) & \dots & x_1(n) \\ \vdots & \dots & \vdots \\ x_m(1) & \dots & x_m(n) \end{bmatrix} \qquad (3)$$

The matrix X consists of „m“ alternatives and n criteria relevant to the problem in question. Thus the matrix is also recalled as the “Decision Matrix.” A reference series, which is a hypothetical series, is established by the utilisation of the Decision Matrix. The series is established by using the best value of each criterion. The reference series is given in equation 4. This vector is then added to the Decision Matrix to acquire the matrix given in equation 5.

$$x_0 = \left(x_0(1),\ x_0(2),\ x_0(3), \dots, x_0(n)\right) \qquad (4)$$

$$\boldsymbol{X}_{yeni} = \begin{bmatrix} x_0(1) & \cdots & x_0(n) \\ \vdots & \ddots & \vdots \\ x_m(1) & \cdots & x_m(n) \end{bmatrix} \qquad (5)$$

The criteria found in equation 5 may be subject to different scales and thus are normalised to be free of scale. In addition, the normalisation procedure narrows down the transition interval since the series located in the matrix may have a wide “transition interval.” This normalisation process is called as “Gray Relational Formation” (Tsai, Chang ve Chen, 2003). There are three different calculation methods according to three objectives during the normalisation process: “higher is better,” “lower is better,” ideal value is better” (Wu and Chen, 1999).[3]

(a) If the expectation is that the higher value is better, then equation 7 (as in the case of calculations associated with utility)

$$x_i(k) = \frac{x_i^{(0)}(k) - \min x_i^{(0)}(k)}{\text{mak}\, x_i^{(0)}(k) - \min x_i^{(0)}(k)} \qquad (7)$$

(b) If the expectation is that the lower value is better, then equation 8 (as in the case of calculations associated with costs or errors)

$$x_i(k) = \frac{mak\ x_i^{(0)}(k) - x_i^{(0)}(k)}{\text{mak}\, x_i^{(0)}(k) - \min x_i^{(0)}(k)} \qquad (8)$$

(c) If the expectation is that the ideal is better, then equation 9.

$$x_i(k) = 1 - \frac{x_i^{(0)}(k) - x^0}{\text{mak}\, x_i^{(0)}(k) - x^0} \qquad (9)$$

After the normalisation of the criteria in the new Xnew matrix, the Gray relational coefficient is calculated. Gray relational coefficient is used to assess how near is the xi(k) to x0(k)’. When the Gray relational coefficient takes a large value, it is an indicator that demonstrates that xi(k) and x0(k) approaches to each other. Equation 10 provides the formula for the calculation of Gray Relational Coefficient.[4]

[3] $x_i(k)$: Gray relational value, $\min x_i^{(0)}(k)$: $x_i^{(0)}$ minimum value, $mak\ x_i^{(0)}(k)$: $x_i^{(0)}$ maximum value, x^0 : target value

[4] δ: Is a distinguishing coefficient and takes values between 0 to 1.

$$\gamma\left(x_0(k), x_i(k)\right) = \frac{\Delta_{min} + \delta\Delta_{max}}{\Delta_{0i}(k) + \delta\Delta_{max}} \qquad (10)$$

$$k = 1,2,3,\dots,n \ \ and \ \ i = 1,2,3,\dots,m \quad n,m \in N \qquad (11)$$

Gray relational degrees are determined by the matrix that involves the Gray relational coefficient calculations. The formula to calculate the Gray relational degree is given in equation 12. The Gray relational degree is determined by the calculation of the mean of Gray relational coefficients of each alternative.

$$r(x_0, x_i) = \frac{1}{n}\sum_{k=1}^{n} \gamma\left(x_0(k), x_i(k)\right) \qquad (12)$$

r(x_0,x_i),represents the Gray relational degree between x_i and x_0. The alternative with the highest Gray relational degree with the reference series is the series which is the most similar series and therefore is the best choice (Kuo, Yang ve Huang, 2008).

Fig.1: Process of calculation for Gray Relational Analysis (GRA)

The GRA is an efficient method as it does not require great computational power or sophisticated software, and it operates with a low number of cases and a large set of variables, where results can be provided almost instantly, during a participatory meeting session, providing strategic advantages over other quantitative methods. It is possible to quickly create a ranking of importance, which, can then feedback into the Delphi Method in iterative rounds within minutes. In such a way, it allows a more reliable, valid and economic way of designing and developing a Smart City Benchmarking Model.

4 THE CASE OF ISTANBUL SMART CITY

Below we provide an example of the proposed process in the case of Smart City Istanbul Benchmarking Model Development work, which was executed by the authors of this paper from Urban Policies Applied Research Centre of Istanbul University under the supervision of the Greater Municipality of Istanbul's Directorate of Smart City and POE ISBAK (Istanbul Information Technologies and Smart City Solutions Corporation).

Since the 1990s Greater Municipality of Istanbul has been investing in the intelligent, digital services and supporting infrastructures. Recently, these efforts are strongly upscaled as the city has become an important international hub in finance, business, transport, and ICT industries. One of the most recent efforts is the Smart Cities Program which covers a range of activities from developing a Smart City benchmark model to the assessment of the metropolitan city with Maturity Models.

The Greater Municipality of Istanbul has also commissioned other benchmarking works previously. As an example, last year an assessment and monitoring model was developed by the authors of this paper aiming to serve Istanbul's development as an international financial centre with a higher quality of life.

Benchmarking works are important for Istanbul as tasks of spatial strategy making and urban planning face significant challenges due to the sheer size and complexity of the Greater Municipality of Istanbul, as well as due to the diversity of stakeholders in a 16 million city. Conflicting agendas leading to incompatible directions have often been an important concern. On the other hand, meticulous encouragement of

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participatory processes in various stages of commissioned works by the Greater Municipality of Istanbul itself has enabled a suitable atmosphere for effective spatial strategy making. Still, time is invaluable in Istanbul, requiring effective and agile approaches to facilitate participatory processes.

4.1 Smart City Monitoring System Development

This emphasis on participatory processes has also been present in the recent project on Smart City Monitoring System Benchmarking Model Development, executed by the authors of this paper. The applied research team employed a variety of techniques which is believed to have improved the participatory processes in at least six ways:

- Improvement of the richness of information provided to the participatory process,
- Establishing trust among participants and practitioners by providing an up to date literature survey which associates domains and practical organisational forms with the Smart City Agenda,
- Improvement of communication across a wide range of heterogeneous stakeholders in a relatively limited amount of time,
- Eliminating indecisiveness, fuzziness, and inconsistencies that arise during large participatory events which evaluate, discuss and decide on a mixture of strategic and tactical aspects of Smart City Monitoring activities,
- Pragmatic and economic transfer of a large variety of opinions and decisions into the development of a set of benchmarking indices addressing a variety of Smart City domains,
- Provide adequately deep but small enough data to sustain a set of indicators to inform Smart City Maturity models to be developed at later stages.

Reducing the costs of updating and increasing the validity and reliability of the benchmarking model which opens up opportunities for long term assessment and evaluation. Furthermore, participatory processes achieved some gender targets where around 40% of external experts and 50% of executive teams consisted of women, including some top managers at IBB and ISBAK.

4.2 Focused Literature Survey, Text Mining, and Selection of Benchmark Cities

The team employed text mining techniques to a thoroughly evaluated body of existing indices or monitoring reports providing a strong coverage of important concepts relevant to particular domains of the Smart City paradigm. The synchronous literature survey did not solely focus on standard Smart City domains but rather functioned to enrich information and deepen understanding of identified domains. There were nine key domains identified as necessary by the associated departments of the Greater Municipality of Istanbul and its enterprise ISBAK. Initially, a total of 311 indicators were selected as the most relevant indicators with smart city domains and covering these nine functional areas. By iterative steps of evaluation between the research team and IBB and ISBAK teams, an initial set of 50 cities from the world was chosen as cases to be included in the benchmarking model, depending on data availability, institutional priorities and opinions of higher-level management.

4.3 Utilisation of Decision-Making Methods for Dimension Reduction, Weight Assessment and Computation of Benchmarking Indices

After the literature survey, text mining and secondary and primary data collection, a participatory workshop was held by the participation of 85 experts (of which 40% were women) from diverse backgrounds. The level of diversity was arranged so as to cover all the nine key domains and represent relevant academic, public, non-governmental and private stakeholders. The experts were chosen so as to attain gender equality in the best way possible, given differences across academic disciplines and professional positions.

The workshop aimed at the improvement of the representation power of the benchmark indices and establishing a consensus about the content across different disciplines and professions and across institutions.

Both the Delphi Method and the Gray Relational Analysis were used iteratively to extract locally embedded knowledge and reach a consensus on the content of indices representing selected Smart City Domains. The Delphi method is employed because it assumes that group-based forecasts are more accurate compared to individual forecasts as mentioned above, which becomes a concern where the subject topic is complex and

information is incomplete. The Delphi Method relieves panellists from worrying about repercussions for their opinions since the responses of the participants are anonymous, and consensus can be reached over time as opinions are swayed.

First, the Delphi technique was employed to practically evaluate information and quickly provide feedback to associated participants to improve their decision making. The participants were organized according to 9 domains. In contrast to Anthopoulos & Reddick (2016), the method was used to returns within the same session to facilitate the advantages of time-saving. Similar to the work of Anthopoulos & Reddick (2016), participants were allowed to offer new indicators in the first session, which were not present in the preliminary work of researchers. This helped in the fine-adjustment of the focus in a very short time. Then, another grading was allowed. After the final group grading of domain indicators, there were 311 indicators in total for further assessment.

Then the next step started. Following real-world examples of strategic plans in Vienna and Seoul, the research team set the objective to decrease the large set of indicators to a smaller, manageable set. For this purpose, the Gray Relational Analysis method was used. The participants were asked to evaluate 310 indicators in terms of their importance, which, then lead to a ranking of indicators. A Likert scale was used where a score of "1" indicated that the indicator was not important and a score of "5" indicated that the indicator in question was very important. After diagnostic[5] procedures, the data set has become suitable for Gray Relational Analysis to evaluate the importance of indicators. The morning session was then completed.

In the afternoon session, overall results were provided to all experts and a participatory discussion with a time limit was allowed, similar to a Delphi Method. Then, participants were asked to grade the importance of each of the nine domains over 100 points. The ranking of the importance of domains established the basis for weighted calculations. The results were presented in real-time to all the participants. No objections were received to the ranking of nine domains and the procedure was stopped and the workshop ended.

After the workshop, indicators were short-listed by the research team, through a complex process of negotiation. These were the important factors in the elimination of tens of indicators from the model:

- Presence and ease of collection of data,
- Data availability for the subject city Istanbul,
- Ranking of each indicator, based on the Gray Relational Analysis of indicators by participants in the workshop.

As a result, the number of indicators were reduced from 311 to 143, spanning in nine domains. This is a higher number compared to other indicator systems used in Vienna and Seoul's strategic urban plans, still easily manageable.

The overall Smart City Benchmark Index was computed by these 143 indicators in 9 domains and the use of weights provided for 9 domains by the Gray Relational Ranking scores obtained from the participatory workshop. The benchmarking index was calculated for Istanbul and 45 world cities as data for other cities could not be reached. Finally, it was agreed by expert supervisors and the research team that the benchmarking model represented the relative position of Istanbul against other smart world cities.

As the methods and approach employed in the overall process were in general found to be suitable, valid, and economic by the commissioners, a monitoring plan was suggested. The plan incorporated repeated cycles of updating the list of indicators and the literature and a re-assessment of the new set of indicators through the use of the same approach every three years.

5 CONCLUSION

One of the lessons learned is that the involvement of Smart City domain-specialised teams of practitioners in the design of participatory processes enhances the possibility of inclusion of highly informed participants that have deep information in the embedded problems and future potentials of the city concerning available technological choices.

A second lesson learned is that a large variety of information can be quickly evaluated and incorporated in a participatory process without compromising the quality of decision making if domains are based on a well-

[5] The details of such procedures can be shared upon request. They are not provided here due to constraints on page size.

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matched combination of empirical and theoretical literature as well as existing organisational structures with the precondition that there are not strong information barriers between these domain-based organisational structures that allow flow of information and joint decision-making processes.

A third lesson learned is that learning by doing processes enables practitioners to provide rich local information to researchers and enable negotiation processes which help eliminating empty signifier problems. This enhances conceptual frameworks through mutual cognitive processes, eliminating risks when larger groups of stakeholders are included in further steps of building decision-making models and thus open the road to mutual intelligence.

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🏆 *reviewed paper*

The Effect of the Physical Environment on Social Interaction: The Case of Educational Campuses

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1 ABSTRACT

Social interaction is an essential component of the collegiate experience. Studies presume that the provision of appropriate space for interaction enhances its possibility. This study aims to reveal the effect of physical urban design elements on the quantity of social interaction between students on their university campuses. It takes place on the Faculty of Engineering campus in Alexandria University. Student questionnaires investigate students' sense of ownership, their satisfaction with their current campus and the features that would make them spend more time on campus. Furthermore, they reveal common movement patterns around campus throughout a standard day, and highlight the common gathering spaces. The on-site observation investigates the urban design components of these spaces. Based on the space syntax theory, which proposes that movement can be a good predictor for social encounters, the results are compared with integration and choice analyses maps along with the physical setting for each gathering space. From this analysis, the physical elements with the highest influence on social interaction are determined and modifications are recommended to the current campus setting. Students were found to be walking the routes that showed high integration values in the space syntax analysis and that these routes were also used for their gatherings. The result will help design better campuses in the future or alter current designs to enhance social interaction. Further research seeks to validate the results by applying the study on more campuses in Egyptian universities.

Keywords: University Campus, Design Elements, Social Interaction, College, Urban Design

2 INTRODUCTION

Time has demonstrated many examples of well-designed spaces, which gained them the privilege of being "places" (Gehl, 1987; Whyte, 1980). Generating chances for social interaction in its many forms is one of the essential goals for most well-designed spaces. The higher the opportunity for social interaction, the more diverse relationships are bound to be established. Social connectedness is then shaped leading to a higher sense of community and belonging. The sense of belonging to a community is seen to be a life motivator and a catalyst for happiness and health. Consequently, this sense of belonging is transferred from the community to the place (Hall, 2014; The Fullframe Initiative, 2013).

Every urban setting has its own identity and characteristics. However, social interaction is mostly essential to all settings. In educational settings, social interaction can be regarded as a necessity. Expanding the circle of relationships and making more contacts with people is one of the main purposes for most university students. University campuses provide three of the most important catalysts for interaction mentioned by Sears, Peplau, & Taylor (1991): similarity, familiarity and physical proximity.

The study aims to reveal the effect of physical urban design elements on university campuses on social interaction between students. It utilizes on-site observation, student questionnaires, and space syntax analysis to reach its objective. The research is carried out on the Faculty of Engineering campus in Alexandria University. It is a part of a more comprehensive plan to study the same factors on two other campuses in Egypt. All three campuses have common attributes being that they belong to a faculty of engineering in a public Egyptian university and that each is dedicated only for that faculty and not a multidiscipline campus.

3 PHYSICAL SOCIAL EXPERIENCE

3.1 Social Interaction

Interpersonal Attraction or Liking is a process where people are bound to approach and interact with each other upon formulating a positive attitude towards each other (Aron & Lewandowski, 2001). In addition to personal characteristics, research suggests that other factors such as similarity, familiarity and physical

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proximity are great contributors to interpersonal attraction (Aron & Lewandowski, 2001; Freedman, Carlsmith, & Sears, 1974; Harvey & Omarzu, 1998; Sears, Peplau, & Taylor, 1991). Most of these factors are considered interrelating and can or have to be affected by the physical environment. Sears et al. (1991) explain similarity as when people tend to have common interests, backgrounds, goals or personality. Familiarity is built upon the repeated exposure to a certain person. It increases preference to that person and likeability. People who live, study and work in the same place, are usually exposed to the same others due to physical proximity.

Social relations between strangers can be categorized into passive and active relations (Aelbrecht, 2016). On one hand, the unplanned unintentional encounter of people is considered a passive social interaction (Abu-Ghazzeh, 1999; Kuper, 1953). On the other hand, active interactions involve a conversation between two or more people and occurs on many levels which are transformational and have a fluid nature (Lofland, 1998). The repeated passive interactions can be transformed into active ones, based on the three previously explained concepts of similarity, familiarity and physical proximity. Additionally, in (Abu-Ghazzeh, 1999), Fleming, Baum, and Singer (1985) suggest that opportunity for contact, proximity to others and the appropriate space to interact enhance the possibility for social interaction.

In the higher education environments where campuses are dedicated for one single faculty/discipline, students could have similar or interconnected fields of studies, which delivers the concept of similarity in one of its forms. Students are daily exposed to each other on campus, building up familiarity. And since the students are on the same campus, physical proximity is definite which provides a solid base for interaction. The provision of chances to interact and a physical environment which supports engagement, students will be encouraged to interact frequently and regularly. Higher opportunities for social interactions create chances for the establishment of more diverse relationships. This results in the reinforcement of social connectedness leading to a higher sense of community and belonging which are seen to be life motivators and catalysts for happiness and health (Hall, 2014; The Fullframe Initiative, 2013).

3.2 Campus Physical Environment

Literature and previous research on the physical environment constructing urban spaces in general (Ewing, Hajrasouliha, Neckerman, Purciel-Hill, & Greene, 2015; Ewing & Handy, 2009; Gehl, 1987; Whyte, 1980) and campuses specifically (Dober, 1992; Eckert, 2012) were reviewed. Many design elements were found essential to the existence of people in spaces. The more a space is frequented the more it is transformed into a place with an identity. This existence could be transformed into frequented visits by the same or different users, which in its turn transforms the space to a place with an identity. Dober (1992) argues that placemaking and campus planning are two faces to the same coin, which expresses how important placemaking is on campuses.

The retrieved elements can be categorized into natural elements such as sun, wind and trees and man-made ones. Man-made elements comprise sitting space, food options, art items and surrounding buildings to name a few. Each of these elements can be found in many forms; For instance, sitting space be found as benches and chairs designed and placed in a space for that purpose or steps that are originally designed for movement, however serve interestingly as a sitting and gathering space. Due to technological advancement and search for constant connectivity, Wi-Fi was also considered as a design element. Although intangible, concepts such cleanliness and safety are effective in people's comfort and existence in spaces.

The literature describing and analyzing American campuses (Dober, 1992, 1996) show critical differences between those campuses and many of public and private universities campuses in Egypt. These differences include access hours to campus buildings and landscape, personnel allowed on campus, layout, life on campus in general to list just a few. All of which could be crucial factors to the student's lifestyle, and perception of his university.

4 METHODOLOGY

The study aims to reveal the effect of physical urban design elements on social interaction between students on university campuses. The study utilizes many methods to achieve its aim such as on-site observation, student questionnaires and the use of software programs to graphically represent data. To construct the basis for the on-site observation and student questionnaires, a literature review was carried out to reveal the physical elements discussed in previous research. Data collection is done through handout student

questionnaires. In some cases, a short interview was held while the student was answering the questionnaire. All questionnaires were filled by the participants while on campus for more involvement and relatability to the questions.

The questionnaire was formed of two major sections. The first is mostly to collect ordinal and scale data related to each student's personal experience on campus. The second is a faculty campus map where students were asked to draw paths and nodes. On one hand, the ordinal and scale data were analyzed via the software IBM SPSS. On the other hand, the graphical data retrieved from the hand drawn paths were first transferred to Microsoft Excel as values. Each path was given an ID and a value of 1 if it had been used, and a value of 0 if not. Hence, preventing any data loss. QGIS along with AutoCAD were used to represent the maps' data digitally. The software DepthmapX was used to perform angular segment analysis based on the space syntax theory. The analysis was performed with a metric radius of 'n' relating each segment on the campus to all the other segments, to determine their to movement (integration) and through movement (choice/betweenness). The results from these analyses were then compared with the students' drawn paths.

5 CASE STUDY

5.1 Setting: Faculty of Engineering, Alexandria University

Alexandria University is a public university in the city of Alexandria, Egypt. It has multiple campuses that are either occupied by one faculty like the case of the Faculty of Engineering, or many faculties like on the Humanities and Social Sciences campus. The Faculty of Engineering campus covers an area of approximately 26 feddan and mainly consists of ten buildings built throughout the years starting 1942 (Figure 1). There are over 20,000 students enrolled in the faculty. The faculty has a five academic years study plan, where students first register in a preparatory year followed by four years in one of the faculty's main ten departments (Alexandria University Team, 2019). Specialized Scientific Programs (S.S.P) are four additional mixed discipline departments where students pay higher fees. Some students enroll in the S.S.P in search for a higher socio-economic group to be part of .

Due to security reasons, only students and affiliated personnel to the faculty are allowed on campus. This not only separates the students entirely from the street and the surrounding community, but also from other students of the same university, but in different campuses. Nevertheless, it could also create a strong identity for each faculty. The campus has gates on three different streets. Students are allowed entrance from four out of six gates yet allowed exit out of all six (Figure 1). Gates close at different times of the day which accordingly affects the students' pattern of movement on campus.

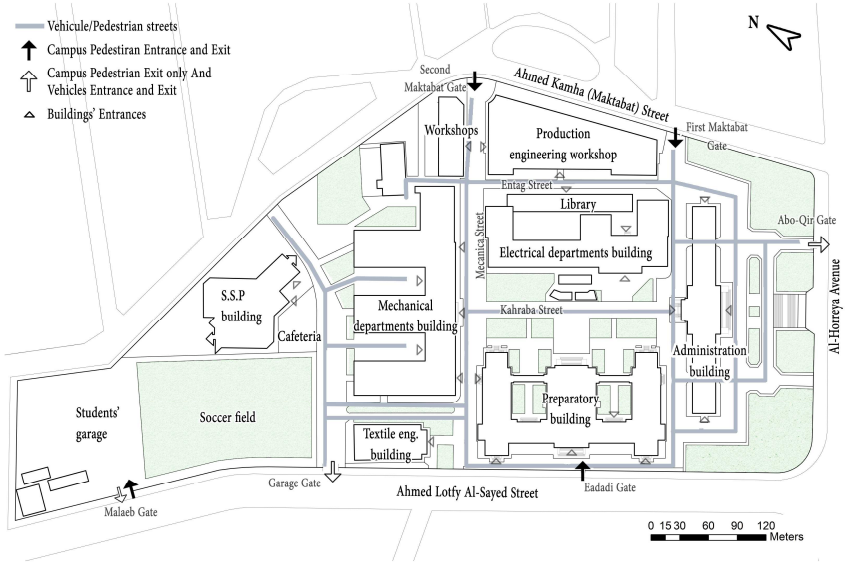

Figure 1 The Faculty of Engineering campus, Alexandria University.

Most of the streets inside the campus are shared between pedestrians and vehicles. Streets have common names between students usually based on the names of the building dominating the street. For example, the central street connecting the entrances of the Administrative building and the Mechanical departments

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building is called Kahraba (Electricity) Street, referring to the Electrical departments building standing along the street. Ahmed Kamha Street outside of the campus is also called Maktabat (Stationeries) Street, hence the naming of the gates falling on it. The street includes many stationaries in addition to some fast food outlets frequented by the students.

Existence on campus is mainly during daytime. The campus closes its gates after the last class of the day, which is usually only an hour or two into the evening. The campus does not house dormitories on its grounds. Therefore, absolutely all students have to do some sort of commuting every day. Between the main and the S.S.P. departments, the faculty holds fourteen scientific departments ranging from architectural and civil engineering, to electrical and mechanical engineering just to name a few. Many of the faculty departments house their students in only one building like the Department of Architecture. However, other departments' classes are spread out to multiple buildings. This is the case of the Specialized Scientific Programs (S.S.P). Although there is a building dedicated to these programs, students still use it in conjunction with other campus buildings.

5.2 Participants

All participants in the study were undergraduate students in the faculty. The questionnaire was handed out and explained personally to each student, especially the second part containing the map. Students gladly participated in the questionnaire once they knew it was related to their own campus, hoping the research would be future cause of improvement. A total of one hundred questionnaires were handed out. Three of the forms came back with incomplete answers and/or maps, rendering them invalid. The survey was mainly held for architecture students for the ease of communication between the researcher and the participants. The final sample was 61 percent females and 39 percent males. A total of 53.6 percent of the participants study in the Architectural Engineering Department, while 44.3 percent of them are enrolled in the Architecture and Construction program of the S.S.P, studying both architectural and civil engineering, and only 2.1 percent were participants from the Electromechanics program of the S.S.P. Students were from the first, second, third and fourth year, with a participation rate of 12, 23,34 and 28 percent respectively.

5.3 Measurements

In the survey, the demography section revealed the students' gender, academic department and year. Four intervals of time were used to determine the amount of time students take for commuting from home to campus, as well as the amount of time they spent interacting on campus while not in class, ranging from up to 15 minutes to more than 60 minutes. Students were given four choices as to where they usually spend time between lectures or after class: outdoors (between campus buildings), in a building's ground floor, in a building's upper floors, and outside the campus. Another question investigated with whom students spent time, whether alone, with one other person, in a group from the same department or in a group from different departments.

A scale of 1 to 10 (10 being the highest) was used to examine the students' sense of ownership and sense of control over what they could change on campus. The same scale was used to test the concept of familiarity, where one should be encouraged to talk to people he does not know, but whom he faces regularly. And one last time, the scale was used to test whether the students favor or avoid coincidental meetings with friends.

To evaluate the campus' physical environment quality, students were asked to indicate their level of satisfaction for sixteen urban design elements. The scale used for this evaluation included five options: being very dissatisfied, dissatisfied, neutral, satisfied or very satisfied. Survey takers were then asked to check from a list the items that would make them spend more time outdoors on campus, with an option to specify any other recommendation.

The main second part of the survey is composed of a simplified map of the faculty campus, representing the surrounding streets, gates, buildings, and green areas. The respondents were asked to draw their usual - most taken - routes from the campus entrances to their destination buildings, and mark the spots where they unintentionally run into friends. They were also asked to circle the spots where they usually hang around with friends, later referred to as hotspots. The hotspots were investigated for their physical and social setting to determine which elements would most affect social interaction presence in a space.

6 ANALYSIS AND DISCUSSION

6.1 Sense of Ownership

During the short interviews held with the students while filling out the forms, students have shown knowledge of the sense of ownership concept. On the scale of 1 to 10, the mean score for the sense of ownership is 5.84, which is slightly above average. The three highest chosen scores were 5,6 and 7 weighing 19.6, 14.4, and 14.4 percent respectively. Meanwhile, on the same scale, the mean score for the sense of capability to make changes on campus is 3.75, with the scores 1,2, and 5 as the highest three scores acquiring 21.6,17.5, and 14.4 percent respectively. A Pearson correlation analysis with a positive hypothesis assuming that the sense of ownership and the sense of capability to make changes on campus was performed. The correlation was positive and significant at the 0.05 level with a significance of 0.035.

The fact that the correlation between the sense of ownership and the sense of capability to make changes on campus was significant, means that enabling students could increase their sense of ownership. The more students are supported to make positive changes, the more they will feel like they have to preserve their environment and make it better, which in turn makes them feel like they belong to that place. Simple features such as the existence of movable furniture or dedicated gathering spots with flexible settings could prove useful. Nevertheless, the results show that the sense of ownership was slightly above average while the capability of making changes on campus was remarkably below average. This shows that other factors play a role in the students' sense of ownership. It is worth mentioning and examining that one of the gravest problems that could be facing students might be the difficulty of issuing permissions to participate in or initiate their desired activities on campus.

6.2 Familiarity

Familiarity was tested with ratings from 1 to 10 with a question about how much students are encouraged to talk to people they do not know that they face regularly on campus. The result gave a median of 5.28 which is below average. Using independent t-tests, it was found that there is no significant difference between males and females, nor between students enrolled in the general architecture program and the ones enrolled in the Architecture and Construction Specialized Scientific Program. Meaning all faculty students similarly are less prone to interact with people they do not know even if they see them regularly.

It was assumed that the time students spend in commuting would affect how long they would stay on campus after class, supposing students who spend less time in transport would have more time to spend on campus. A Spearman correlation test was conducted with a negative correlation hypothesis. The result produced was insignificant at 0.05 proving no correlation.

6.3 Time Measurements

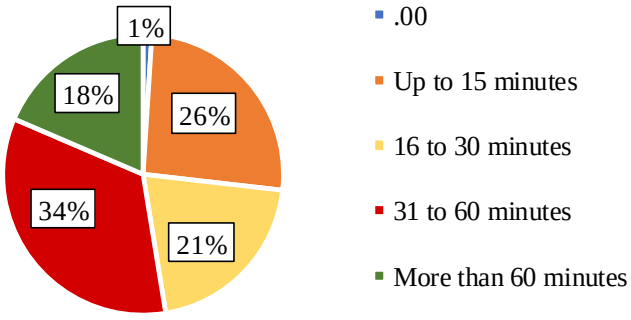

Figure 2 Time spent after class on campus based on 97 students.

Figure 2 shows the percentage of participants based on the time they spend on the campus' outdoors after class, whether socializing, studying, playing, or participating in activities on campus. There appears to be no clear distinction between the intervals. Nevertheless, the highest share with 34 percent was for students who spend more between 30 and 60 minutes on campus. This period comprises between 8 and 14 percent of their daily existence in the faculty, with classes assumed to occupy 6 hours of the day.

A Spearman correlation test was conducted to examine the probable association between the time students spend on campus and their satisfaction of the campus physical environment. The result showed a significant

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correlation at the 0.05 level. Therefore, the more students are satisfied with their campus the more time they will spend on it. This proves that the physical environment has a positive effect on students' presence on campus.

The relationship between the time students spend commuting and the time they spend interacting on campus everyday could be truly insignificant but some other factors could be affecting it. An example for these factors could be that some students who live further could be spending more time on campus to avoid the rush hour. Another considerable factor could be the question form in the questionnaire itself not giving accurate results because it asked students how long it takes them to get from home to campus not the opposite.

6.4 Campus Physical Elements

The overall mean satisfaction with the campus physical environment is 2.73 on the scale from 1 to 5 (1 being very dissatisfied, and 5 being very satisfied) which shows students' dissatisfaction with their physical environment. It is worth mentioning that the option 'neutral' in the questionnaire was either used if the respondent wanted to give an intermediate answer between satisfied and dissatisfied or if the item being rated was not of relevant importance to their personal experience. Table 1 displays the mean result for each of the sixteen examined elements. The elements with the highest satisfaction rate are highlighted in green while the ones with the lowest are highlighted in red.

Campus physical elements	Mean Satisfaction Score (1 to 5 Scale)
Amount of open accessible green spaces	3.39
Amount of trees on campus	3.72
Amount of art items	2.35
Amount of meeting spaces	2.79
Amount of benches	2.68
Quality of benches	2.06
Amount and quality of sitting places in general (e.g., steps)	2.70
Amount of trash bins	3.14
Sidewalks (Safe walking away from vehicles)	3.25
Food options	1.63
Sports fields	2.19
Changing rooms associated to sports	1.70
Attractiveness of buildings' design	3.40
Cleanliness of campus	3.16
Safety of campus	3.33
Campus WI-FI	2.16
Overall	2.73

Table 1 Campus physical elements mean satisfaction scores from students' questionnaires.

Only a few campus features were awarded a score above neutrality. On one hand, the three highest scores were given to the campus landscape and buildings' design, which basically establish the campus physical environment. On the other hand, students were most dissatisfied with the food options on campus. In his book, "The Social Life of the Small Urban Spaces", Whyte (1980) argues that food is an essential element to a lively social life. This is proven drastically in the survey part where students are asked to choose from a list of elements that would make them spend more time on campus (Table 2). On the investigated campus, two of the elements were expected to have a very low score for their non-existence, these elements being art items and changing rooms associated with sports.

The results shown in Table 2 are for the query where students were requested to check all the elements would make them spend more time outdoors on campus from a list. Normally, the percent of cases would relate the N (Number of students choosing the element) to the entire 97 valid questionnaires. However, three questionnaire takers did not pick any answers, making the valid surveys only 94 for this question. The three most desired elements that, in their opinion, would enhance the students' experience on campus are food and drink options, access to Wi-Fi, and shaded seating.

Desired campus elements	Responses		Percent of Cases
	N	Percent	
Open green spaces	54	12.1%	57.4%
Food and drink options (Cafeterias/Restaurants)	76	17.0%	80.9%
Shaded benches/seating (Under trees or sheds)	64	14.3%	68.1%
Outdoor tables for studying or meeting	55	12.3%	58.5%
Sports Fields	14	3.1%	14.9%
Sports changing rooms	7	1.6%	7.4%
Access to WI-FI	67	15.0%	71.3%
Electrical outlets	36	8.1%	38.3%
A clean campus	44	9.9%	46.8%
Activities on campus	21	4.7%	22.3%
Other	8	1.8%	8.5%
Total	446	100.0%	474.5%

Table 2 Campus physical elements that 97 students stated would make them spend more time on campus.

6.5 Movement paths and Gathering spaces

6.5.1 Current movement paths

The paths routinely used were drawn manually on a map handed out as part of the questionnaire. The respondents' illustrations varied from one direct route from a gate to a specific building used for both their entrance and exit to more complex routes going through many of the campus' streets. The paths drawn in the 97 valid questionnaires were agglomerated into one map showing the most and least frequented routes (Figure 3 - Left). The same was done for the spaces students circled as the spots where they gathered to hang around (Figure 3 - Right). Classification of paths and gathering spaces was done according to the natural breaks method. Paths were given letters and nodes determining their start and end, while gathering spaces (G.s.) were given Roman numerals.

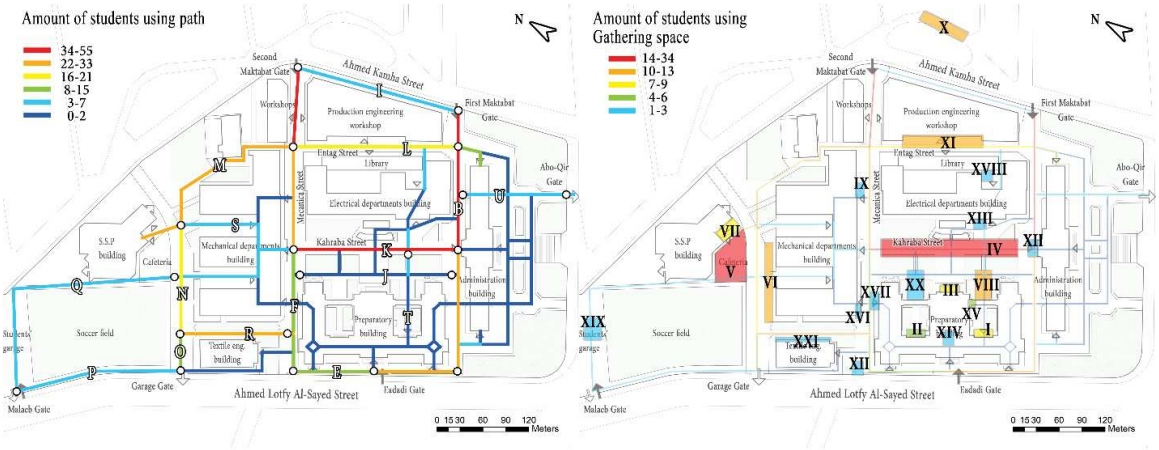

Figure 3 (Left) Students current movement based on the questionnaire. (Right) Current gathering spaces as indicated by the surveyed students.

Figure 4 (left) Kahraba Street [Path K and Gathering space IV], (middle) Entag Street [Path L and Gathering space XI], (right) Mecanica Street [Path F, G and H]

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Figure 5 (left) Gathering space VIII, (middle) Gathering space X, (left) Gathering space

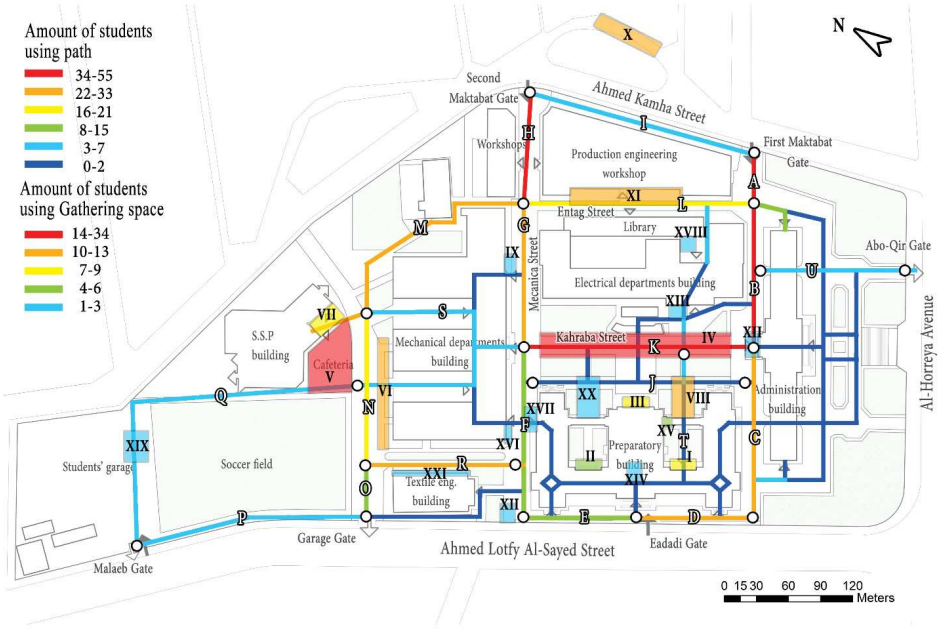

Figure 6 Students current movement paths and gathering spaces.

The Architectural Department to whom half the respondents belong to is housed in the Administration building. While the S.S.P. Architecture and Construction students (44.3 percent of the sample) travel mainly between the administrative building and the S.S.P. building, with some of their courses being in the Electrical departments building and Preparatory building as well.

The fact that the Administration building is the most used by the sampled students explains the intensity of movement in Paths A and B being the shortest route from any of the entrances to the building. Some movement can also be spotted from Path A to the side entrance of the destination. Another frequently used is Path H, distributing and gathering its movement to and from Path H, G and M. It has been previously stated that students are not allowed entrance from all gates. It is also worth noting that some gates close earlier than others. During the interviews, students expressed that they exit through the Second Maktabat gate when the First is closed, which explains some of the movement on Path H and also L. The intense activity on the eastern side of the campus can also be explained by the existence of the stationaries and restaurants outside the campus on that side.

Kahraba Street (Path K) was one of the most walked paths. It is considered among students to be the main campus street. It's been already shown that a large number of students sit along that street and that is considered an important gathering space (Figure 3 - Right). During the questionnaire, students were asked whether they prefer to walk in spaces where there is a higher chance of meeting a friend. They were asked to rate this preference on a scale of 1 to 10. The mean result was 6.85, which sheds more light on the frequented use of that path.

Three of the campus' buildings have their main entrance on that street which can also be used to justify the high movement as well as it being an important gathering space as shown in Figure 6. When examined for its urban design features, Kahraba Street (G.S IV) got a score of 7 which is considerably and only surpassed by Entag Street (G.s. XI) with a score of 8 (Figure 7). Both streets along with Mecanica Street which was also one of the highest walked paths can be seen in Figure 4.

It can be noticed that gathering spaces with high numbers of occupiers fall either on a path with a high movement rate or at least near one as is the case with Gathering spaces IV, V, VIII, and XI.

Urban design features		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	Score (22)
Green Space		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	0
Around landscape elements		●	●	○	●	○	●	○	●	●	●	●	●	○	○	●	●	○	○	○	●	●	○	13
Art Items		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	0
Formal or Informal Meeting Space		●	●	●	○	●	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○	○	5
Sitting Spaces	Benches/Chairs	○	○	○	●	●	●	○	●	○	○	●	○	○	○	○	○	○	○	○	●	○	○	6
	or Stairs/Ledges	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	○	○	●	●	●	20
Trash bins		○	○	○	●	○	●	○	●	●	○	●	○	●	○	○	●	○	○	○	●	○	○	8
Food options		○	○	○	○	●	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	2
Wi-fi Coverage		●	●	●	●	○	○	○	●	●	○	●	○	●	●	●	●	●	●	○	●	○	●	15
Shade		●	●	○	●	●	●	○	●	●	●	●	●	○	●	●	●	●	●	○	●	●	○	17
On one of the most used movement paths		○	○	○	●	●	●	●	○	●	○	●	○	○	○	○	●	●	○	○	○	●	●	10
Score (11)		5	5	3	7	6	6	2	6	6	4	8	3	3	3	4	6	4	2	0	6	4	3	

Figure 7 Gathering spaces urban design features.

According to Figure 7, which investigates the urban design elements in the students' choices for hanging around, the existence of somewhere to sit no matter its quality or form proved to be the most important feature in gathering spaces. Since the weather in Alexandria is usually sunny and hot during a long period of the academic year, the provision of shade has come second with a score of 17 out of 22. Although Wi-fi coverage came third, it might not actually be used since Wi-fi got a really low mean satisfaction score from students shown in Table 1. Spaces that had 6 or more out of 11 investigated urban design features were usually also the spaces students used most often to hang around and interact. This is proven in Gathering spots IV,V,VI,VIII,and XI. Although space X scored only 4, it has a considerably high activity, this is because it has food outlets, which are scarce on campus. It had previously been discussed that food options are the most asked for requirement for spending time in a place.

6.5.2 Space Syntax angular segment analysis

In the space syntax theory, spaces and streets could be ranked from most integrated to most segregated based on the Integration analysis. The more integrated a space or a street is the more likely it is to be a destination location for it is easier to reach from/closer to all other spaces or streets (Hillier, 2007). Research in different cultural settings, scales and environments have shown a clear correlation between the integration of a street and the number of people using it (Bafna, 2003). Another analysis is the Choice analysis (Betweenness) that shows how much a street could be used as the shortest path from and to all other streets, predicting through movement in that street or space (Al-Sayed, 2018). Segment maps are used for finer grained representation where each segment/street is defined by its intersection points with surrounding streets rather than axial maps where streets are represented as continuous lines based on the longest line of sight.

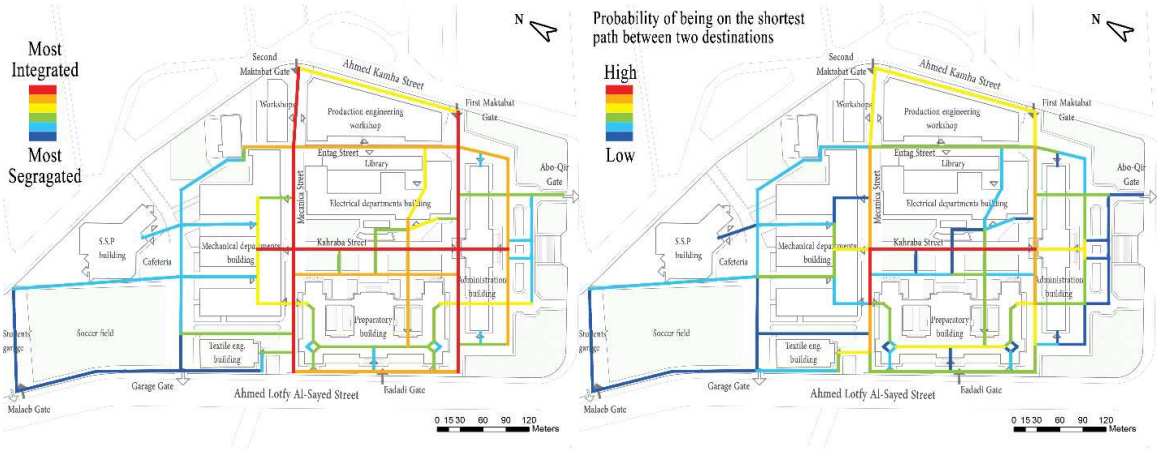

Figure 8 (Left) Space syntax segment Integration map. (Right) Space syntax segment Choice (Betweenness) map.

Comparing between the integration and the choice (Betweenness) maps, the integration map displays a closer result to the routes actually used by the students. It is mainly because the choice map measures the shortest

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paths from each segment to its surrounding ones. While a truer representation would have examined the shorter paths from the segments on the edges of the map to all other segments since students were asked to draw their paths from entrances to destination buildings.

According to both Integration (Figure 8 – Left) and Choice (Figure 8 – Right) analyses, Kahraba Street (Path K) shows the highest values, predicting that it will be home to the highest both to and through movement. The model was indeed proven accurate according to the left of Figure 3 which represents the actual movement. The integration analysis has shown an adequate correlation with the actual current investigation predicting high movement patterns on many other paths such as Path A, B, C and D. This shows their connectedness to the system and ease of movement in these paths.

On the actual movement map, Path M - connecting between Mecanica Street and the S.S.P. building - shows a high movement rate. This activity was unmatched in neither the integration nor the choice analyses. That unrelatedness could be due to the many turns one has to make on that path, which lowers its integration value. This path is usually walked by S.S.P. students as it is the shortest path from an accessible gate to their building.

7 CONCLUSION AND RECOMMENDATION

The study of movement on campus supported by the investigation of gathering spaces is essential to understanding students' needs. Providing students with a proper physical environment to interact will draw them to spend more time on campus. In this study, movement results cannot be generalized on the whole campus because the study was mainly focused on architecture students which restricts their movement to two buildings. However, these two buildings sit on two ends of the campus which stretched the movement patterns along the whole campus area. It was found that students that are more satisfied with the campus' features are bound to spend more time interacting with others. Students were found dissatisfied with their campus physical environment in the Faculty of Engineering in Alexandria University, which in turn affects their sense of ownership, sense of capability of making change, and most definitely the time they spend on campus.

Gathering spaces with more urban design features were found to be more attractive to students. Sitting spaces were found to be a common feature between almost all the gathering spaces. Food and drinks options are most required on the studied campus as they were found to be a very attractive element to students. They were also voted to be the most important factor for students spending more time in a place. Although the cafeteria is considerably far from the campus' main axis revealed from students' movement and space syntax analysis, it still had high activity. Which in turn proposes that providing students with an activity center where multiple food options are available at the far northern end of the campus could expand the movement patterns and increase its dynamic.

Space syntax analysis has proven useful in small urban places such as the investigated campus to predict and determine the most important movement paths. The campus' formal arrangement of buildings could have been an important factor in the successful prediction. The axis created from this arrangement in the center of the campus was found to be the most active movement path and gathering space. The existence of alternative streets for vehicles could be a motivator to turn this street into a pedestrian only street. Implementing ideas envisioned by the students for such a spine to fit their needs will enhance their sense of ownership and belonging.

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🏆 *reviewed paper*

The Possible Role of Brownfields Sites in a Circular Way in the Example of the "Isola Bergamasca"

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1 ABSTRACT

The circular economy looks at systems as a set of components designed to never leave the game, but to reinvent itself a role when the one previously assumed runs out.

In other words, we look at systems as sets in which someone's waste becomes a resource for someone else.

To achieve these objectives, a strong innovative capacity is required and it is necessary to focus on the production of components with a controlled life cycle.

In the circular model, matter is constantly reused, no waste products are present, resources do not decay, but are seen as capable of regenerating. In a context of circularity, the world of research and the world of business meet in a system of relationships guaranteed by territorial political institutions to build opportunities for growth and development.

Territorial planning is certainly one of the activities supported by the circular economy with a view to guaranteeing the real vocation of a territory, safeguarding its natural areas and privileging the choice of areas those already compromised or, in any case, affected by pre-existing interventions.

The concept of circular economy applied to land management appears to be of great use in putting into practice the legislative dictates aimed at containing soil consumption and promoting urban regeneration.

In the definition of uses of the areas, in order to control their evolutionary process, it is necessary to take into account the numerous databases available by crossing specific data, making use of the potential offered by IT tools.

The discussion on the need to restart the world of construction is very topical, but at the same time it is essential to work for interventions to protect the environment and guarantee better quality of life.

In terms of circular economy, it is spontaneous to think interventions in areas that have already been compromised, as suggested by the Law 31/2014 of the Lombardy Region. It is then necessary to verify that the areas chosen are actually suitable to accommodate the proposed transformations.

We have all the information to act correctly; the municipal planning, in its plan documents, has collected them diligently, it is a matter of actually taking into account the information and where it is necessary to intervene on areas that require consumption of new soil or burdened by constraints of different nature, it is necessary to forsee pilot interventions capable of presenting themselves as a manifesto of good practices.

The research work has set itself the objective of identifying the areas of transformation and the brownfield sites within a territorial area choosed as case study, which in the specific case was identified in the so-called Bergamo Island to guide the development of the territory towards an integrated model with characteristics of circularity. L'Isola Bergamasca is made up of a territory that brings together 21 municipalities in the Province of Bergamo. Altogether it has about 120,000 inhabitants. The area is called "Island" because it is enclosed by two rivers, precisely to the east the Brembo river and to the west the Adda river, while to the north it is delimited by Mount Canto. The Adda also marks the border between the provinces of Bergamo and Milan and the provinces of Monza-Brianza and Lecco.

Keywords: Brownfields, Circular economy, Land planning, Urban planning, Regeneration

2 INTRODUCTION

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3 DESCRIPTION OF THE AREA

The "Isola Bergamasca" brings together 21 municipalities in the Province of Bergamo; these are: Ambivere, Bonate Sopra, Bonate Sotto, Bottanuco, Brembate, Brembate di Sopra, Calusco d’Adda, Capriate San Gervasio, Carvico, Chignolo d’Isola, Filago, Madone, Mapello, Medolago, Ponte San Pietro, Presezzo, Solza, Suisio, Sotto il Monte Giovanni XXIII, Terno d’Isola e Villa d’Adda. In order to represent and coordinate territorial policies, the administrations of these municipalities in 1964 established, in the form of free association, the inter-municipal body of the Community of the Isle of the Bergamo land. Overall, this territory has about 121,000 inhabitants in the year 2017.

The triangular shaped territory of the Island extends for about 90 km²; wedged between the river Adda and the river Brembo. The confluence of the latter in the first determines the vertex facing south, while the base facing north is represented by the pre-Alpine belt that separates the plain from the mountainous area. The territory is mainly flat with altitudes ranging from 280 m s.l.m. of Carvico at 150 m a.s.l. of the southern part. The weak reliefs present to the north have their maximum elevation in the 710 m a.s.l. of Mount Canto. In the past, between Carvico and Calusco d’Adda, there was also Mount Giglio, today practically disappeared following the extraction activity, of which it was object, aimed at the production of cement.

In addition to the two large rivers that characterize the island, the territory is crossed by small streams and streams, whose waters are initially collected by the Dordo torrent, coming from the Val S. Martino and finally poured into the Brembo river near Marne, hamlet of Filago. A peculiarity characterizes the Island: built-up areas are arranged mainly on the perimeter of the triangle that identifies it, making a green heart emerge. It is a singular condition in Italy, dictated by the particular morphological conditions, which recalls in a much smaller form the green heart oft he dutch randstatt.

The river Adda represents the western limit that defines the Island. It is a river rich of water, at an alpine regime, which flows in a deep furrow dug in the high plain.

In the southern part of the Island, in the municipality of Capriate San Gervasio, the river Adda laps an important worker village of the late nineteenth century (1875), the village of Crespi d 'Adda, now a

UNESCO heritage site. Throughout history, the river has represented an important commercial communication route both towards Bergamo and, above all, towards Milan. It has been navigable since Roman times; in the Middle Ages Leonardo lived not far from here and dedicated many studies to the Adda; these studies in the following centuries contributed to inspire the construction of navigation channels. The river water feeds several hydroelectric plants, in particular the Semenza plant in the municipality of Calusco d'Adda.

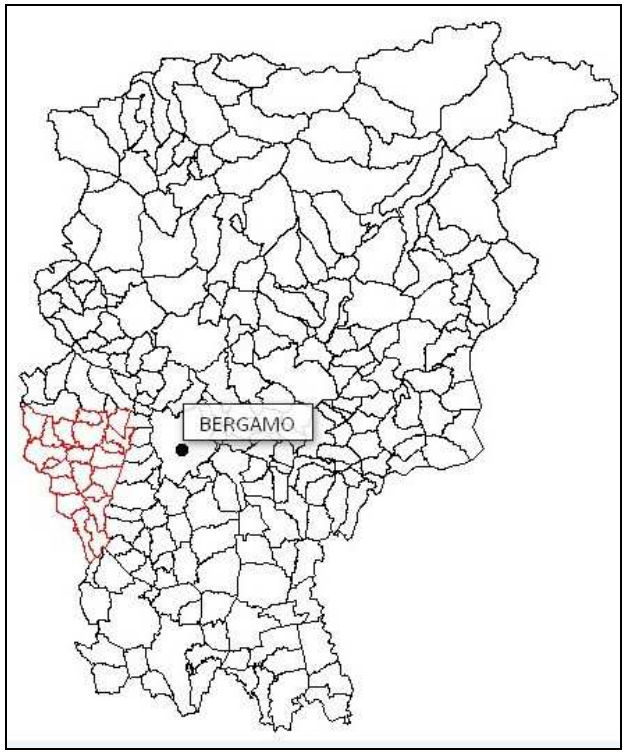

Figure 1 Colour red identifies the mosaic of the municipalities that make up the Bergamo Island, drawing by Vanessa Verdi

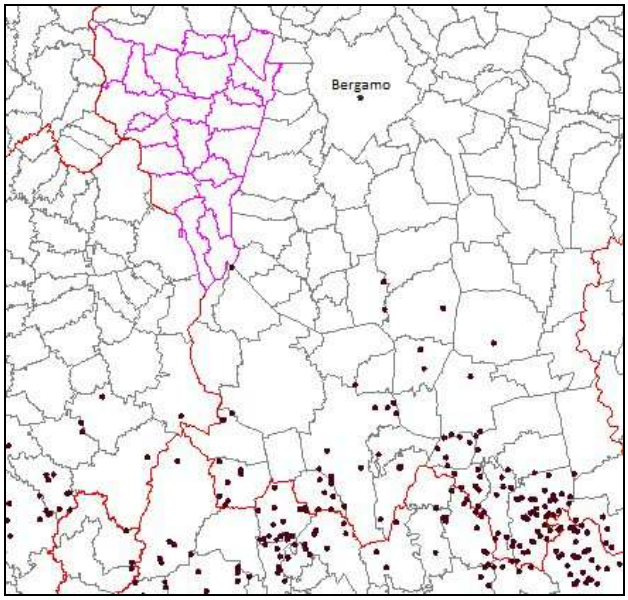

Figure 2 The dotting indicates the characteristic sources of the low plain, whose concentration identifies what is called the sources line, a line that precisely marks the passage between the two types of plain, drawing by Vanessa Verdi

The river Brembo, that represents the eastern limit, instead has an irregular regime. Unlike the river Adda it runs totally in the province of Bergamo. Along its course there are several industries too, including Legler, now dismantled, in the municipality of Ponte San Pietro. The Canto Mount represents an important element in the territory of the Island. It acts as a border towards the Valle San Martino, but at the same time the hilly area has for centuries been a link road with the same valley. In fact, the roads followed the line of the hills for a long time before to follow that of the plain. In front of the hilly system extends the portion of the plain

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which is part of the wider Po plain. The Bergamo plain, apparently uniform, stands out for the "high" plain, dry and permeable, consisting of the debris of rivers, pebbles and gravel, and in the "low" plain, with a bottom consisting of sands and clays and above all rich in waters coming from sources.

The plain of the Island is high and dry; this condition has deeply influenced its history, especially since the advent of advances in agriculture, linked to irrigation, have effectively excluded the dry plains, destined to become poor plains. The natural face of the island was also characteristic and remained so for centuries: the plain was covered with forests of oak, elm, lime, maple and ash trees where the spaces of crops and human settlements barely made space their way.

Knowing and analyzing this aspect, as well as the other characteristics of the territory, is very important for a project as it allows you to understand the future evolutionary scenarios of a place and thus have a clear vision of the context in which you are operating.

3.1 Population

The analysis of the census data shows the tendency of the resident population to increase over the years. With reference to the data of the last population census (2011), a table representative of population density has been constructed.

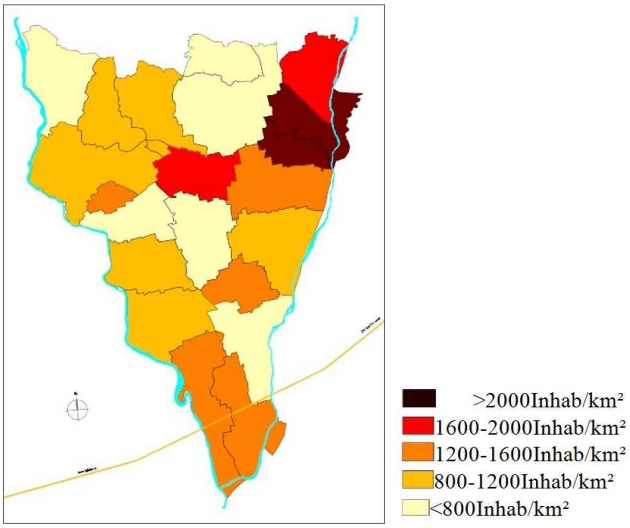

Figure 3 Distribution of population density, represented for the 21 municipalities of the Bergamo island, drawing by Vanessa Verdi

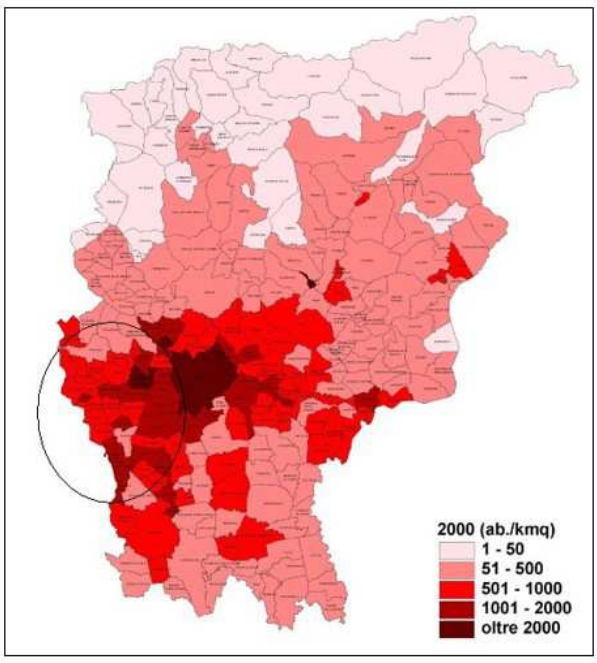

Figure 4 Source: PTCP of the Bergamo province; population density

This image highlights how the territory of the Island is characterized by a high density. In fact, as well as that of the entire Bergamo province, fragmented in numerous municipalities with limited extension compared to the national average of 37.3 km² , the population is distributed more or less homogeneously with densities higher than the provincial average that is be equal to 399.3 inhab / km² , with peaks at the municipalities closest to the city of Bergamo. An image extracted from the PTCP (Territorial Coordination Plan) of the province of Bergamo helps to understand this dynamic; it can be noted that even less populated municipalities within the island such as Villa d'Adda, Mapello, Ambivere, Medolago, Chignolo d'Isola and Filago, have values far above the provincial average. The possible reasons can be traced both to the numerous industrial sites that have attracted a lot of manpower in the past and to the proximity to the cities of Milan and Bergamo, both easily accessible by highway and rail links.

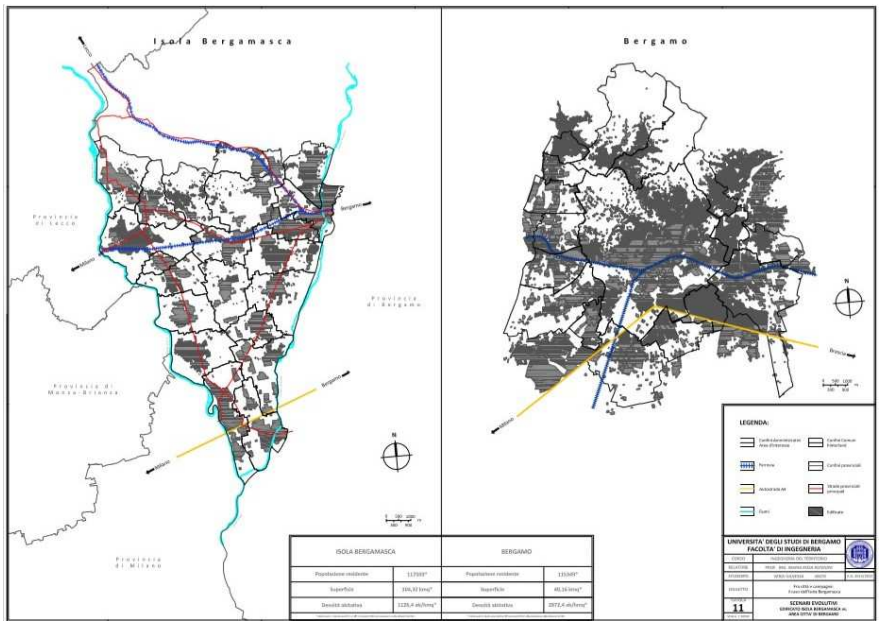

Figure 5 The table compares the territory of the Bergamasca Island with that of the Municipality of Bergamo considering the resident population (117,503 inhabitants against 115,349), the territorial extent (104.32 km² against 40.16 km²) and the consequent population density (1126 , 4 inhabited / km² against 2872.4 inhabited / km²), drawing by Vanessa Verdi

3.2 Mobility

As regards the mobility, it may be of interest to report some maps that help to frame the territory in its context. A map relating to the main road and rail connections, which serve the Island and two schemes depicting deplacements to and from Bergamo and internal ones.

Commuting towards Bergamo is significant, which frames the Island as a satellite of the city. It was not possible to acquire the data for Milan. The internal displacement map underlines the inviolability of the green heart inside the Island.

4 PLANNING TOOLS

An important regulatory reference is the Lombardy Region Regional Law of November 28, 2014 n. 31 "Disposizioni per la riduzione del consumo di suolo e per la riqualificazione del suolo degradato". ("Provisions for the reduction of soil consumption and for the requalification of degraded soil").

The law provides that the instruments of the government of the territory direct their expansions towards areas already built, degraded and abandoned, already waterproofed, to be recovered or regenerated, with the aim of not compromising the environment, the landscape and the agricultural activity. It reiterates that soil is a non-renewable and common good of fundamental importance for environmental balance, health protection, agricultural production aimed at food and defense against hydrogeological instability. Among the objectives of environmental protection there is also that of reaching zero land occupation by 2050.

Main planning tools to which we referred is the following:

Regional Land Plan (PTR) Lombardy Region. Orients, directs and prescribes the choices of territorial and urban planning (government of the territory) formulated by municipalities, provinces, mountain

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communities, park management bodies and any other competent body. It expresses the criteria and the technical guidelines to be applied in the instruments of the government of the territory to contain the expansion on new ground.

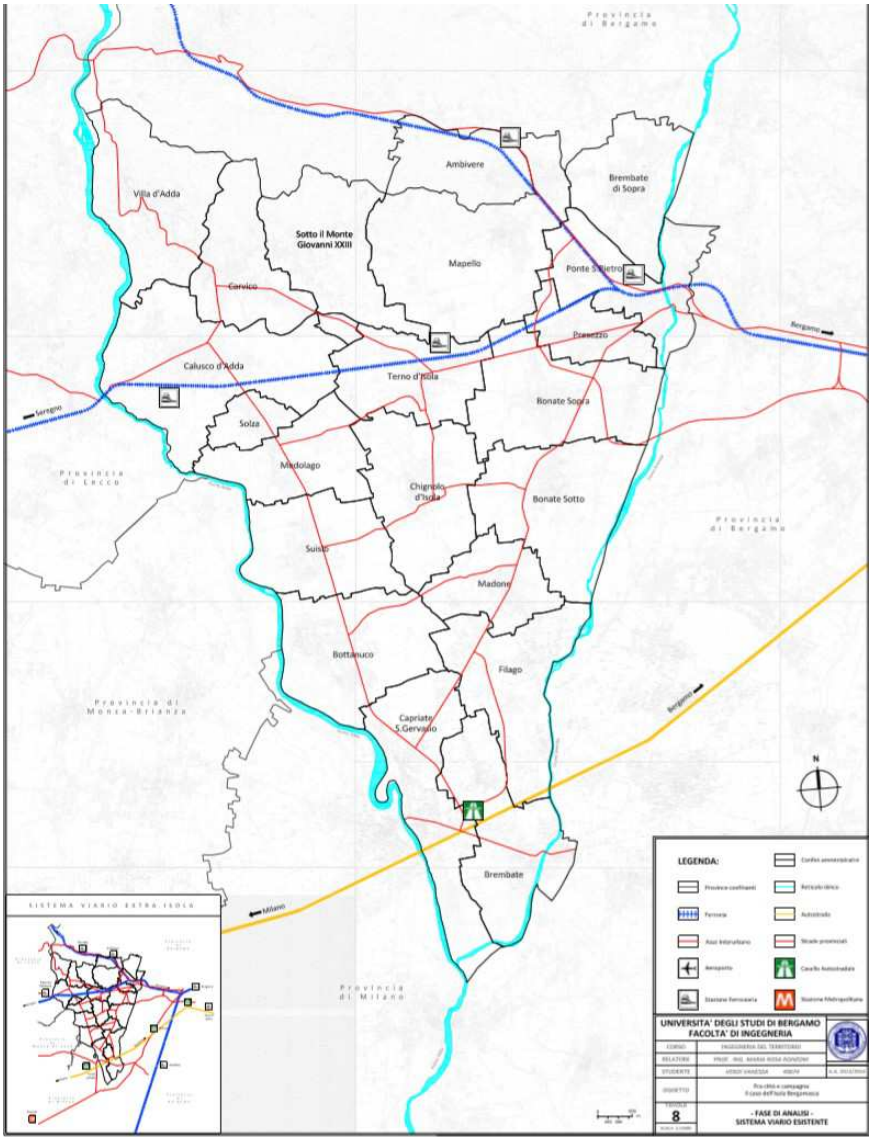

Figure 6 Main roads and rails insisting on the Bergamasca Island, drawing by Vanessa Verdi

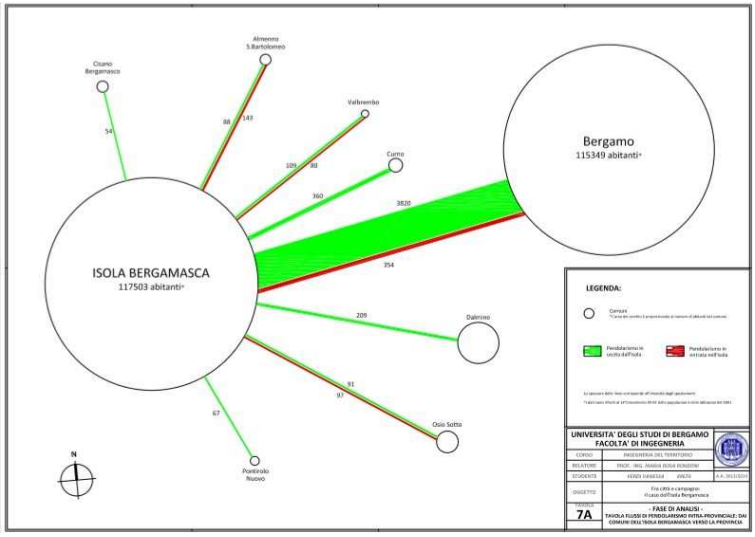

Figure 7 Commuter flows going from the municipalities of the island to the province of Bergamo and back, drawing by Vanessa Verdi

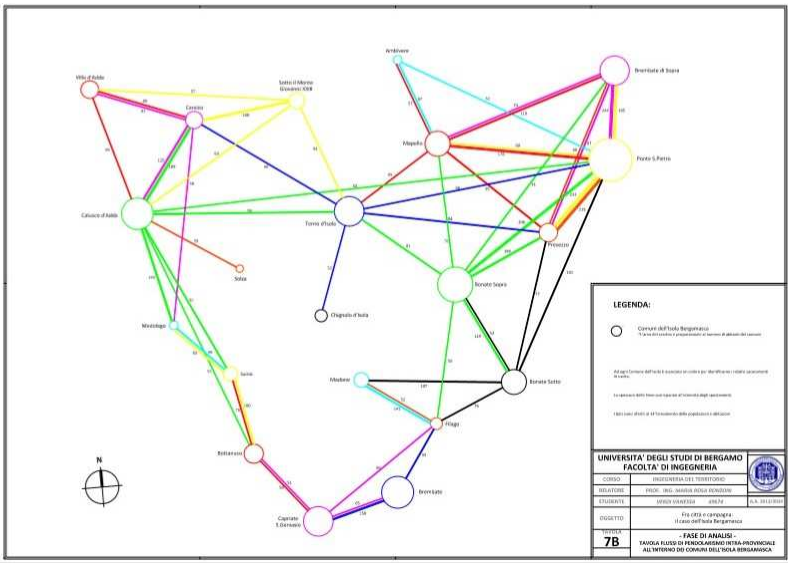

Figure 8 Commuter flows within the Bergamo area, drawing by Vanessa Verdi

P.A.I., Piano di Assetto Idrogeologico, (Hydrogeological Structure Plan), is the cognitive, regulatory and technical-operational tool through which the actions, interventions and rules of use relating to the defense against the hydrogeological risk of the territory are planned and programmed. It is a real territorial planning tool that must be the starting point for the anthropization of the environment. It was introduced by a law in 1998. The P.A.I. is configured as the territorial planning tool through which the Basin Authority aims to determine a territorial structure that ensures conditions of balance and compatibility between the hydrogeological dynamics and the growing anthropization of the territory in order to obtain both the safety of the existing settlements and infrastructures and the compatible development of future activities. The P.A.I. pursues the improvement of the hydrogeological structure of the basin through structural interventions (preventive and for risk reduction) and regulatory provisions for the correct management of the territory, the prevention of new risk situations, the application of safeguard measures in cases of ascertained risk.

PTCP, Piano Territoriale di Coordinamento Provinciale (Provincial Territorial Coordination Plan): coordinates the activities of the municipalities in compliance with the indications of the PTR. It recognizes the need to divide the provincial territory into ambits; in particular, the Bergamasca Island is divided into two ambits: one comprising the municipalities of the foothills and one the municipalities in the flat belt.

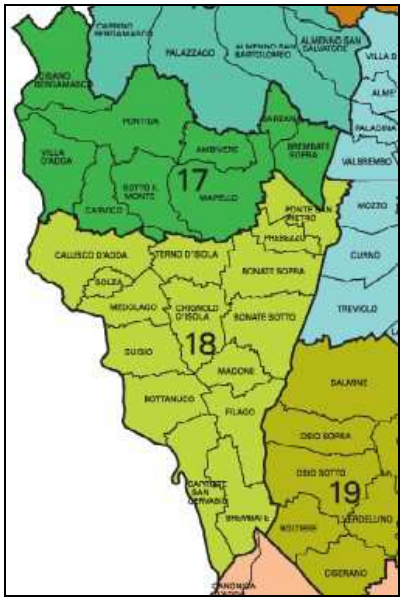

Figure 9 Source: PTCP Bergamo, Extract from Table E5.1, perimeter of the ambits

In order to limit the consumption of soil, the PTCP favors the recovery and enhancement actions of the existing, also ensuring the presence of greenery and mitigation spaces in the event of the construction of new

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buildings and infrastructure. It also incorporates the provisions of the PTR as regards the territory of the island.

An observatory is forseen which periodically monitors the level of soil consumption in relation to built-up and unused spaces using measurement and detection methods.There is also a land use map, it constitutes a necessary and binding prerequisite for the realization of public and private building interventions that also involve a partial consumption of soil and is an integral part of any general or partial variation of the PGT.

In addition, regional funding and simplification measures are envisaged for municipalities operating in the direction of urban regeneration.

PGT, Piano di Governo del Territorio (Land Government Plan). The planning tool in force, in the Lombardy Region, on an urban scale. At municipal level, the Land Government Plan, PGT, provides for the consumption of soil only in cases where the Plan Document demonstrates the technical and economic unsustainability of requalifying already built-up areas or recovering brownfields areas. The municipal instruments of the territory government cannot order new expansion forecasts until the transformation forecasts in force on the date of entry into force of the law have been fully implemented.

For the Island area, all the PGTs of the 21 municipalities that make it up were analyzed and for these were drawn up cards, which systematically report the objectives of the plan, identify the transformation areas, the agricultural areas, the Adda Nord Regional Park and the PLIS (Local Park of Supra-municipal Interest), where present, in addition to the main indications relating to the mobility system. By way of example, two of these cards are reported, relating to the municipalities of Bottanuco and Brembate:

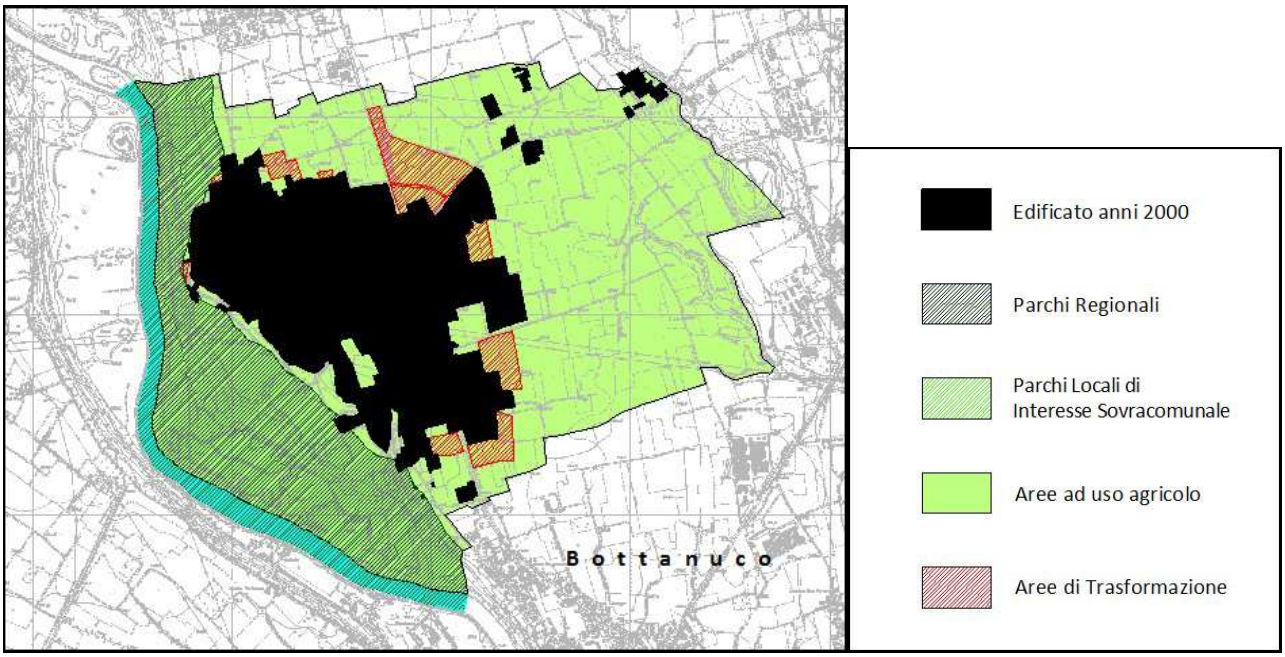

Figure 10 Municipality Bottanuco, drawing by Vanessa Verdi

Targets: minimize land use.

Transformation areas: North of the inhabited center, areas intended for industria are planned to complete the production auction on the Riviera that runs through the Municipality. The remaining areas are instead intended for residential expansion.

Regional Park Adda Nord: the plan provides for the enhancement of the area by proposing the expansion of the territorial perimeter to join the valley in the east of the Municipality and the development of connections between the agricultural and inhabited areas. Particular attention is paid to the redevelopment of the "quarries" area, which occupies a considerable area of the territory, this both from an environmental point of view and as regards services.

Mobility: critical issues are reported regarding the works envisaged in the PTCP such as: the construction of the East Railway Gutter for freight transport which falls south of the territory with a new crossing on the Adda River, the construction of the foothills speedway which does not provide for interconnections with the local road network and would constitute a mere crossing of the Municipality with its environmental and

landscape impact. The construction of a new provincial street parallel to the existing one is envisaged, which would allow the redevelopment of the latter to be planted with trees.

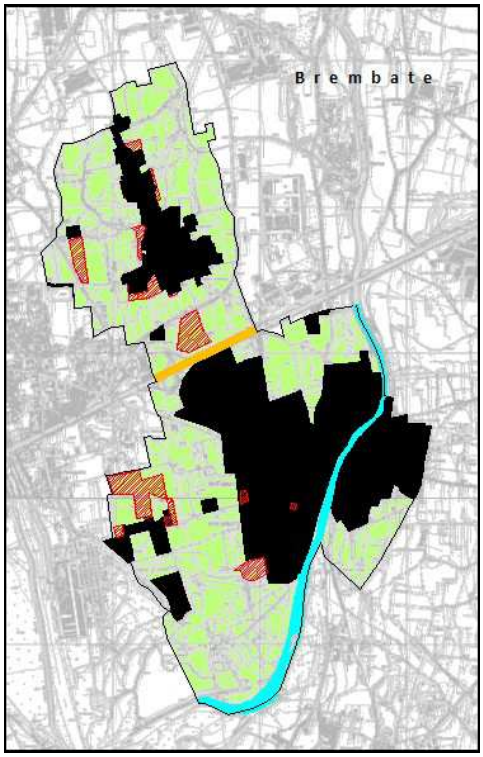

Figure 11 Municipality Brembate, drawing by Vanessa Verdi

Targets: priority is given to actions aimed at redeveloping the appearance of the municipal area, especially with regard to the quality and use of "green" as well as safeguarding the environment.

Transformation areas: they are provided in the internal part of the Municipality and are all residential. New industrial sites are planned in areas close to the A4 motorway.

Agricultural areas: agricultural areas of protection and safeguard are envisaged in which all forms of construction are prohibited, agricultural areas around the settlements and strategic agricultural areas within which to encourage agricultural activities.

Quarries Plan: the PGT acknowledges the prescriptions imposed at provincial level and hypothesizes recovery scenarios.

Mobility: the document incorporates what is indicated at regional and provincial level regarding the construction of the Pedemontana motorway and the related link with Bre.Be.Mi and, as in the case of other interested municipalities, highlights its critical issues regarding the environmental impact and landscaping.

5 TARGETS

The research work has set itself the objective of identifying the areas of transformation and abandoned areas within a territorial area chosen as studies case, which in the specific case has been identified in the so-called "Isola Bergamasca" to address the territorial development towards an integrated model with circular characteristics.

It was divided into the following phases:

Analysis of municipal planning tools and identification of data to be acquired to activate a circularity process. Data relating to the transformation areas provided for in the Land Government Plans of the 21 municipalities making up the Bergamo Island were collected.

Identification of the transformation areas for the functions they will host: residential, commercial or productive.

Identification of brownfield sites in the municipalities covered by the study.

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Superimposition of the hydrogeological risk map to the mapping of transformation and brownfield areas. Balance sheet of areas (transformation and brownfields).

Starting from the PGTs of the municipalities of the Bergamasca Island, the transformation areas for residential and production use have been identified.

At the same time, a classification was made of the brownfields areas on the Island.

This research was carried out by consulting the databases of the Lombardy Region, that of the research laboratory of the University of Bergamo Diathesis and the data available from the municipalities as well as a direct analysis conducted on the site.

Unfortunately, none of the databases identified were found to be complete and often the data collected were not comparable. The information collected was represented on a map.

It was also considered appropriate to proceed with the verification of the possible hydrogeological risk. In this regard, the areas at risk have been identified. The reference was the IFFI Project which documents landslides and hydrogeological instability. Evaluation forms have been created for each municipality, which take into consideration the areas of transformation and the brownfields areas in order to verify whether all or even only a part of the planned volumes could have been built in the disused area. For each municipality located on the Island of Bergamo, a scheme has been produced that documents the dimension of the possible areas in play. The case of Ponte San Pietro is shown as an example.

Municipality	AD1	ATR1	ATR2	ATR3	ATR4	ATR6	ATR7	ATR8	ATR9	ATRR	TOT
Ponte San Pietro	m²	m²	m²	m²	m²	m²	m²	m²	m²	m²	m²
	+155.000	-4.150	-11.643	-2.841	-5.787	-21.429	-14.643	-8.127	-10.100	-17.977	+58.303

AD is brownfield area - ATR are transformations area

As for the areas subject to flooding, with regard to the Adda river, it is noted that only the southern part of the Bergamasca Island, which falls in the municipality of Capriate San Gervasio, is affected by the overflow of the river. The industrial village of Crespi d'Adda, now a brownfield area, insists on this site. This type of flooding is classified with a low hazard level defined as a rare scenario. If we consider the level of risk instead, this area is classified at risk one, (in the risk scale corresponds to a moderate risk) and risk two (in the risk scale corresponds to an average risk). It means that the return time with which this scenario occurs is 500 years and the level of risk can cause marginal social and economic damage to environmental and cultural goods. On the other side of the island, the Brembo river overflows affecting urbanized areas in a small portion in the municipalities of Brembate Sopra, Brembate and Filago. In all these cases, the type of scenario is rare and the risk category is classified as moderate.

Considering also the smaller waterways it can be concluded that the flooding scenarios of rivers and streams in the urbanized territory of the Bergamasca Island are considered rare, with a return time ranging from 200 to 500 years, and at moderate risk. As regards landslides in the Bergamo area, all the areas concerned are far from inhabited and urbanized areas while areas subject to hydrogeological constraints are present in the context of Mount Canto in the municipalities of Ambivere, Carvico, Mapello, Sotto il Monte Giovanni XXIII and Villa d'Adda. Su questa parte del territorio esiste solo un'area di trasformazione ad uso residenziale con consumo di nuova terra nel comune di Sotto il Monte Giovanni XXIII. È soggetto al rispetto della presenza del vincolo idrogeologico.

6 METHODOLOGICAL APPROACH

First, a comparison was made between the past and the current situation to analyze the development of the settlement.

Starting from research on historical maps, comparing the urbanization of the mid-nineteenth century (1842-1843) and the current state, an attempt was made to understand how this evolved on the territory of the island and what the factors were that they determined this distribution. The comparison was possible thanks to the use of maps of the Austrian Land Registry, preserved in the Historical Archive of Bergamo, dating back to the years 1842-1843. The cadastral representations, in the original maps, are in scale 1: 2000 for the general territory and 1: 1000 for the built area, the buildings are marked by maps in pink, the churches are in red and the waterways in blue. The map relating to the Municipality of Ambivere is shown as an example, but the research was conducted for the 21 municipalities of the Island.

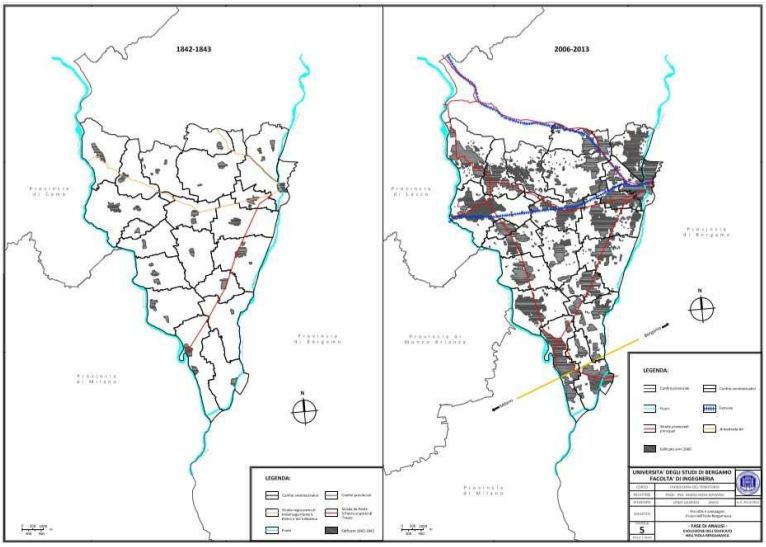

Figure 12 Comparison between the urbanized of the mid-nineteenth century (1842-1843) and the current state, drawing by Vanessa Verdi

Comune	Data mappa	Mappa
Ambivere 	1843	

Figure 13 Source: map of the Austrian Cadastre, Bergamo Historical Archive

6.1 Data collection and municipal planning tools analysis (PGT)

To identify the transformation areas and the brownfields areas in the territory of the Island, planning tools were consulted starting from the regional level expressed by the PTRs, going down to the provincial level with the PTCPs, up to the local level with the PGTs.

The consultation of the tools at regional and provincial level was useful for understanding the guidelines expressed by the territorial planning, while the examination of the PGTs allowed to identify the areas of transformation envisaged in the municipal territories examined, on which it will be possible to intervene in line with what expressed by the Regional Law n.31 on the reduction of land consumption.

Intended use of transformation areas

The analysis of the PGTs of the 21 Municipalities of the Bergamasca Island has made it possible to map this territory by quantifying all the areas of transformation envisaged, divided into areas for production, commercial and residential. The most significant brownfields areas were also identified, in particular those that have the greatest impact in terms of extension.

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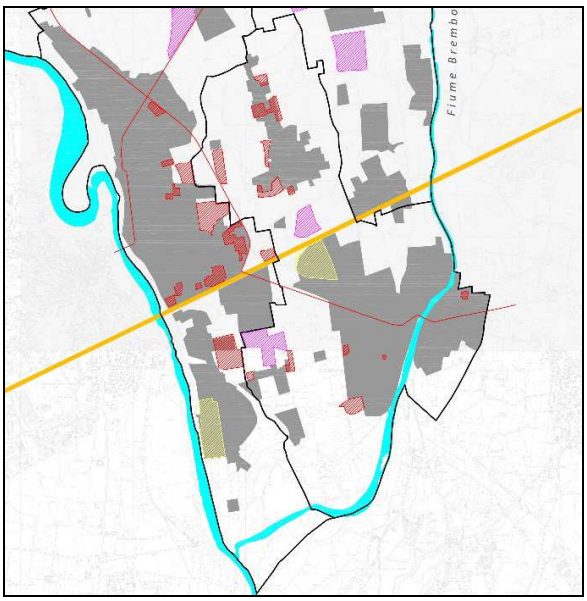


Figure 14 Drawing by Vanessa Verdi and Chiara Grigis

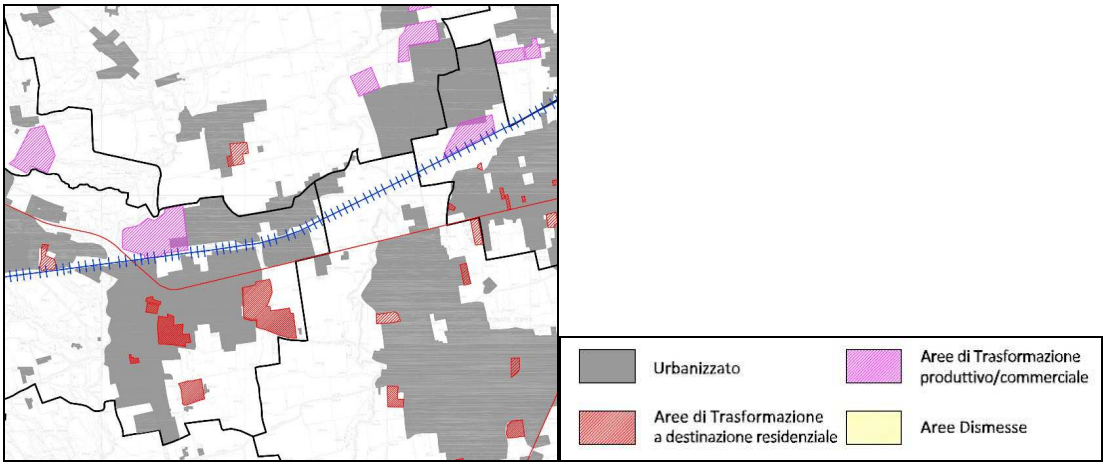


Figure 15 Drawing by Vanessa Verdi and Chiara Grigis

6.2 Balance between transformations areas and brownfields areas

It was decided to differentiate the transformation areas for industrial use from those for residential use by quantifying their respective dimensions. On a map all the information are reported. Together with the transformation areas, some brownfield sites are also reported in order to evaluate what contribution could derive from the re-use of these areas to contain soil consumption in compliance with the needs, as defined in the PGT and also in accordance with the provisions of the Law Regional no. 31 of 2014.

A further map was drawed which the map of the hydrogeological risk areas was superimposed on the map that shows the transformation areas to verify the real aptitude of the transformation areas identified to accommodate new buildings within it.

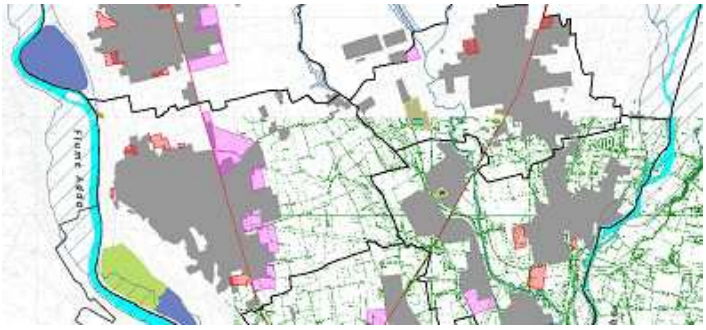
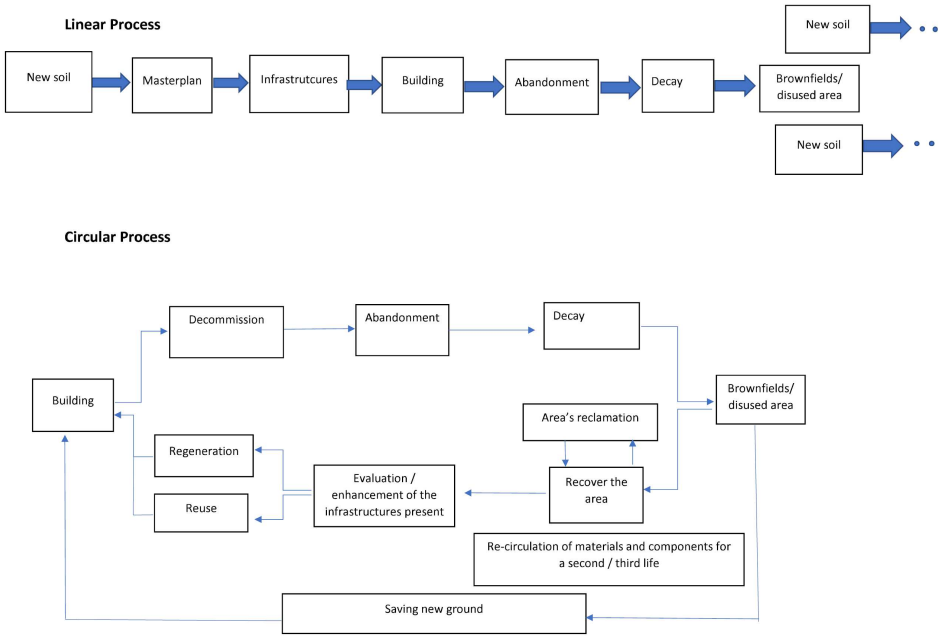


Figure 16 Balance between transformations areas and brownfields sites with superimposed hidrogeological risk areas, drawing by Vanessa Verdi and Chiara Grigis

7 THE CIRCULAR ECONOMY APPLIED TO LAND CONSUMPTION



Bringing abandoned areas back into play traces the principles of the circular economy. The above scheme aims to describe the process that must guide the recovery of the abandoned area with consequent saving of new soil.

8 CONCLUSION

The work is not finished, there is room for further additions and insights. It would be necessary to integrate the research by incorporating all the abandoned areas of the Island, not only the more substantial ones, it would then also be necessary to document the state of occupation of the accommodation, to have a sense of how effectively it can be absorbed by the existing. Finally, a reflection on how to intervene on the building up is also needed to redistribute the buildings where this is possible, this also to reconfigure areas not sufficiently structured. The work wants to be preparatory for a possible regeneration / redevelopment project of this territory aimed at giving greater quality to places and greater dignity for living.

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🏆 *reviewed paper*

The Vertical Urban Factory as a Concept for Mixed Use in Future Cities

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1 ABSTRACT

In many European cities, production in backyards and inner city multi-storey buildings had been part of the cityscape since industrialisation. However, since then, such production spaces have continued to move to greenfield sites and have thereby created monofunctional industrial areas in the periphery. While the drivers for this 'spatial decoupling' are manifold (e.g. economies of scale, mass motorization, land prices, regulatory restrictions), strategies to influence and counteract segregation remain scarce. Mixing residential and working areas contributes significantly to energy-efficient urban development and the achievement of ambitious smart city goals and a lively urban fabric.

While the digital transformation of industrial production ('Industry 4.0') seems to prepare the return of urban industry to mixed-use neighbourhoods, there are still considerable obstacles. Concepts to make production in the city attractive again for companies are currently still the exception. Nonetheless there are approaches in European cities: Berlin adopted a masterplan ('Masterplan Industriestadt Berlin 2018-2021') to improve the framework conditions for industrial companies. The 'Regional Sustainable Development Plan' of the city of Brussels provides support for urban production by planning instruments, such as 'ZEMU' zones; these zones enable a more intensive and mixed-use of industrial land. The spatial development strategy in London, known as 'the London Plan', contains provision for the protection of industrial land within the city.

Against this background, our research project 'Vertical Urban Factory' analyses architectural, legal and transportation parameters for mixing working and residential areas in cities. For the project, we build on the concept of vertical urban factories and explore the potentials of reintegrating multi-storey production in European cities. In doing so, we use Vienna as an example of a typical European city which has recently developed a planning strategy for the 'Productive City'. Based on results from basic scientific research, case studies, best practice examples and numerous interviews with companies, we ultimately develop five innovative, city-compatible and vertically organized building prototypes of 'vertical urban factories'. These consider the existing urban structure, legal restrictions, global and local objectives, production needs and urban freight logistics.

In the present paper, we will give an overview of key results from our project. In doing so, we will introduce essential aspects and characteristics of a 'productive city'. Based on this understanding, we will first discuss architectural parameters and transportation aspects of reintegrating production in cities illustrated by three prototypes. Then, we will engage with legal approaches (e.g. financial incentives, spatial planning instruments) and their framework conditions relevant for enabling production in the city.

Keywords: mixed-use, urban factory, productive city, urban production, regional planning

2 INTRODUCTION

Essential drivers for the relocation of city production premises to monofunctional industrial areas are, beside high land prices and regulatory restrictions, the change in production (from individual manufacturing to mass production) and in consumption over the last centuries. The loss of operating areas and thus of urban workplaces can also be traced back to the increase in the city population, which pressures cities to develop new locations for residential construction. In Vienna, for example, since 2001 the share of space of

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manufacturing enterprises has declined by 16.5 % that of industrial areas by even 30 % (Municipal Department 18, 2017).

In light of the growing scarcity of urban space, measures against a spatial separation of designated living and working areas are urgently required. The consequence of spatial decoupling is that potential synergies cannot be exploited sustainably (e.g. energy/waste heat utilization, cycle and cascade economy, urban value creation, micro-economic local networks). Furthermore, such a segregation induces motorised individual transport, which leads in the end to higher CO2 emissions. A mixed-use structure can therefore help cities on their way to achieve the transformation towards a low-carbon economy.

Industrial production has recently become increasingly efficient, together with lower pollutant and noise emissions. Companies in urban areas benefit from the urban infrastructure, the spatial proximity to customers, training centers, the availability of personnel, especially among specialist staff, as well as the advantages of cooperation with research institutions (universities, universities of applied sciences) and the formation of production networks. In particular the formation of innovative production networks, also known as 'urban manufacturing', is increasingly being perceived as an attractive form of city-compatible production in the immediate vicinity of the consumer. Nowadays, business and industry have modern production methods that can be integrated well in an urban context. Industry 4.0 summarizes production processes that are largely automated or digitized. At the same time, mass production is increasingly being replaced by flexible production in many manufacturing areas. 'Production on Demand', that means not producing on stock and warehousing but adapted to the current demand, opens up new possibilities to produce also in more urban areas.

In 2014, Vienna introduced the 'Urban Development Plan Vienna – STEP 2025', which contains targets to be achieved by 2025 (Municipal Department 18, 2014). The STEP 2025 is supplemented by various specialist concepts, e.g. 'Productive City' and 'Public Space' concepts. The 'Productive City' concept (Municipal Department 18, 2017) contains areas that should be kept available to promote urban production. Further, the concept provides a city map with possible future production locations. These designated areas can be used as the basis for the location of prototypes of vertical urban production.

The vertical production promotes building density and thus also an efficient and city-compatible design of logistics systems and intelligent transport and traffic concepts. However, there is also the challenge of integrating freight transport necessary for urban production into liveable cities. We developed prototypes for vertical urban factories that reflect the challenges and show possible solutions. A more detailed analysis of the transportation parameters for the 'Vertical Urban Factory' project is presented in the paper of Frey H. et al (in press).

3 PROTOTYPES

For our purposes, the urban structure of Vienna can be divided into three different types of areas for production facilities: integrated individual production facility, mixed commercial area and industrial-commercial area. These types correspond to the areas defined in the city's thematic concept 'Productive City' (Municipal Department 18, 2017). The integrated individual production facility is a single factory, embedded in a dense urban structure with mainly residential use. Existing factories of this type are usually historic ones that were built in an industrial area where residential buildings have approached with city expansion. Mixed commercial areas combine residential, commercial and industrial use. Such areas have generally been densified more recently and still show lower building density. Industrial-commercial areas can be found usually on the outskirts of the city. They have no residential buildings, mostly hall constructions and spacious traffic areas.

We present three different prototypes of vertical urban factories. They reflect common challenges according to the type of area as well as suitable solutions. Certain principles of transport planning are part of all the prototypes. These include priority access by public transport, walking and cycling and bicycle parking close to the entrance. Yellow shaded areas inside the buildings are 'access cores' featuring logistics areas, elevators and staircases. Underground parking was included in the prototypes to account for existing laws requiring car parking.[1] We would like to state that on-site parking is not in line with global and city

[1] For example, Gesetz über das Einstellen von Kraftfahrzeugen, kraftbetriebene Parkeinrichtungen und Tankstellen in Wien (Wiener Garagengesetz 2008), State Law Gazette I 2009/34, last amended by State Law Gazette I 2018/71.

objectives to reduce private car use. It creates an advantage for the use of private cars compared to public transport (see e.g. Parikesit D., 1996; Knoflacher H., 2006 and Emberger G., Pfaffenbichler P., 2017).

3.1 Integrated individual production facility

Prototype 1 represents the variant of a commercial courtyard. Several small and medium-sized businesses share a building or a building complex as tenants. Suitable locations are mixed urban areas with good connections to urban infrastructure and customer proximity. Commercial estates are rented by very different companies from trade, craft, service and the creative sector. Advantages result from the possibility of synergistic use of rooms (e.g. meeting and event rooms), resources (e.g. raw materials) or sharing of transport, storage and logistics infrastructure. A focus on certain industries (e.g. recycling/re-use; food direct marketer) could further increase the attractiveness. Fitness, sport and leisure facilities or co-working spaces could be provided as a structural separation from the adjacent residential development - here in the crossbar.

A particular challenge of this prototype is the conflict of space in the densely built environment. One solution for this are sharing concepts. In our prototype, the courtyard serves as a shared logistics and meeting area. Large delivery trucks can access the courtyard in a one-way manner, though use of smaller vehicles such as cargo bikes is encouraged by designated cargo bike parking. Outside the building, in public space, is a ‘multifunctional lane’ which can serve as delivery zone, parking space or seating area depending on the time of day and year. Figure 1 to Figure 4 show the 3D visualization, urban structure, material and people flows and transportation concept of the prototype.

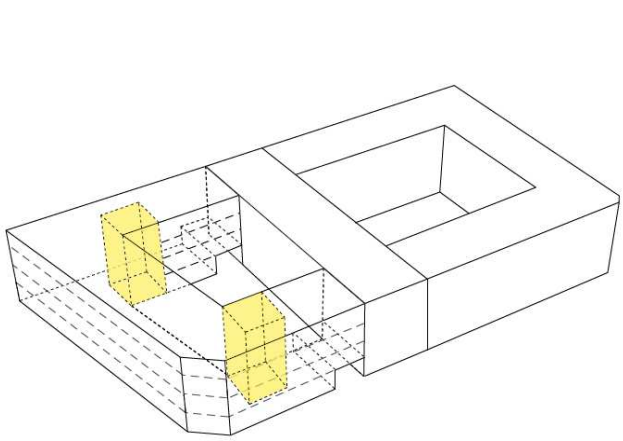

Figure 1 (left): 3D visualization prototype integrated individual production facility. Figure 2 (right): Urban structure integrated individual production facility

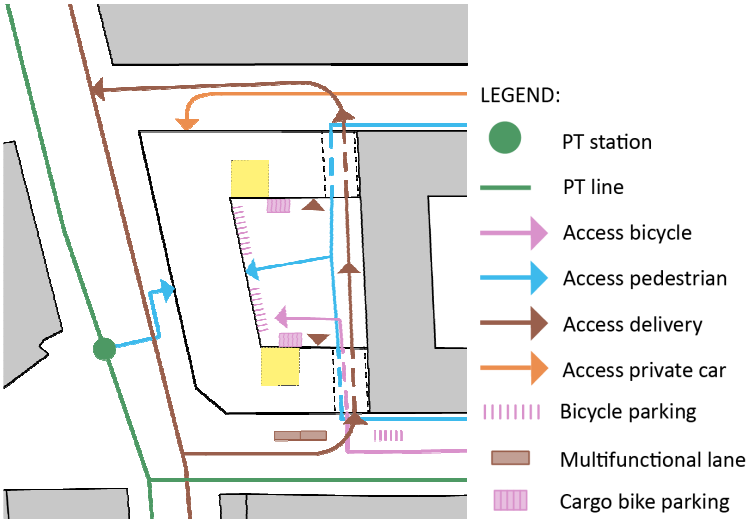

Figure 3: Transportation concept integrated individual production facility

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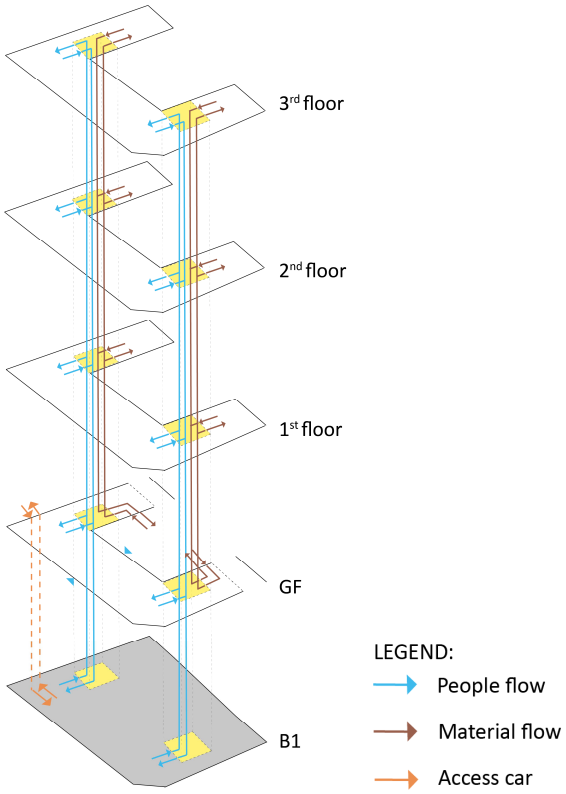

Figure 4: People and material flow integrated individual production facility. GF…Ground floor, B…Basement

3.2 High-Rise Building

Prototype 2 is planned as a high-rise building and therefore as a prototype for low space availability. Similar to the industrial estate, several companies share the available production space as tenants. Usable space can be rented to different companies per floor. Each level offers the possibility of its own access. Ceiling heights of up to 6 meters allow individual expansion and installation of mezzanines. Financing, construction and administration are carried out by operating companies, as is the case with commercial yards. This prototype has its location in the outskirts with large-volume buildings, e.g. urban expansion areas from the 1960s. As a 'catalyst', the production building can contribute to diversity and a mix of uses for the city quarter. Start-up companies from all industries that appreciate the proximity to research and educational institutions are particularly addressed. Similar to the commercial center, there are synergies for the joint use of rooms, resources and infrastructure. Building sections with multifunctional use (e.g. cultural and event rooms) are conceivable as a structural separation from residential construction.

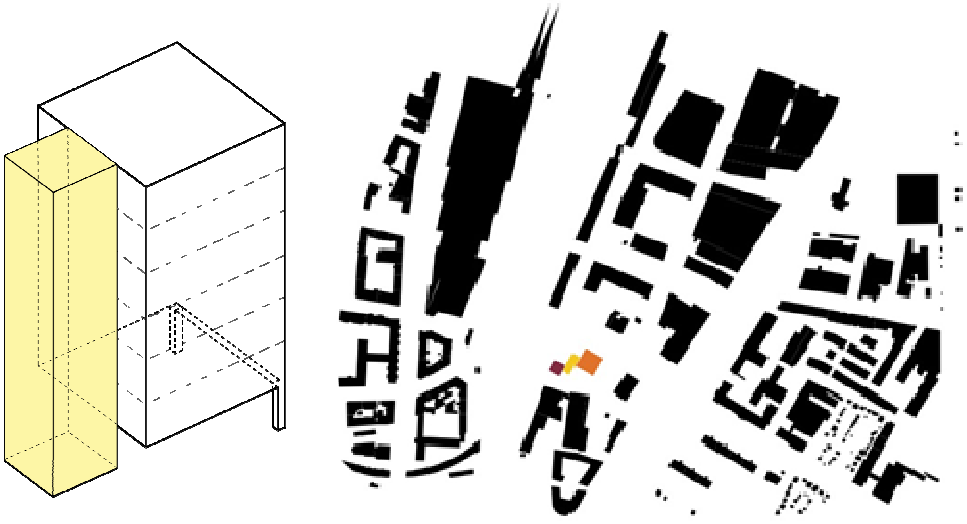

Figure 5 (left): 3D visualization prototype high-rise building. Figure 6 (right): Urban structure high-rise building

For this protoype, we developed a concept where all logistics areas are shared and placed at the open ground floor level in order to save space. Access for people and delivery vehicles is located directly at the 'access core' (marked yellow). Given enough space at the back of the building, even large delivery trucks are able to access. Parking spaces for smaller vehicles such as cargo bicylces are located close to the delivery access, next to the logistics and storage area.

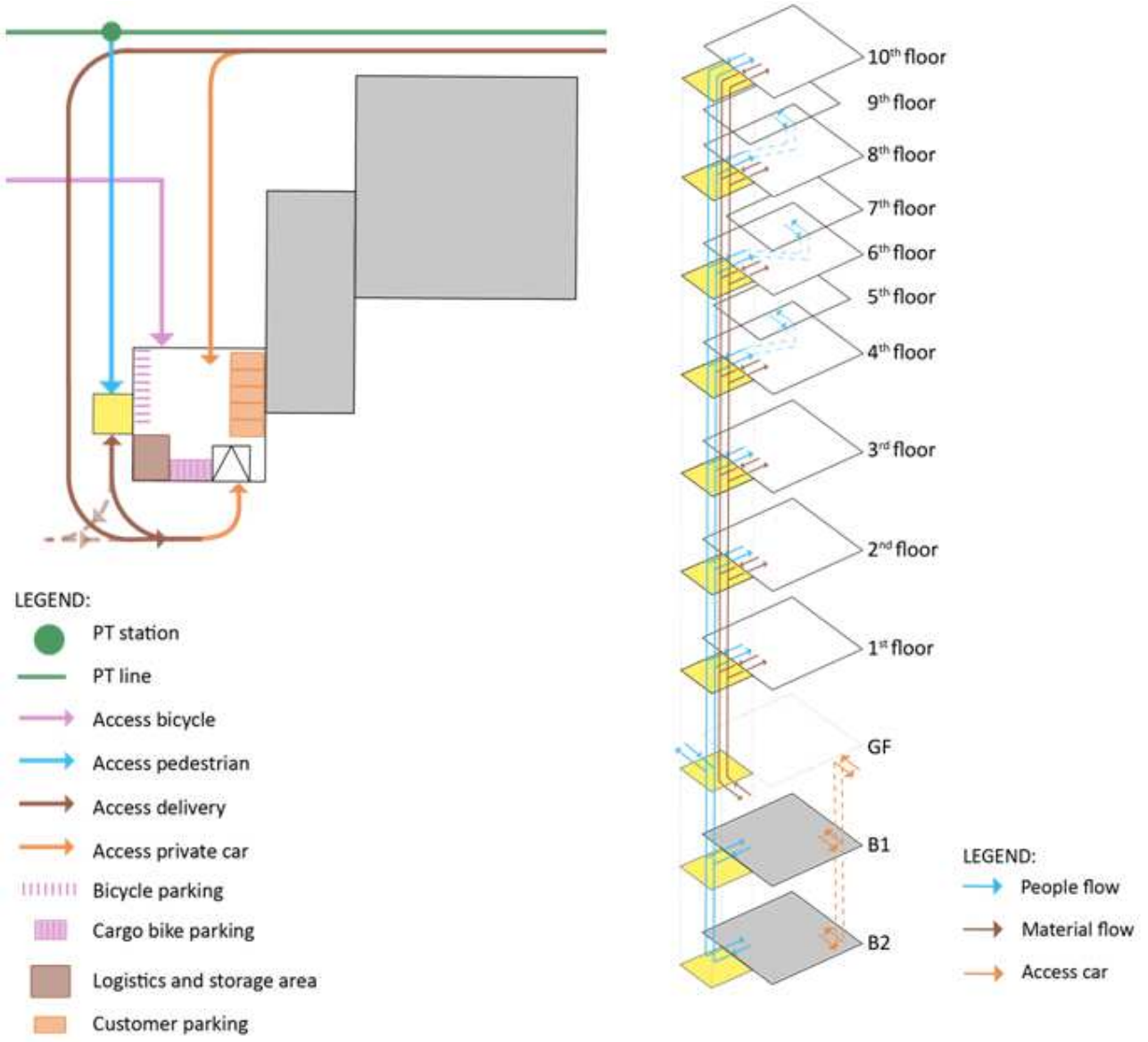

Figure 7 (left): Transportation concept high-rise building. Figure 8 (right): People and material flow integrated high-rise building. GF…Ground floor, B…Basement

3.3 Row Building

Prototype 3 is designed for locations in mixed commercial areas and for companies with high requirements of usable space. In addition, future expansion of operations should be secured by potential areas. The proximity and infrastructural connection to specific research sectors (e.g. pharmaceuticals, health and medicine) could represent an additional benefit. The row type takes into account several parallel production processes in different building sections. The floor plans can be flexibly divided into smaller units. The building complex is spatially distant from the surrounding (residential) buildings and clearly delimited. A common use of company social infrastructure (e.g. event rooms, company restaurant) or green and open spaces in between could be planned. Unused waste heat potential from production could supply surrounding residential buildings. Depending on the industry, a high potential for circular economy and recycling of residues could also be generated.

This prototype serves as a kind of buffer between the residential area on one side of the building and a transportation axis on the other side, such as train tracks or a high-level street. Access for pedestrians and

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cyclists is given at the residential side whereas access for delivery vehicles and space for logistics areas are located at the side of the transportation axis. This way, residents and people accessing the building are shielded from noise and exhausts.

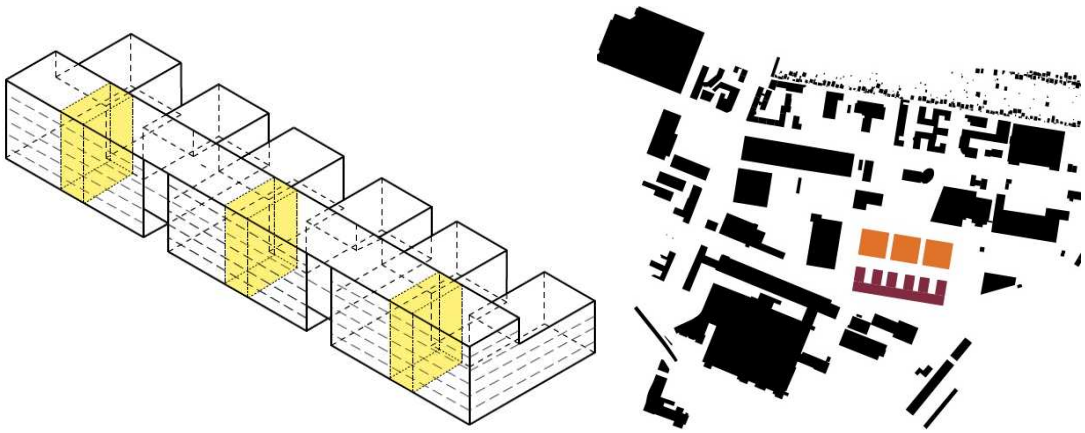

Figure 9 (left): 3D visualization prototype row building. Figure 10 (right): Urban structure row building

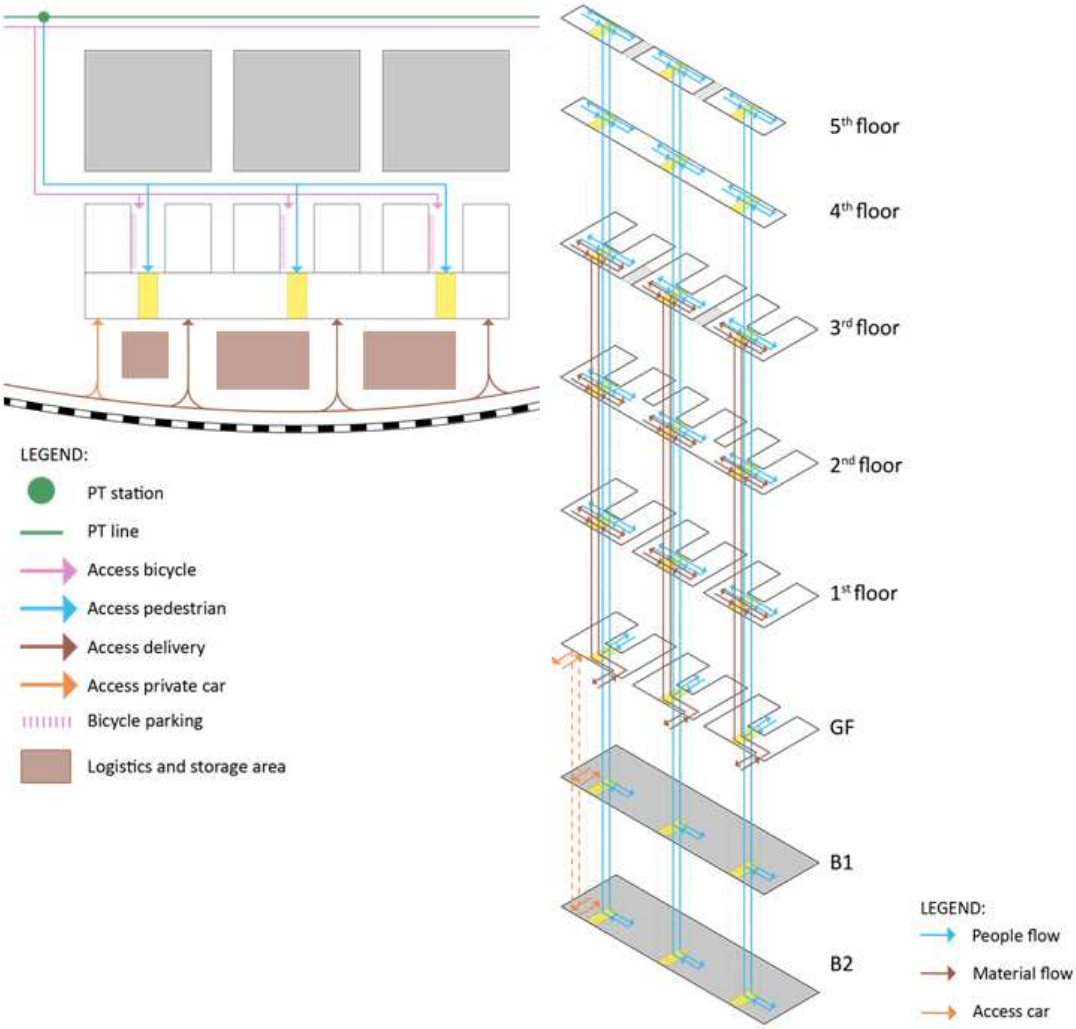

Figure 11 (left): Transportation concept row building. Figure 12 (right): People and material flow row building. GF…Ground floor, B…Basement

4 LEGAL APPROACHES FOR INTERMIXING WORKING AND HOUSING

The intermixing of working and housing contributes essentially to an innovative and sustainable urban development. Scarcity of space increasingly leads to calls for developing mixed-use structures and stacked functions allowing to achieve synergies in the sense of the urban planning model of the ‘city of short distances’ (approaches for achieving a ‘city of short distances’, see Madner V., Grob L.-M., 2019).

In the light of these considerations, we first focused on identifying legal requirements for the promotion of a mixed-use structure and the (vertical) production within the city of Vienna. We found that there are no provisions explicitly prescribing the intermixing of working and housing. However, at the same time, we found that certain factors including legal requirements in practice indeed lead to the emergence of a mixed-use structure. These factors include financial measures, regional and local planning instruments as well as approval procedures. Against this background, this chapter gives an overview of potential factors including legal requirements, which (indirectly) affect the emergence of mixed-use structures.

One factor, which may have an impact on the emergence of mixed-use structures, are financial incentives. These include, in particular, numerous tax measures such as the commuter tax allowance or various municipal taxes, e.g. the property tax. The purpose of the commuter tax allowance is to compensate employees' traffic expenses for their distance between workplace and residence, which means that the existing tax benefit does not create an incentive for achieving mixed-used neighbourhoods. Another potentially relevant instrument under Austrian tax law is the so-called 'Verkehrsanschlussabgabe': Municipalities are entitled to levy charges on businesses in order to cover costs of connecting their premises to public transport. In this way, businesses profiting from local public transport – in particular those built on greenfield sites such as shopping centres or leisure parks – are supposed to contribute to the costs of such public transport. However, as municipalities compete to attract businesses, no municipality in Austria has so far levied such a charge. Apart from taxes, relevant financial measures also include subsidies. In fact, there exist numerous subsidies, which indirectly influence the intermixing of working and housing as well as the production within the city.

Another factor, which has a significant impact on (the prevention of) 'spatial decoupling' concerns the field of spatial planning. In Austria, the legislative and executive power in this area lies largely with the Länder (states). The states adopt not only rules laying down principles and objectives for regional planning strategies and concepts but also legal provisions on land-use plans.

As regards planning strategies, the city of Vienna (which is also a state with legislative powers) recently introduced the 'Productive City' concept (Municipal Department 18, 2017). This overarching strategy, underlines the importance of production within the city. The aim of the concept is to strengthen the urban productive sector by providing and maintaining suitable and sufficient production areas. To this end, the 'Productive City' concept introduces three types of areas, serving as a long-term, spatial orientation for the city administration in order to secure existing and develop new business locations. The three different types are industrial-commercial area, mixed commercial area and integrated individual production facility. The categories differ with a view to permissible usage and the following parameters include location, infrastructure, emissions and mobility. Despite the clear commitment to provide spatial capacities for production sites within the city of Vienna, it should be noted that the 'Productive City' concept is not legally binding for further planning instruments. However, the concept represents a strategic orientiation function for the planning authority in Vienna (for details see Donner C. et al, 2014).

As regards legally binding planning instruments, the land-use plan has to conform to the requirements stipulated in Vienna's spatial planning act ('Bauordnung für Wien').[2] This act determines permitted land uses and distinguishes between different zoning types, for example residential zones, commercial zones, mixed zones and industrial zones. These zones differ with regard to permissible uses and the extent of pollution (noise, dust, smell etc.). Whereas residential zones are mainly suited for housing, mixed zones combine usage for residential and production purposes.

On this basis, the municipal council of Vienna enacts the (legally binding) land-use plan, designating which areas fall under which of the different land-use plan zones. Thus, it becomes obvious that the local planning authority has considerable influence on the mixing of working and housing within the city.

Against this background, our legal analysis showed that mixed-use neighbourhoods can be achieved both by designating a mixed zone next to an industrial zone or within one type of zone, by differentiating between either floor levels or adjacent properties (for details see Grob, 2018). However, the spatial planning act permits a mixed-use structure only within residential zones and mixed zones. In this regard, it is essential that buildings within these two zoning types must be compatible with the intended usage and must not lead

[2] Wiener Stadtentwicklungs-, Stadtplanungs- und Baugesetzbuch (Bauordnung für Wien), State Law Gazette I 1930/11, last amended by State Law Gazette I 2018/71.

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to any dangers and excessive disturbances for the neighbours. In this regard, it is noteworthy that the two zoning types for mixed-use structures in Vienna – residential zones and mixed zones – correspond approximately to the mixed commercial areas and integrated individual production facility identified in the 'Productive City' concept. Moreover, it deserves mention that the Vienna land-use plan also contains binding specifications for building development, such as building height or building density, which have significant effect for vertical production processes.

In light of the above, it becomes clear that spatial planning has a great potential for counteracting spatial segregation, in particular at the local planning level. However, it has to be kept in mind that property owners are not obliged to build and thus to actually realise the intended usages laid down in the land-use plan. Therefore, municipalities often have to designate additional (residential) zones – often in the periphery – to cover the demand for housing and working space. This often undermines the realisation of mixed-use neighbourhoods and a lively urban fabric. In order to counteract this problem and prevent further urban sprawl, municipalities can decide to attach a time limit to the designation of (residential) zones. If the newly designated residential zone is not used accordingly within the limited period (i.e. no buildings are being built), the municipality may alter zoning type, e.g. from residential zone to green zone, where neither residential nor production usage is permitted.

The actual implementation of urban production – ie the construction or amendment of business premises – requires special permits. Due to the federal distribution of competences anchored in the Austrian constitution, both the federal government (as legislator for industrial law) and the federal states (as legislators for building law) may enact regulations regarding the development of urban production sites. Usually both a building permit and an industrial installation permit are required.

The building permit procedure reviews inter alia whether the newly constructed or amended building is in compliance with the demands set out in the land-use plan, e.g. zoning type, building height and density. In addition, the building laws aim to protect residential neighbours from industrial or commercial pollution (noise, dust, smell etc.). Furthermore – according to the case law of the Constitutional Court that has been taken up by some state legislators (including Vienna) – also urban producers have the right to take legal action against new residential developments that may cause conflict because of their proximity to the production site.

The development and amendment of urban production sites usually requires an industrial installation permit. This permit procedure also aims to protect neighbours either from a threat to their life or health, or from nuisances through noise, odours or other emissions. Although urban producers have the right to take legal action against new residential developments in the context of the building permit procedure, at the same time the industrial installation permitting procedure can result in obligations to restrict production to protect health interests of residential neighbours (enacted by industrial installation law authority). This lack of legal certainty is one of the drivers for the relocation of production to greenfields as well as industrial and commercial parks working against mixed-use structures.

5 CONCLUSION

The previous explanations have shown modular models of vertically organized and urban integrated building typologies. Depending on the type of area, type of development or infrastructural conditions, very different space-saving concepts are possible, which can be adapted according to company-specific requirements. Space requirements, building equipment, spatial planning aspects, options for mixed use with residential construction, energy potential, noise and emissions protection, legal aspects as well as aspects of traffic and logistics were included in the considerations. These model types show that the multi-storey construction is a real viable alternative for limited space and urban production. The compact design and organization of the production processes in a multi-storey building is not only possible from an economic point of view, depending on the type of production, but is also generally more cost-effective to implement.

Regarding transportation parameters, vertical urban factories in densley built-up areas would best fulfil policy objectives. There are restrictions for motorized individual transport but in view of new production techniques and smaller lot sizes, smaller vehicles, alternative engines and cargo bikes could play a major role in the future of urban freight and render production more compatible with the urban environment. A high

potential for vertical urban factories can also be seen in mixed commercial areas with space reserves that will be subject to densification.

The analysis of the legal framework shows that the approaches for the intermixing of working and residential usage are manifold: The relevant legal provisions range from financial incentives over strategic planning, such as the 'Productive City' concept and legally binding determinations in the land-use plan to legal requirements regarding the approval procedures. We found that the Austrian tax law provides no incentives for businesses to contribute to mixed-use neighbourhoods so far. With the instrument of the 'Verkehrsanschlussabgabe', the municipalities would have a direct steering effect on the development of mixed-use structures; however, this "lever" is currently not made use of. As a result of the federal distribution of competences parallel approval procedures are required, such as building permit and industrial installation permit procedures. Approaches for their coordination as well as for overcoming duplication are available, e.g. common procedure. The conflict-free (re)integration of (vertical) production in the city may indeed represent a challenge, especially with regard to neighbourhood protection. To this end, it is essential to communicate early with the residential neighbours and involve them in the planning process.

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🏆 *reviewed paper*

The Viennese Building Stock from 1920 to 2018: a Prototype Model

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1 ABSTRACT

Historical urban archives and todays geospatial data provide rich information about the development of settlements. The goal of our study is to show the historical development of the building stock in the city of Vienna. We developed a spatial-temporal model and tested its application on the Viennese 18th district. Four steps were carried out. First, we made a 3D reconstruction of the building stock of 1920. We digitalized historical city maps and manually converted them into vector data. The building heights originate from a historical building registry and the construction period from a historical thematic map. Second, we used the existing building stock model for 2018 from the city government and attributed the construction period to each building. To get the best quality data on the construction periods, we merged three different spatial datasets from the city of Vienna. Third, we developed an algorithm to compare the building stock of 1920 and 2018. The comparative analysis produced thematic maps with demolished and newly constructed buildings. Fourth, we used these bottom-up results and developed an optimization model to determine the construction and demolition rates over time. We found that the total built area increased from 0,8 to 1,1 Mio m². About 0.02 Mio m² have been demolished and replaced with about 0.03 Mio m². About 0.02 Mio m³ have been newly constructed without prior demolition. The annual demolition rate (demolished built area over total built area) ranges between 0.1 and 0.3% p.a. The annual construction rate (constructed built area over total built area) steadily declines from 1.3% p.a. in 1920 to 0.3% p.a. in 2018. In the future, we will extend the geographical scope of the analysis to the entire city. At the end of the project, the datasets will be available under a creative common license and can be used for applications in the field of urban history and cultural heritage research.

Keywords: geographical, spatial, building stock, development, trends

2 INTRODUCTION

2.1 State-of-the art modelling approaches

Settlements, its buildings and infrastructure, change their physical apperance over space and time. Urban archives are viable information pools to recontruct historic urban patterns, and present GIS-based building stock models provide accurate physical building paramters (location, built area and volume). Despite other purposes, researchers use the historical tracking of settlement data to estimate the material flows and stocks associated with buildings and infrastructure. The latest overview on material stock and flow models for the built environment is given by Lanau et al. (2019). The review shows three distinctive approaches for dynamic modelling of the housing stock. First, using statistics with physical building paramters over time (e.g. Aksözen et al. 2017, B. Müller 2006). Second, using GIS-based building stock models to estimate building stock paramters of today, and using statistics and backwards calculation to estimate physical paramter of the past (e.g. Džubur and Laner 2018, Lederer et al. 2019). Third, using GIS-based building stock models at different points in time to analyse spatio-temporal changes. For instance, Tanikawa and Hashimoto (2009) analyzed the changes of Salford in Manchester, UK, from 1849 to 2004. Another example is given by Kleemann et al. (2016), who used a change detection methodology based on areal images to identify demolished buildings between 2013 and 2014. This third approach is addressed in this conference paper.

2.2 Aim and structure of the paper

The aim of this conference paper is to characterize the spatio-temporal development of the building stock in Vienna. We established a modelling approach (section 3.1), defined the system boundries in time and space (section 3.2), collected and digitalized raw data (section 3.3), established a city map of 1920 and 2018 (section 3.4, 3.5), made a spatio-temporal comparsion of the buildings between 1920 and 2018 (section 3.6) and finally estimated the development of the built area per building (section3.7). The results are presented in section 4.

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It is noted that collecting and digitalizing historical data are very time consuming. For this reason, we developed a protoype that limits the geographical scope to a relatively small area in the city of Vienna (section 2.2.1). The development of the protopye enabled us to develop an effective and effizent way for collecting and processing relevant data. In the future, we will use the same modelling approach and extend the geographical scope to the entire city.

3 MATERIALS AND METHODS

3.1 Modelling approach

The goal of our study is to identify spatio-temporal changes in the Viennese building stock between 1920 and 2018. Basically, we compare city maps of two different points in time, which enables the identification of buildings that have been demolished, replaced and constructed. To run the analysis, we developed a modelling approach as given in in Fig. 2. First, we defined the system boundaries in space and time. Second, we were looking for historical raw data in archives. As most of the data are available in analog format only, we converted them into a machine readable-format. Third, we linked the digital raw data and established a city of map 1920 by mapping all buildings in a geographical information system (GIS) and added the attributes, built area, volume and construction period. Fourth, we compiled datasets from the city government and established a city map for 2018, including the attributes volume and construction period for each building. Fifth, we used the spatial and temporal dimensions of each building (location, built area, construction period) and compared the 1920 and 2018 city maps. This allows identification of buildings that have been demolished and newly constructed. Sixth and last, we used the bottom-up data and estimated the annual rates of demolished and constructed buildings.

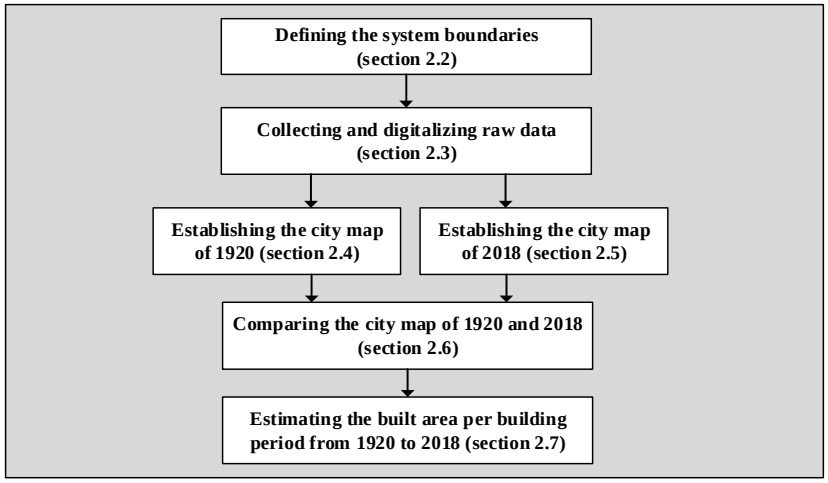

Fig. 1: Overview of the modelling approach. Each task corresponds with one of the subsequent sections in this paper.

3.2 Defining the system boundaries

3.2.1 Geographical scope

We developed the prototype for the cadastral communities 1501 (Gersthof), 1514 (Währing) und 1515 (Weinhaus), which are largly located in the 18th district in the city of Vienna, Austria (Fig. 2). The selection of this case study area has three reasons. First, the urban development of the area is well documented by Eigler (1990). This gives us the opportunity to put the development of the building stock in urban planning perspective. Second, we as study authors know the 18th district very well. To know the way around the place helps to interpret, process and validate building data. Third, a vector-based map was available including all buildings in the study area at the year 1920. The map was produced by Friedrich Hauer, deliverd to the Wiener Stadt- und Landesarchiv and published in the “Historischer Atlas von Wien (Wiener Stadt- und Landesarchiv 2015).

3.2.2 Temporal scope

We analysed the development of the bulding stock from 1920 to 2018. We started with 1920, because it marks a turning point in the demographic and political development and the building culture and urban design. In a demographic perspective, the population peaked in 1920 at about 2 Mio inhabitants. This was

the highest number in the city's history. From a political perspective, the Austrian-Hungarian monarchy (1867-1918) ended and the the first republic started (1918-1938). Furthermore, the urban design and architectural culture changed drastically. In 1918, the so-called founder period (in German: Gründerzeit) ended and therewith the building block structure and the representative building culture of the empire. Between 1923 and 1934, the socio-democrats implemented a social housing program and constructured close to 70'000 apartments, which gave home to about 10% of the total population (Stadt Wien 2019a).

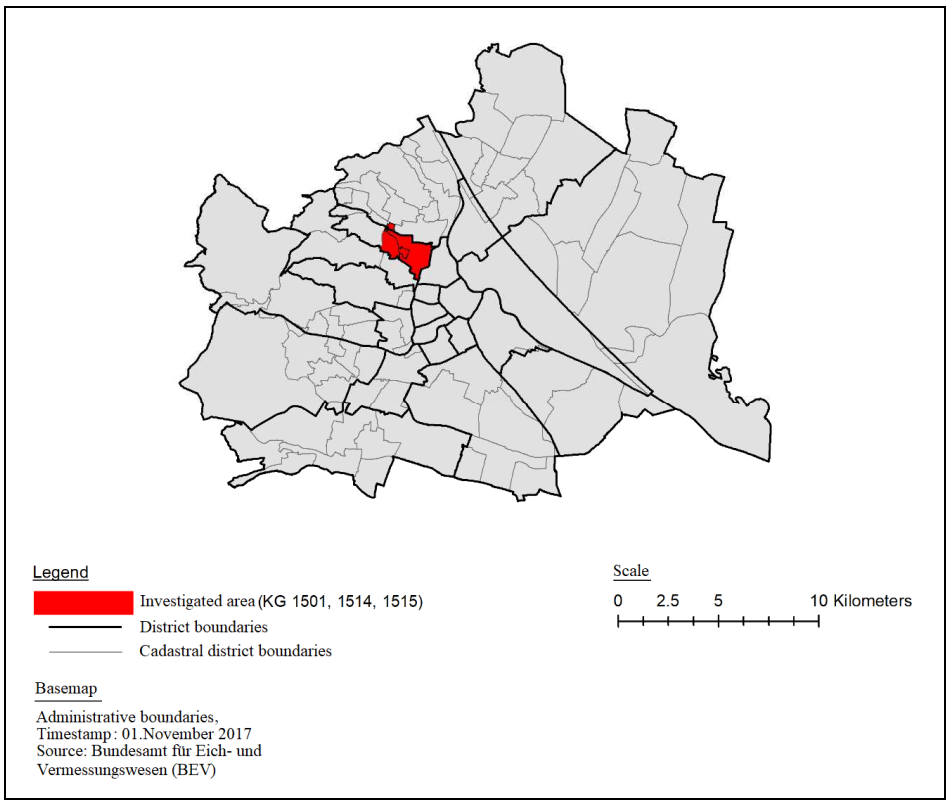

Fig. 2: Area under investigation (red colored), located in the city of Vienna, Austria.

3.3 Collecting and digitalizing raw data

Tab. 1 provides an overview on the raw data and indicates wheater the raw data source is available in a machine-readable format, or not. Latter ones were converted into machine-readable formats as followed:

- Building Cadastre of Vienna: For the analogue scan of the Building Cadastre of 1928 (Salzberg 1928) we used the optical character recognition feature of the "ABBYY FineReader" software. We then applied an algorithm written in Python to identify misplaced characters using "regular expressions", an encoding standard for text patterns. If extracted information such as a building address deviated from a given text pattern, the algorithm applied corrective procedures. In other cases where needed to manually review and correct the output.
- City map 1975: A geoferenced raster image of the 18th district of Vienna, imaging the buildings in 1975. We vectorized the dataset and created building polygons.
- Building age map: To convert the thematic information of the building age map 1920 (Wiener Stadt- und Landesarchiv 2015) into machine-readable format, we used a machine-learning algorithm called "Maximum Likelihood Classification". This algorithm is integrated in the geo-information systems software ArcGIS. It classifies the colours in a raster data set into predefined categories. The resulting categories of our application corresponded to the thematic colour encoding in the map, thus making the thematic information digitally available.
- Building property documents: We randomly selected 39 buildings, which were present in 1920, and acquired the original construction plans for building permission (Stadt Wien 2018). For each building, we measured the number of floors, the eave height, and the built area, and formulated a linear regression with the eave height as response variable and the number of floors and the built areas as explanatory variables.

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Title	Content	Format	Machine-readable	Reference
Building Cadastre of Vienna, 1928	A directory released in 1928, listing all buildings per address. For most buildings, the following details are given: number of floors, area, year of construction, number of flats, number of commercial units, buyer, rental income.	PDF	No	Salzberg (1928)
Basemap 1920	A 2D map with geoferenced building polygons in the 18th Viennese district in 1920.	DWG	Yes	Hauer (2018)
City map 1975	A 2D map in the form of raster data, showing the buildings of the 18th district in 1975	JPG	No	Stadt Wien (2019b)
Building age map 1920	A thematic map showing the construction period for the buildings in Vienna in the year 1920.	JPG	No	Wiener Stadt- und Landesarchiv (2015)
Historic Fire Brigade Map	A city map from 1933, made for the fire brigade, showing street names and the individual buildings including their address number.	TIFF	No	BEV (2018b)
Property cadastre	Georeferenced property polygons of the 18th district.	SHP	Yes	BEV (2018c)
	Data table of the properties in the 18th district. Includes cadastral district, property code, address, postal code, street code, geographic coordinates	CSV	Yes	BEV (2018a)
Adress Service Vienna	Identification of an address according to given geographic coordinates, and identification of the geographic coordinates of a given address.	JSON	Yes	Stadt Wien (2018b)
Building property documents	Documents that include all legal information about a building and a history of legal proceedings concerning the building.	Paper	No	Stadt Wien (2018e)
Area-multi-purpose map	Georeferenced building polygons of Vienna, recorded through annual overflights, where 1/3 of Vienna is covered in each year.	WFS	Yes	Stadt Wien (2018d)
Construction period and Building Typologies	Georeferenced building polygons with the period of construction for a limited set of buildings (about 60'000) in Vienna and the inventory date.	SHP	Yes	Stadt Wien (2018c)
Urban Inventory	Georeferenced building polygons containing inventory data such as construction type, construction period, use, number of floors, given space below ground, and date of inventory.	SHP	Yes	Stadt Wien (2018f)
Adress, building and apartment register	The database registers each building and attributes a wide range of building specific data, as for instance, geographical location, construction period, date of inventory.	XLS	Yes	Stadt Wien (2018a)

Tab. 1: Raw data sources

After we collected and processed all data for the map of 1920, we combined the data into a single comprehensive data set. The resulting data set is a shape file containing the buildings of 1920 in a vector graphics format, with data attached to each shape. The relevant data resulting for each building is the a) location and built area, b) building volume and c) year or period of construction.

- Location and built area: The basemap of 1920 includes the polygons of the buildings in 1920, without georeferencing (Hauer 2018). By comparing the district boundary and the outlines of the blocks formed by building clusters in the map of 1920 with a map of today, we gave the correct geographical location to each building as well as its correct scale. We added the built area by using the integrated function "calculate area" in ArcGIS, which calculates the respective area of a polygon that has been geographicaly located, as can be seen in Fig. 1.

Fig. 3: Geographic adjustment of the basemap 1920

- Building volume: In order to calculate the volume of each building, we used the number of floors to estimate its height. We took this information from the building directory of 1928 (Salzberg 1928), which we had previously digitized. To identify each building in the directory on the map of 1920, we needed the address each building had in 1928. We acquired the address of 2018 for each building by

using the Viennese reverse geocoding service (Stadt Wien 2018b). To know whether an address has changed since 1928, we compared building addresses of 2018 with the addresses in the directory of 1928. Adresses of 1920 that didn't match with 2018 adresses were manually corrected. The final result are two addresses attached to each building, one for 1928 and one for 2018.

To validate each address of the buildings in 1928, we used the map of the fire brigade from 1933 (BEV 2018b), where every building unit has an address label.

After we attached the address to each building in the map of 1920, we added the number of floors as an attribute, as well as the eave height (see section 2.3). We then multiplied the height estimate with the ground area covered to calculate an estimate for the buildings' volume.

- Year or construction period. To receive the period of construction for each building in 1920, we extracted the relevant data from the building age map 1920 (Wiener Stadt- und Landesarchiv 2015), which we had previously digitized. To combine the colour-encoded data of construction periods with the vector graphics in the map of 1920, we fitted the raster data set showing construction periods in 1920 to the 1920 vector data set and applied the function "tabulate area" in the software ArcGIS.

The "tabulate area" function aggregates the data from a raster data set within the confines of individual polygons in a vector data set. The result is visible in Fig. 4. We used a statistic of the raster data each vector shape covers, and determined the respective construction period for each building.

Fig. 4: Basemap of 1920 (Hauer 2018) combined with the construction period data from the building age map of 1920 (Wiener Stadt- und Landesarchiv 2015)

3.4 Establishing the city map of 2018

For the city map of 2018, we used the area-multi-purpose map (Stadt Wien 2018d), which includes the geoferenced building polygons and attributed the built area, the building volume and the year or period of construction.

- Location and built area: The area-multi-purpose map (Stadt Wien 2018d) already contains the correct geographical location of each building. We used the "calculate area" function in ArcGIS to add the built area.
- Building volume: The area-multi-purpose map (Stadt Wien 2018d) includes the attributes "O_KOTE", the height of the highest point of the building in meters above sea level, and "HOEHE_DGM", the height of the buildings ground floor center point above sea level. By subtracting "O_KOTE" from "HOEHE_DGM" in ArcGIS, we added the height of the building. We then multiplied the built area with its calculated height to receive the volume of the building.
- Year or construction period: For the building age of 2018, we had three datasets available: the "Construction period and Building Typologies" (Stadt Wien 2018c), the Urban Inventory (Stadt Wien 2018f) and the "Adress, building and apartment register" (Stadt Wien 2018a). All datasets contained the year of inventorization. For inventory years until 2000 we have chosen the

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construction period with the latest update. For the years starting from 2001 we have chosen the building age information from "Adress, building and apartment register" (Stadt Wien 2018a), because this data source was most precise. We then transferred the preselected building age information to the area-multi-purpose map.

3.5 Comparing the city map of 1920 and 2018

We made a spatio-temporal comparison of the buildings between 1920 and 2018. To assign each building its inter-temporal counterpart, we connected every building shape of 1920 to the building shape of 2018, and vice-versa. The criteria for the connection was the grade of spatial overlapping. With respect to the temporal dimension, we compared the construction period of the buildings in 1920 and in 2018 in relation to each other. Based on the comparison, we applied the scheme in Fig. 5 and defined the status of the buildings in 2018.

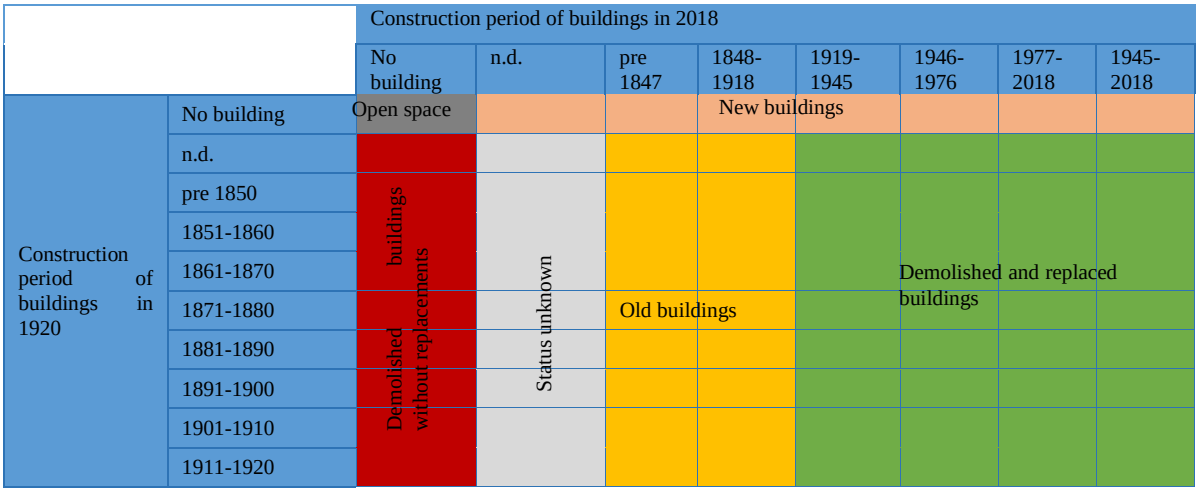

Fig. 5: Scheme for identifying the building status. Notes: n.d. = not defined.

3.6 Estimating the built area per construction periods from 1920 to 2018

The basic idea is to use known data on the built area at specific points of time and to estimate the unknown continuous development of the built area from 1920 to 2018. After we have established and compared the city maps of 1920 and 2018 (section 2.4, 2.5, 2.6), we calculated a) the total built area of all buildings of 1920, 1975 and 2018, b) the built area of buildings constructed before 1920, at the time of 1945, 1975 and 2018, c) the share of the total built area per construction period in 2018. These datapoints are plotted with green colored boxes in Fig. 6.

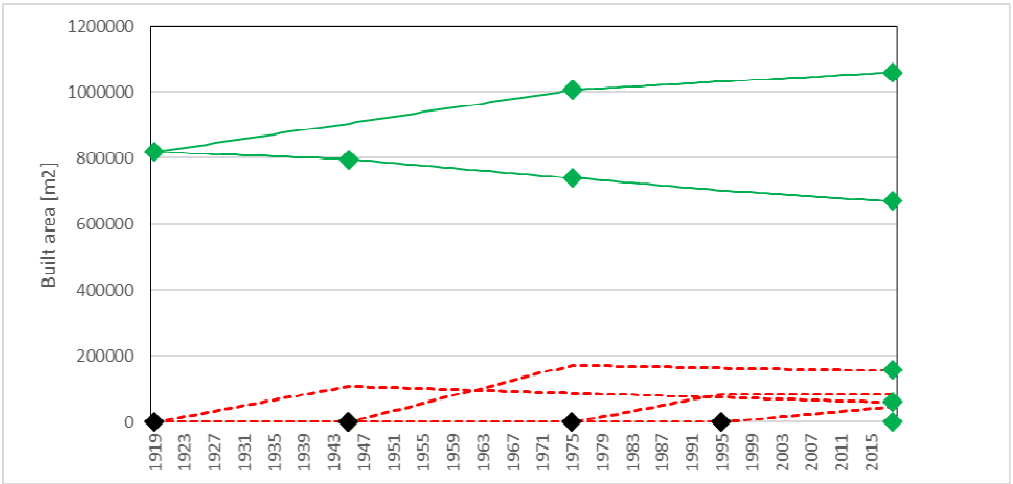

Fig. 6: Scheme for estimating the built area per construction period. The green colored datapoints orginate from the GIS analysis and act as input data for the model. The temporal developments of the built area per construction period (red dotted lines) are unknown.

To simply the analysis, we assumed a linear development of the built area between the known data points, a constant rate of new buildings within the construction period (e.g. 1945-1975), no demolitions within the

construction period, and a constant rate of demolitions after the end of the construction period (e.g. after 1976).

Based on the known datapoints and the assumptions, we calculated the unknown peaks for the built area of each construction period (red dotted lines in Fig. 6). The peak is the end of each construction period and consideres that at each point of time, the sum of the build areas from the individual construction periods results the total built area.

4 RESULTS

4.1 Mapping demolished, replaced and new constructed buildings

Based on the comparision of the city maps of 1920 and 2018, as described in section 2.7, we produced a new spatial data set including georeferenced building polygons. The building polygons (location, built area) represents the situation 2018 and the attribute “building status”. The building status “old” stands for a building that remains unchanged between 1920 and 2018. The building status “demolished with replacement” shows the building polygon of 2018. It existed in 1920 and has been demolished and replaced between 1920 and 2018. A building with the status “new” did not exist in 1920 and has been newly constructed between 1920 and 2018. Apart from the building status, each the following attributes (if known) have been attached to the building polygons: “construction period”, “address”, “built area” and “volume”. Each attribute is given twice, one for the year 1920 and one for the year 2018.

From a spatial perspective, we found that former rural areas in the northwest and southwest of the case study area have been settled, included the construction of new buildings. This finding is line with Eigler (1990), who describes the extension of the city towards the Wienerwald. The replacement of old buildings by new one is scattered over the entire case study area.

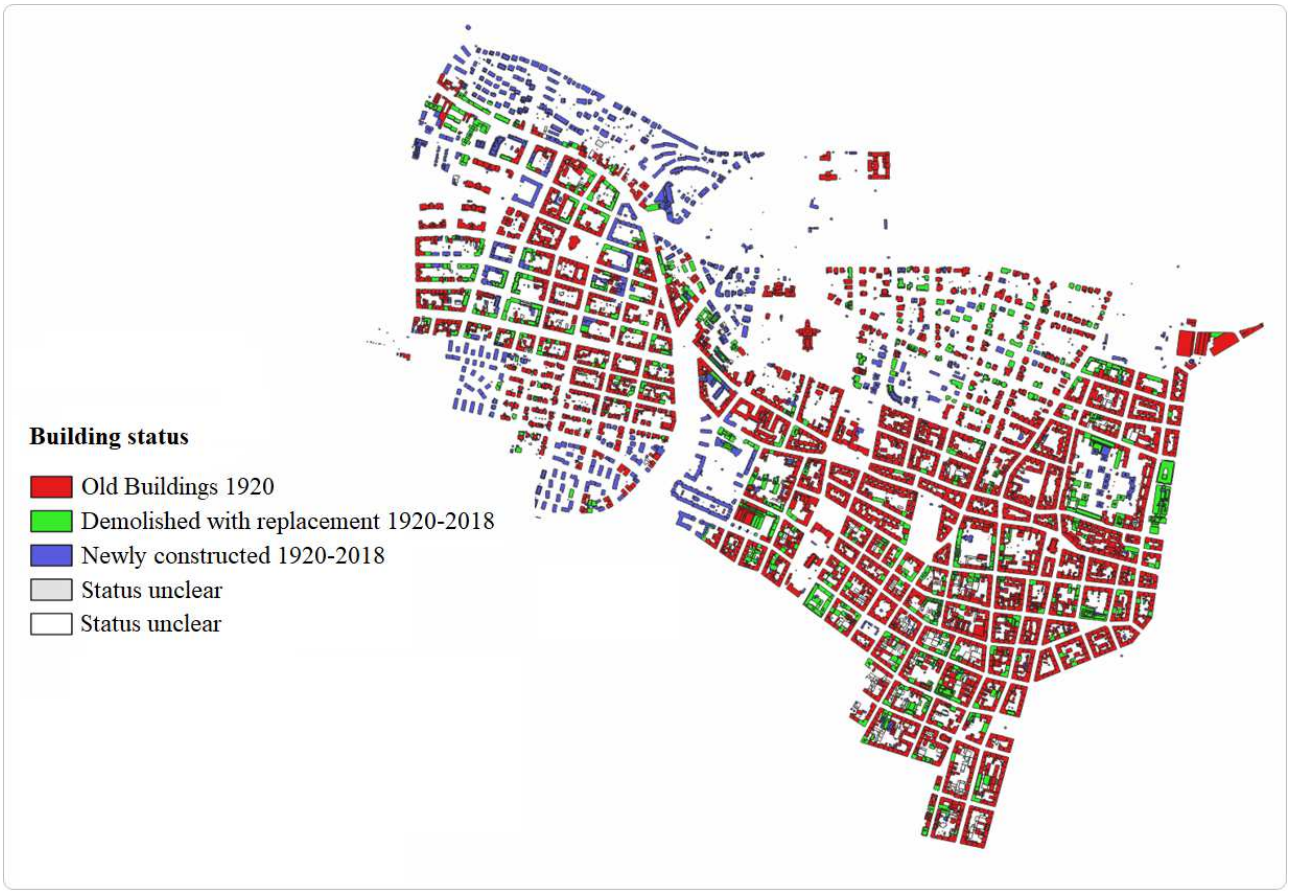

Fig. 7: Building stock of the year 2018.

4.2 Results for changes of built area between 1920 and 2018

Figure 4 shows a waterfall chart representing the total built area in 1920 and 2018 and the changes between 1920 and 2018. We summarized the built areas of the buildings in the city map 1920 and plotted the result

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(82 * 104 m²), subtracted the demolitions from the building stock 1920 (18 * 104 m²), added the replacements and extensions (25 * 104 m²), added the new constructions (17 * 104 m²) and resulted 106 * 104 m² in 2018.

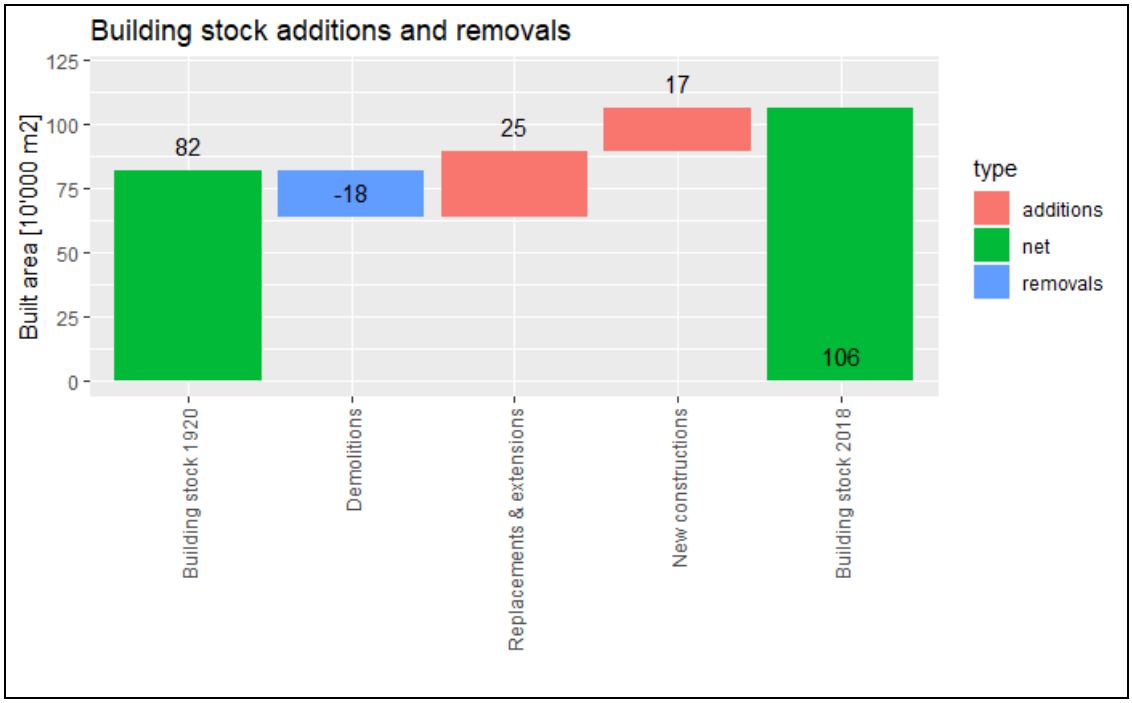

Fig. 8: Total built areas from 1920 to 2018 per building status.

4.3 Built areas per construction period from 1920 to 2018

Fig. 5 shows the development of the total built area between 1920 and 2018 per construction period. We found that the total built area increased from 0,82 million m² (mio m²) to 1,06 mio m². The buildings, which have been constructed before 1920, dominate the building stock all over the time (red line). However, this cohort has lost about 27% of the built area between 1920 and 2018. The second largest built areas orginate from buildings constructed after second world war, between 1945 and 1975 (magenda line).

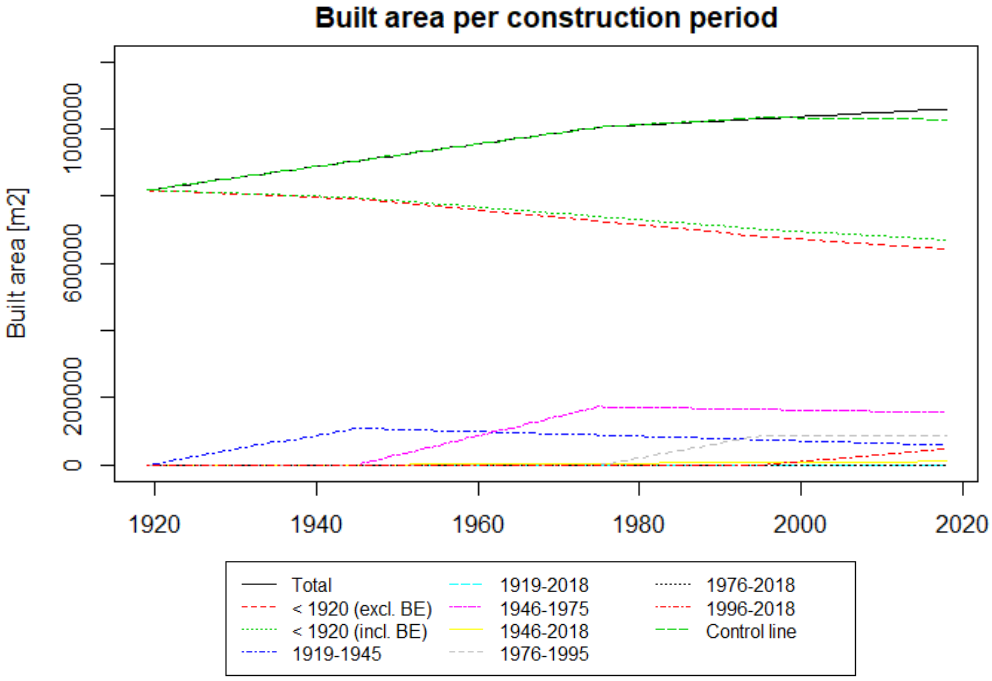

Fig. 9: Development of the building area from 1920 to 2018 per construction period. Notes: BE = Building Extensions.

4.4 Rates of annual built area additions and removals

Fig. 9 is the starting point to estimate the annual increase and decrease of the total built area in the case study region. The annual increase rate is the annual addition of the built area (due to replacements and new constructions) over the total built area at the start of the year. The annual decrease is the annual removal of the builts area (due to demolition) over the total built area the the beginning of the year.

We found that the addition of built area starts with 1.3% per anno (p.a.) in 1920 and steadly declines to 0.3% p.a. in 2018 (Fig. 10). The removal of built area is at 0.1% p.a. between 1920 and 1945 and steps up to 0.3% p.a from 1945 to 2018. Since mid of the 1990, the removals and additions are balanced.

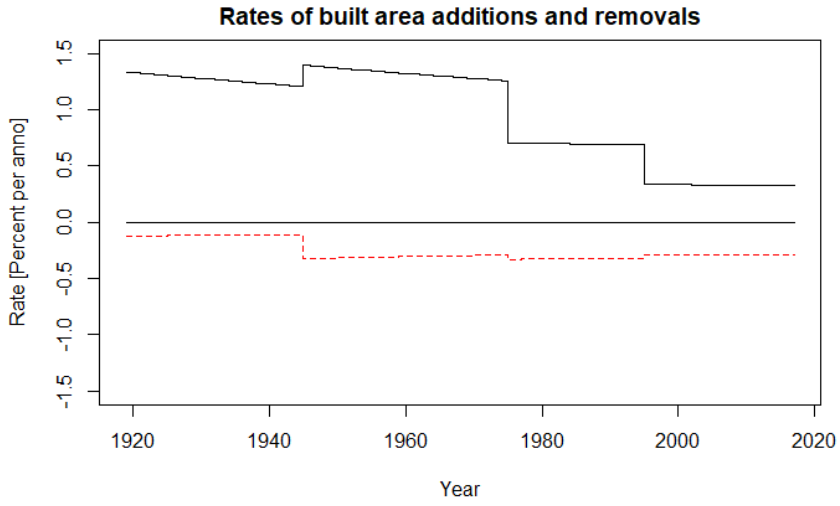

Fig. 10: Annual rates of added (black line) and removed built areas (red line).

5 CONCLUSION AND OUTLOOK

We developed a routine to analyse the spatio-temporal development of an building stock and applied the routine in a case study area in the city of Vienna for 1920 to 2018. The results include, on the one hand, new machine-readable datasets for the city of Vienna (e.g. building stock model for 1920, harmonized dataset for bulding periods in 2018). On the other hand, the linkage of the new datasets provides building-specific insights regarding demolitions, replacements and new constructions between 1920 and 2018. The computation of demoliation and construction rates over nearly 100 years goes beyond the existing body of knowledge in Viennas urban history research. Our project is still ongoing, and we plan to make the new datasets and results publicy available in a machine-readable format. We feel that the datasets can be used for applications in the field of urban history and cultural heritage research on the one hand, and waste and resource management on the other hand. As the results show long-term trends in urban planning, they can be a starting point to to develop future planning scenarios. Socio-economic factors may be embedded in the analysis, investigating correlation and causality with changes in the structure of the urban environment. Another use case of the data refer to waste and resource management, because the results of our study inform decion makers about construction and demolition activities. Our data can be linked with a material inventory of buildings, which reveals material consumption and waste generation in a long-term perspectictive. An analysis of historic urban changes with a projection into the future may help planning for capacities and location of recycling facilities and help formulate operational goals in relation to an expected trend of re-using and recycling construction and demolition waste.

6 ACKNOWLEDGEMENTS

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Topics and Sentiments in Online Place Reviews, an Innovative Way of Understanding the Perception of a City without Asking

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1 ABSTRACT

User-generated content provides rich and easily accessible data for tourism destination managers, especially when combined with a sentiment analysis to uncover perceptions and attitudes. These reviews are often primarily useful in a business/attraction-context and scaling up their relevance for destination management is problematic. Furthermore, the reliability of such online sources can be questioned, thereby impeding its application for research and practice. By combining data of a traditional in-situ survey in five main cultural heritage attraction in Antwerp (Belgium) with scraped data of these same attractions from the TripAdvisor website, this paper attempts to shed a light on the added value and reliability of a big data sentiment analysis. The sentiment analysis combines two lexicons as well as Latent Dirichlet Allocation. The results show promise in that, even though the characteristics between the in-situ sample and the scraped sample are quite different, the sentiments and themes are largely overlapping while the Net Promotor Score as calculated via the TripAdvisor reviews is close to the measured Net Promotor Score through the visitor survey. Still, certain limitations remain within the big data sentiment analysis approach, leading to the conclusion that both methods can be highly compatible in order to efficiently generate deeper, more complete results.

Keywords: sentiment analysis, latent dirichlet allocation, natural language processing, reliability testing

2 INTRODUCTION

Social media are gaining importance as a channel to share information on a diverse set of experiences (Munar & Jacobsen, 2014; Whiting & Williams, 2013). Ranging from photos and tweets to customer feedback or entire blogs, social media offer a wealth of information. Entrepreneurs use it as timely and direct feedback channels, while researchers explore the potential application as a data source for empirical research (see e.g. Garay Tamajón & Cànoves Valiente, 2017; Stella & Mavragani, 2015; Wong & Qi, 2017). Among other techniques, applying sentiment analysis to make sense of large sets of unstructered texts present on social media is for example used to uncover political preferences of social media users (Ceron et al., 2014), predict stock prices (Nguyen & Shirai, 2015) or measure customer satisfaction (Alaei et al., 2019). While the number of start-ups and academic papers applying sentiment analysis of social media is skyrocketing, a number of research gaps still exists. A prime example is that since the utility of sentiment analysis application to social media to improve service quality of hotels or other business has been proven (Duan et al., 2016; Chang et al., 2019), linking business/attraction-level reviews with a higher-level perception of place and visitor behaviour could assist destination management organizations and city planners (van Weerdenburg et al., 2019). To this purpose, web-scraped user-generated content needs to be analysed with respect to sentiments and topics in order to evaluate overarching themes and patterns which would otherwise be difficult to detect.

A second research gap relates to the reliability of user-generated content for attitudinal and perception research. Reliability issues could potentially originate from non-authentic reviews (e.g. Balagué et al., 2016) but can also be caused by non-representativeness of online reviewers as compared to the actual population of site/destination visitors (Xiang et al., 2017). User-generated content is potentially skewed towards younger users, limited by availability of language groups, and might attract reviews at the polar ends of satisfaction scales (Presi et al., 2014). The lack of insight into the representativeness, and thus into the usefulness of social media can be seen as a major impediment to its applicability for both research and practice.

This paper presents a proof of concept of what type of information can be obtained through sentiment analysis and topic mining, in comparison with tradional survey techniques, particularly focusing on individual's value structures and attitudes towards specific locations in the city of Antwerp, Belgium. We are interested in the question to what extent place descriptions in online reviews actually reflect the diversity of

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topics and sentiments that can be found in surveys. By combining the outcome of semantic analysis of scraped reviews on a selection of urban cultural heritage attractions from TripAdvisor with surveys collected in-situ, the results can uncover similarities and differences between both methods and assess the reliability of user-generated content as an alternative to traditional survey methods. Furthermore, a topical analysis of the TripAdvisor reviews on 5 urban visitor attractions might uncover city-level themes and therefore elevate the scope of individual businesses. Such information could be used to improve city marketing and planning practices.

3 URBAN TOURISM AND DESTINATION COMPETITIVENESS

Studies on urban tourism and the city as a place of recreation are relatively new, with the research topic only really maturing since the 1980s. Prior to this, and originating from a spatial modelling history forwarded by the likes of Christaller (1963), Miossec (1976), and Yokeno (1968), tourism and recreation were seen as functions of the urban periphery. An additional problem has been the difficulty to distinguish recreational visitors from other users in a multifunctional urban entity where facilties are largely co-consumed by a multitude of user types (Ashworth & Page, 2011). Changes in the economic fabric of cities, and the role of tourism as a potential catalyst for a service-oriented urban development, inspired a surge of research during the 1990s and 2000s.

While academic interest in the field of urban tourism is therefore relatively new, the activity itself has a much longer history, with urban regions being well-established destinations due to their function as political and economic centers and transportation hubs, even before tourism was acknowledged as a recreational activity (Urry, 1990). The importance of cities as a tourism destination has grown exponentially, mirroring the continuous rise of a new leisure society (Pearce, 2001). In 2018 the top 20 international tourist cities alone accounted for roughly 18.0% of global international tourist arrivals (mastercard, 2019) – thereby even taking abstraction of the multitude of domestic tourists and excursionists being attracted to cities for leisure purposes. The same source estimates international tourist expenditure for the top 20 urban tourism destinations at US$258.99 billion (mastercard, 2019). As such, there is a clear economic incentive for cities to compete on the international tourist market (van der Borg et al., 1996; Judd & Fainstein, 1999; Zukin, 1995).

Within the inter-urban global competition, cultural heritage is used as a main source to stand out (Ashworth & Page, 2011). Particularly for the leisure market, culture and heritage are among the top visitor motivations (Richards, 2018). For long term success it is essential that the marketing message reflects the reality of the experience and a positive referal is generated (Govers & Go, 2004; Martín-Santana, 2017). It is therefore common practice for destinations to perform visitor surveys in order to collect a wide range of variables on visitor characteristics, transport methods, information sources used, motivations, attractions visited, tourist experiences, and satisfaction and loyalty (Lewalter et al., 2015; Pearce & Moscardo, 1985). While insightful and providing details that cannot be learned from pure arrival data collected by national statistical bureaus, a limitation of these visitor surveys is the expense related to the necessity of an on-site face-to-face methodology. Next to this, surveys are generally consisting of predetermined, closed questions which do not allow exploration of enot included topics (Alaei et al., 2019). Therefore, and also resulting from the ever increasing availability of online big data, there is an increasing interest and opportunity for destination management organizations to study online user-generated content as a potential alternative to uncover tourist motivations, behaviour, satisfaction, and spread (Alaei et al., 2019; Oriade & Robinson, 2018; Taecharungroj & Mathayomchan, 2019; van der Zee et al., 2020).

4 METHODOLOGY

4.1 On-site Visitor Surveys in 5 Tourist Attractions

During the period 2014-2019, Visit Flanders, the destination management organization of Flanders (Belgium), developed a subsidy-programme for tourism projects and attractions with leveraging potential for the wider sector and destination. Such projects were primarily focused on international visitors and mainly – although not uniquely – in the theme of cultural heritage. Since accountability is becoming increasingly important, a return-of-investment evaluation of publicly financed projects was warrented. Therefore, as a requirement, recipients of subsidies were required to conduct visitor surveys at the attraction in order to

collect data on, among other things, economic return, project scale, visitor satisfaction, brand effects, and international potential.

For the sake of this study, five projects were selected from the overarching thematic programme 'Antwerp Baroque': Museum aan de Stroom, Onze-Lieve-Vrouwe Kathedraal, Plantin Moretus, Rubenshuis, and Sint Carolus Boromeus. Visitor surveys took place on-site, using tablets for answer registration and being interviewer completed. The main survey ran between 1 June 2018 until 6 January 2019. Questions related to visitor profile, visitor experience, and destination. Table 1 provides a short overview of the main questions and measurement levels.

Category	Variable	Question	Measurement level
Personal characteristics	Gender	What is your gender?	Categorical
	Age	When were you born?	Ratio
	Place of residence	Where do you live?	Categorical
Trip characteristics	Information	Via which information sources have you learned of [SITE]	Categorical
	Experience	How often do you visit a museum or exhibition?	Ordinal
	Visitor type	Are you staying overnight in Antwerp or in another area in Flanders?	Categorical
	Travel company	How many people are in your travel company?	Ratio
	Children	Are there children in your travel company?	Categorical
Visitor experience	Site recommendation	Would you recommend [SITE] to friends, family and relatives?	Ratio
	Motivation	How important was 'Antwerp Baroque' for your visit to Antwerp?	Ordinal
Destination	City recommendation	Would you recommend Antwerp as a cultural destination?	Ratio
	Other attractions	Which other attractions have you visited in Antwerp?	Categorical

Table 1. Overview of main visitor survey questions

At the five combined attractions, a total of 2,474 surveys were collected, 45.6% identified as male visitors and 54.1% respondents were female. In terms of age, the majority of visitors belonged to higher age groups: 20.8% were above 64, 20.7% between 55 and 64, 18.2% from 45 to 54, 14.4% between 35 and 44, 14.6% between 25 and 34, and the remaining 11.2% being from 18 to 24. Locals were best represented in the sample, with 36.2% living in Belgium. About one in ten (12%) were travelling as a family. Visitors from the Netherlands were the second largest group at 13.8%, followed by Germany (10.1%), France (7.5%), the United Kingdom (5.3%), the United States (4.5%), and Spain (4.4%). The remaining 303 responses (12.3%) were collected from a wide range of nationalities.

The primary information sources used to plan the visit are undefined other sources (30.4%) – which an for instance relate to organized group tours – followed by the attraction website (20.6%) and recommendations by friends and family (19.1%). Review sites such as TripAdvisor only informed 3.3% of the sample respondents. The majority of the sample (50.5%) were motivated cultural tourists, visiting cultural sites 5 times a year or more. Over half (54%) did not visit more than one attraction, and if multiple attractions were visited, these were most likely a combination of Onze-Lieve-Vrouwe Kathedraal, Rubenshuis, Sint Carolus Boromeus and/or Sint-Pauluskerk. The Net Promotor Score (i.e. difference between promotors with a satisfaction score of 9 or 10 and detractors with a satisfaction score of 0 to 6) in the sample was +45.

4.2 Natural Language Processing on Scraped Review and Survey Data

Visitor sentiments of the 5 Antwerp tourist attractions were scraped from TripAdvisor on 19 december 2019. In order to simplify the Natural Language Processing (NLP) only reviews in English were collected. Scraping used the RSelenium – for fetching the page – and rvest – for extracting page components – libraries in R 3.4.0. Through the use of Document Object Model (DOM-) parsing, the dynamic contents of the TripAdvisor pages could be retrieved.

A total of 2,438 reviews were retrieved, 70 for Museum aan de Stroom, 1,339 for Onze-Lieve-Vrouwe Kathedraal, 35 for Plantin Moretus, 1,004 for Rubenshuis, and 35 for Carolos Boromeus. It turned out that (a) the number of scraped reviews is almost similar to the number of on-site surveys collected, and (b) by far the biggest contribution to review data comes from Onze-Lieve-Vrouwe Kathedraal and Rubenshuis. In terms of pure sample size, one might therefore wonder what the added value of web scraping is in comparison to traditional survey methods. One advantage is the comparatively low time and effort required for automatized scraping. In contrast, on-site reviews are time-consuming, demanding for both interviewer and interviewee, and costly. A second advantage is the opportunity to collect historic visitor data. In our sample, the earliest review was given in 2010, with 64 reviews written in 2011, 139 reviews in 2012, 193

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reviews in 2013, and 245 reviews in 2014. The majority of reviews (72.1%) originated in the last five years, with 411 reviews in 2015, 377 reviews in 2016, 372 reviews in 2017, 331 reviews in 2018 and 299 reviews in 2019. The final 51 reviews missed information on the date of experience.

In terms of travel company, 14.1% of reviewers declared themselves as solo travellers, with 37.7% travelling as a couple, 11.8% being part of a family trip, and 17.2% travelled with a group of friends. Only 3.6% of the scraped sample were marked as business travel while for 15.6% of the sample, the composition of the travel company was not known. In terms of country of residence, the singular scraping of English-language reviews is clearly reflected in the numbers, with – of the 2,226 reviews with location data – Belgium accounting for 328 reviews, the Netherlands for 125 reviews, France for just 29 observations, German tourists writing 44 comments, and Spain accounting for 20 reviews. By far the largest data is generated by tourists from The United Kingdom (with 618 reviews), and the United States (with 477 reviews), therefore providing an imbalance between actual visiting nationalities, and collected sample via scraping. If we recalculate the 5-level TripAdvisor score on a 10-point scale the Net Promotor Score can be calculated as +53.2, being quite close to the Net Promotor Score of the on-site survey.

An increasingly popular way of analysing large quantities of unstructured, qualitative data is through NLP (Alaei et al., 2019). NLP is often applied to ascribe sentiments to microblogs, such as tweets and reviews in order to analyse how people feel, but also to uncover clusters of discussed topics in order to make sense of what people are writing about.

Sentiment analysis can be defined as extracting “a sentiment expressed in a document toward a certain aspect based on the subjectivity and the linguistic characteristics of the words within an unstructured text” (Kirilenko et al., 2018 p 1013). In this paper, we analyse both the review dataset as well as the open-ended survey questions answered in English using two different, unsupervised approaches to NLP. From 556 answers to the open-ended questions, a total of 163 entries in English were used for the analysis. Minimum, mean, and maximum word lengths of the survey entries are 1, 6, and 61 words respectively. The corresponding word lengths for the reviews are 9, 58, and 1019 words respectively. Overall, there are significant differences between the two datasets both in terms of the number of entries and entry size.

For the first NLP approach, we used two different predefined, ‘off-the-shelf’ sentiment lexicons and tested how the survey and review datasets match the lexicons. While using off-the-shelf sentiment analysis approaches have some downsides, e.g. the fact that they were not created for the purpose of the study and are thus possibly less suitable for uncovering topic-specific sentiments, using pre-existing (Alaei et al., 2019), verified lexicons saves a large amount of time and resources (Kirilenko et al., 2018). In order to cross-validate the sentiment analysis, the data was both matched to the AFINN lexicon (Nielsen, 2011) as well as to the NRC lexicon (Mohammad et al., 2013).

The AFINN lexicon consists of 2477 words which are ascribed a score ranging from -5 (derogative, words such as “bastard”) to 5 (very positive, words such as “breathtaking” or “superb”). The AFINN lexicon is biased toward negative words that constitute 65% of the lexicon. The NRC emtion lexicon is a dataset of 6468 English words, which have been ascribed to one of 8 emotions (anger, anticipation, disgust, fear, joy, sadness, surprise, and trust) and optionally either a positive or negative sentiment resulting in 13.901 entries. While the AFINN lexicon was created by a single person based on manually examining and scoring tweets, the NRC lexicon was created through crowd-sourcing (Mohammad & Turner, 2010). Both lexicons have been verified by peers and have been widely applied to uncover sentiments from short texts such as Tweets (see e.g. Mohammad et al., 2013), online reviews (Kiritchenko et al., 2014) or open-ended survey questions (Kirilenko et al., 2018). The combination between the two lexicons allows to not only to examine the level of positive and negative sentiments, but also to see which emotions can be ascribed to the texts in the datasets, allowing to better understand what causes positive or negative sentiments. For the analysis, we used the tidytext library in R v3.6.2 that by default includes both lexicons.

For the second NLP approach, the review and survey data have been studied for the presence of re-occuring topics applying a machine learning technique known as Latent Dirichlet Allocation (Blei et al., 2003). This unsupervised bag-of-words method examines the frequency distribution of words over texts and automatically extracts a predefined number of latent topics in the form of probability vectors over the corpus dictionary (Rosetti et al., 2016). The word probabilities indicate the likelihood of words co-occuring under the same topic. Furthermore, for each topic, the method generates the probability of occurrence in a text

document. In this way, LDA is able to represent the text corpus as a mixture of topics, where the document-topic probability estimates the topic mixture of a given text, and the topic-word probability estimates the mixture of words that are used to talk about a topic. The unsupervised LDA models can be used both for analysing texts according to topic dimensions, as well as to predict topic occurrences in new texts. LDA topic models have previously been applied to give further explanation on why tourist ratings in TripAdvisor reviews (Rosetti et al., 2016), to use various online sources in order to extract place activities for locations within a city (van Weerdenburg et al., 2019) and to derive controllable dimensions for managing hotel-guest interactions from online reviews (Guo et al., 2017). In this paper, we apply an unsupervised LDA topic model to uncover which topics are present in review and open-ended survey data on a selected set of heritage attractions in Antwerp. This approach allows us not only to uncover how visitors feel about their visis (which is done by a sentiment analysis), but also what they say about the touristic attractions when asked directly (in the open-ended surveys) and when they voluntarily choose to share their opion online (in the review dataset). By comparing the probability of texts over the different topics which occur in both datasets, an estimation can be given on whether the same topics are discussed.

In order to train the LDA model, we first cleaned both corpora by removing punctuation, whitespace and english stopwords, and then turned them into document-term matrices using the term-frequency inverse document frequency (tf-idf) measure, removing all words which are less frequent than 0.1. Then we estimated different LDA models on the review texts for topic numbers from 2 to 15. We picked a model with 14 topics, because it showed the highest log-likelihood. We then applied this model to estimate corresponding topic probabilities for the survey texts. The probabilities were then compared against each other, and we also used them to pick example texts from the online reviews.

4.3 Results and discussion

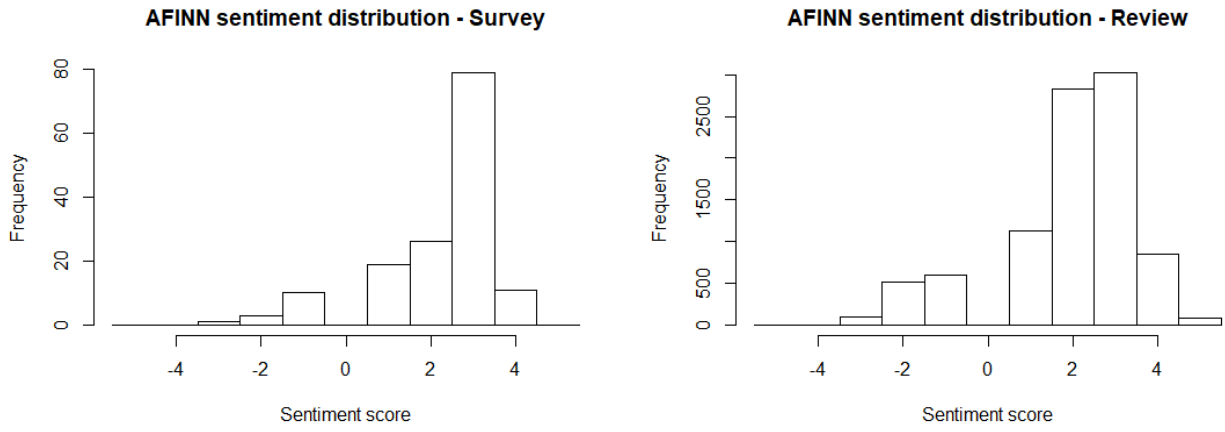

Figure 1. Distribution of sentiment scores in survey and review texts applying the AFINN lexicon

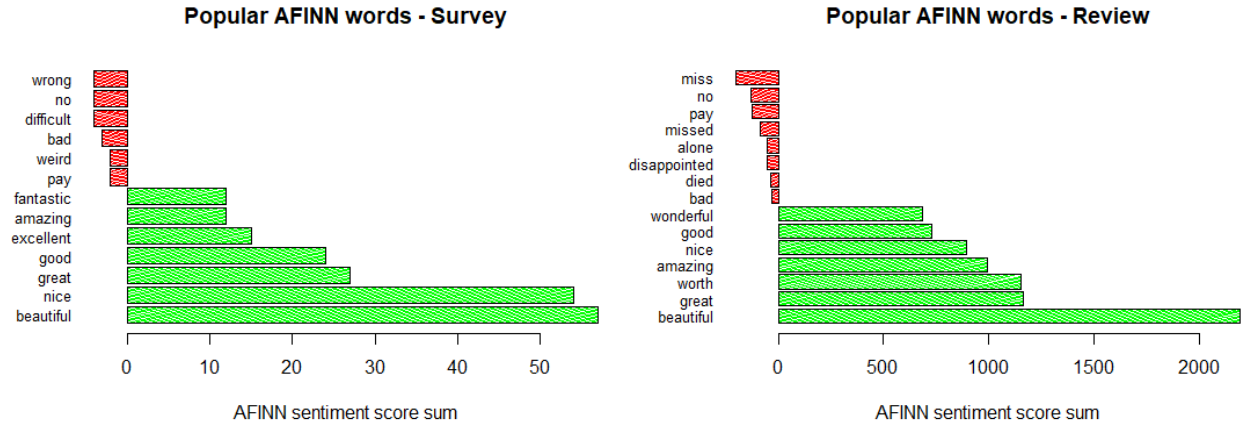

Figure 2. Frequently occuring words and related positive and negative sentiments in the survey and review texts applying the AFINN lexicon

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When comparing the survey and review datasets applying the AFINN lexicon, similar patterns appear. The positive sentiments strongly outnumber negative sentiments in both reviews and surveys. This result is significant considering the negative bias of the AFINN lexicon. Among the seven highest scoring positive words, beautiful, nice, great, good, and amazing are common to the review and survey datasets. Among the seven lowest scoring negative words, pay, bad, and no occur in both datasets. This result suggests similarities between the two datasets at the lexicon level as well as the sentiment level. The survey data, although less numerous in the number of texts as well as in average word length, contains a higher proportion of words that match a score of +3 or higher. The most frequent words, “beautiful”, “great” and “nice” arescored according to the AFINN lexiconwith a +3. In a majority of the cases, a word such as ‘nice’ relates to the entire attraction (e.g. “nice place”) or a part of the attraction (“nice garden” / “rooftop”). In some cases however, “nice” relates to a suggestion by the reviewer or survey respondent: e.g. “information in German would have been nice”. The present bag-of-words approach is not able to filter the words for the context in which they are used. In the review texts, more words are present which are scored +2. Examples are the word ‘worth’, which is often used in the context of “worth a visit”. Words with negative scores, such as ‘miss’ or ‘missed’ (score -2) are sometimes used in a negative context (“we missed part of the exhibition due to unclear signage or limited opening hours”), but also sometimes in a more positive way (“not to miss!”).

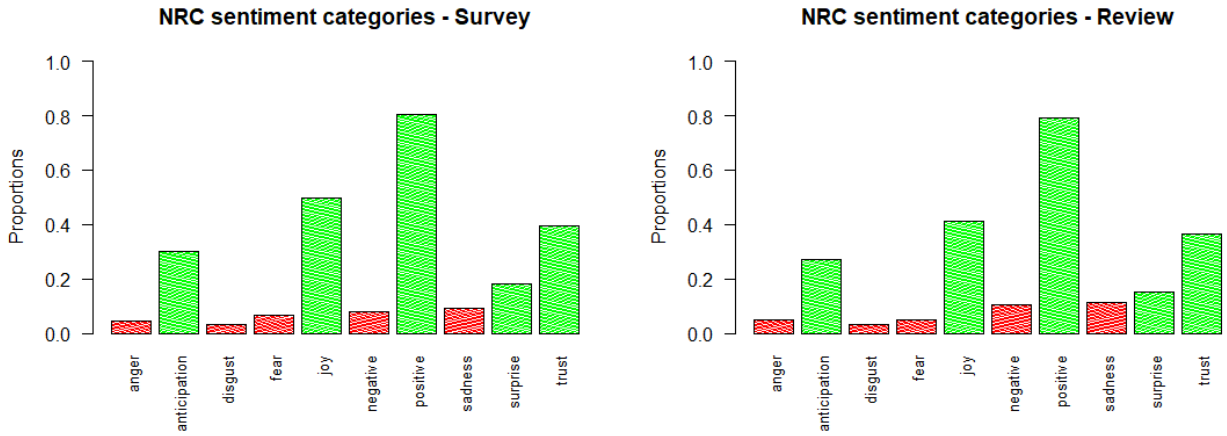

Figure 3. Distribution of emotions in survey and review texts applying the NRC lexicon

The survey and reviews were then analysed with the NRC lexicon which uncovers 7 emotions (Figure 3) and related words (Figure 4). In both Figure 3 and Figure 4, an interesting resemblance can be found between the emotions present in the survey and in the review datasets. Both positive and negative emotions are present in similar proportions. In both sets, positive emotions are related to ‘joy’, ‘trust’ and ‘anticipation’, which correspond to the presence of words such as ‘beautiful’. The emotional state of ‘joy’ was linked to words such as ‘information’, while ‘trust’ corresponded with words such as ‘guide’. Words such as ‘church’ or ‘art’ related to multiple emotions: ‘joy’, ‘anticipation’ and ‘trust’.

Negative emotions are rather rare in the dataset. In the surveys, some texts refer to the availability of toilets. Some of the words ascribed to negative emotions appear to have a less negative connotation when cross-checked manually: references to the word ‘cross’ in the reviews relate to descriptions of paintings within some of the churches and museums, which can depict scenes related to suffering and martyrdom and reviewers use words matching negative emotions to describe them, whilst the same review describes these paintings as ‘beautiful’ as well. In general, negative comments relate to a lack of information, entrance fees and a lack of available toilets.

In the 14 topic LDA model, latent topics are described by the probability of words that describe the topic. Manuel analysis of the 10 most probable words therefore allows us to label and interprete these topics (Fig. 5). In the online review dataset, some topics relate to tickets and admission fees and whether these are worth to spend in relation to what the attraction offers (topic 1) or related to its striking appearance (topic 6). Topic 8 also mentions tickets, but this topic relates more to practical information on tickets (topic 8). Topic 14 relates to practical information considering visiting times and ongoing renovations. Other topics relate to the quality of the presented works of art or exhibitions (topic 2), artifacts (topic 9), the buildings themselves (topic 4), gothic architecture (topic 11), the direct surroundings (topic 7), views and vistas (topic 10), history

of daily live (of Ruebens, topic 12) and some other remember us not too miss certain places (topic 13 and 3). Topic 5 relates to the provided touristic information and (audio) guides. The fact that these topics can be interpreted well in the context is an indication that the word frequencies actually capture a diversity of themes running across the texts, as opposed to mere text artefacts.

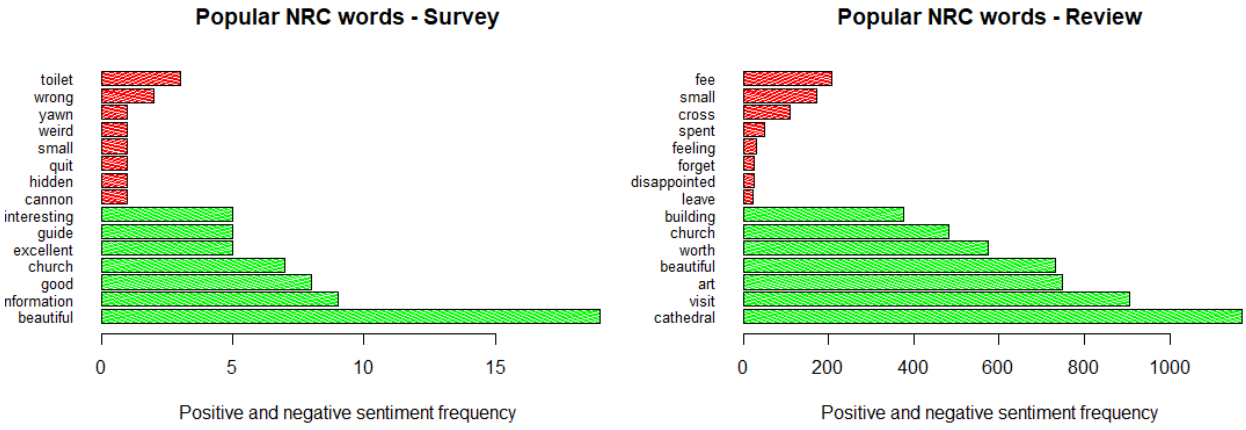

Figure 4. Frequently occuring words and related positive and negative sentiments in the survey and review texts applying the NRC lexicon

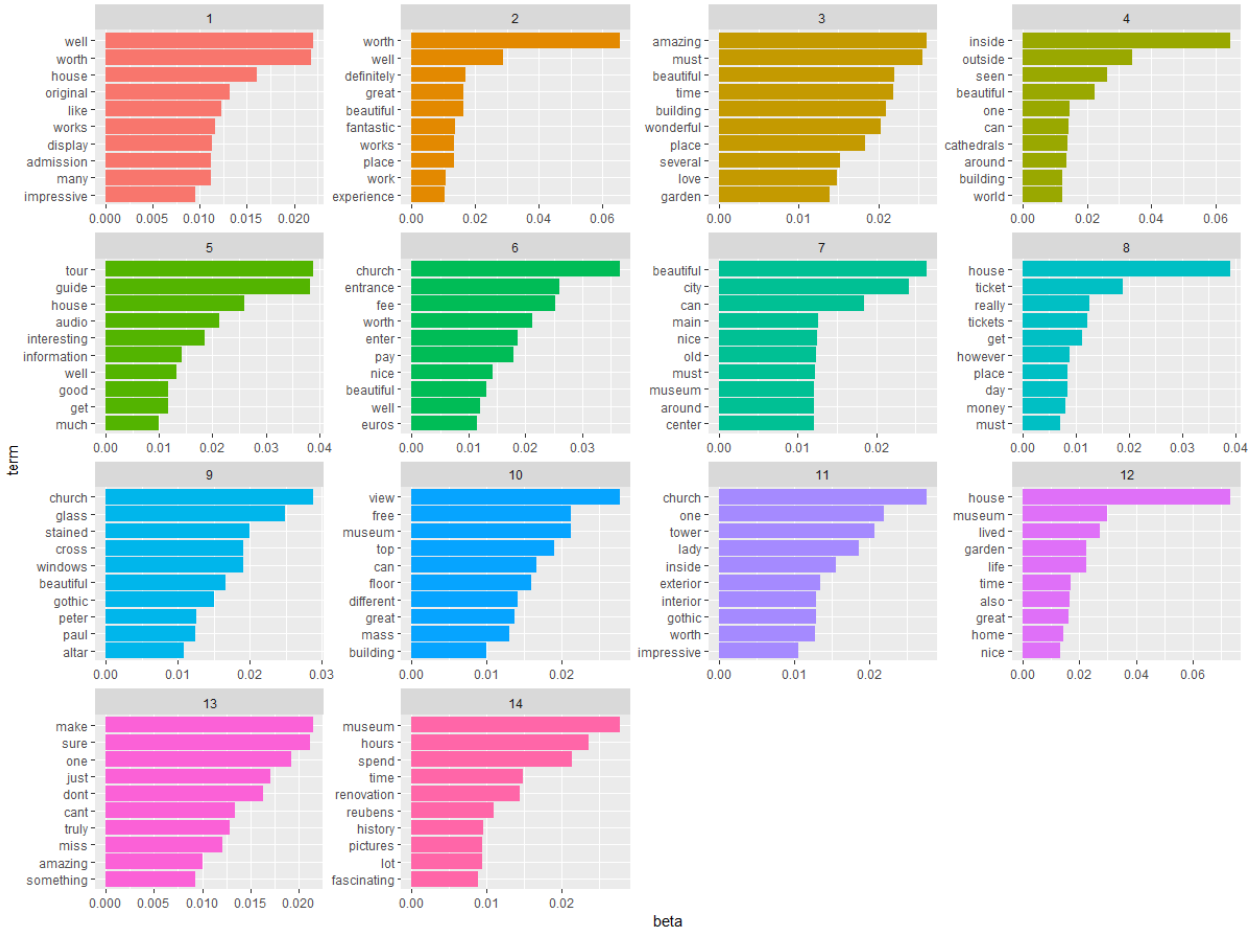

Figure 5. 14 topics derived from unsupervised topic LDA model

Furthermore, we also computed the average probability of each topic over all text documents, for both reviews and survey texts. This provides us with a way to directly compare the presence or dominance of the topics in the two corpora. In Fig.6, Topic 5, 12 and 14 stand out, while the other topics have quite similar levels of presence in both datasets. Topic 5, which relates to provided information, (audio) guides and its added value, and topic 14, relating to opening hours, time to spend in the attraction and renovations, obviously have a higher probability of being discussed in reviews. This may be due to online reviews often

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focusing on practical information about the usability of the touristic infrastructure. Correspondingly, topics 4 and 12, which both relate to describing the in- and exterior of attractions, have a higher probability to be discussed in review texts. Topic 5 has a the highest probable occurrence on average, followed by topic 12 and 6. This indicates that discussing the quality of provided information and audio guides (topic 5) is a relatively important theme, as well as discussing whether the aesthetics of a building makes up for charging an entrance fee (topic 6), or to what extent the attraction helps to give a vivid display of history (topic 12). In general, our analysis indicates that the topic distributions are very similar across both corpora. The small differences in the average need to be seen in the context of a high topic variance across all text documents, which lowers the significance of the differences in the mean. In the future, we plan to test these differences more systematically.

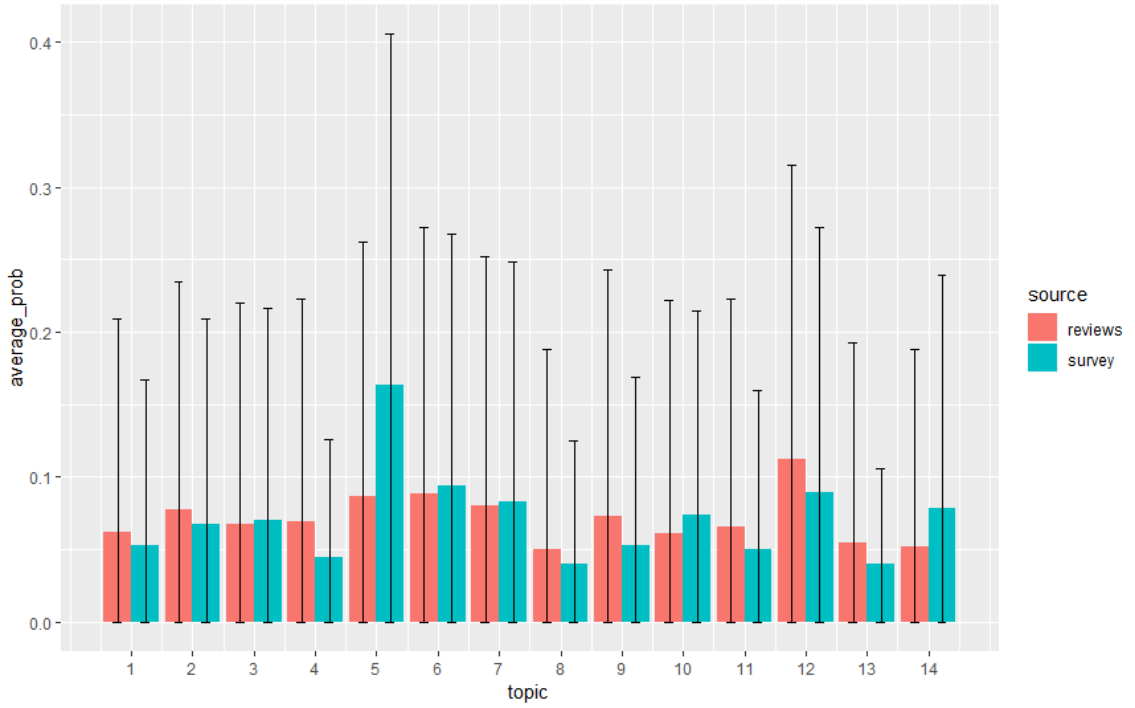

Figure 6. Probability of presence of LDA topics in review and survey dataset

5 CONCLUSIONS

This proof of concept paper on the opportunities provided by big data sentiment analysis as an alternative to on-site visitor surveys set out to answer two research questions: (a) to what extent web-scraped user-generated content could provide both internal (attraction-specific) and external (destination-wide) topics that might assist destination marketing and planning, and (b) to test the reliability of topics and sentiments of online reviews by comparing them with the results from more representative in-situ visitor surveys.

The answer to the second question is the most straightforward, the overlap in themes and emotions between the open-ended questions of in-situ surveys and online reviews was significant for both the AFINN and NRC lexicons. This is particularly interesting, since the make-up of survey respondents and online reviewers was very dissimilar. We might therefore hypothesize that visitors to tourism attractions have a rather fixed set of elements that are deemed important for evaluating a visit.

The first research question cannot be answered definitely. While the results of the LDA analysis do show promise in also uncovering extra-mural topics (e.g. Topics 4 and 7), both survey and TripAdvisor reviews remain predominantly – and quite logically – focused on the attraction being visited. In this sense, the LDA offers an interesting algorithm for gaining a deeper understanding of correlating topics, using the sentiment analysis as a stepping stone for a city-level reputational study would require additional sources, not in the least a combination of geo-localized data. A potential opportunity for further research would then be to run the sentiment analysis on an attraction-specific basis for multiple attractions across a city which can then, when combined, create a more in-depth analysis of the strengths and weaknesses of the broader service sector.

As a general summary, we might conclude that rather than seeing big data sentiment analysis as an alternative to traditional surveys, both methods can complement each other. Given the strong correlations between the open questions in the surveys and the online reviews, a higher efficiency might therefore be achieved by limiting on-site surveys to closed ended questions on visitor profiles, information sources used, and combined visits, elements which are difficult to uncover from online reviews. On the other hand, particularly the unstructured LDA supports a richer analysis of experiences, which is difficult to achieve via a traditional survey method.

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Transdisciplinarity in Urban Planning for Future Challenges at the Example of Digital Transformation

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1 ABSTRACT

The tasks of spatial planning are becoming ever more complex as a result of the increasing and growing number of demands, such as climate change, digital transformation or densification. This increases the importance of inter- and transdisciplinarity in planning. Integrated perspectives are necessary for the sustainable design of future settlement and landscape areas. The understanding of other disciplines and views is crucial for a fair and expedient balancing of interests.

This paper aims to analyse and compare the views and assessments of three spatial disciplines: spatial development, transport planning and landscape planning. The topic of digital transformation provides an ideal basis for discussion, as it brings with it future challenges and uncertainties, besides all three planning areas are affected.

The basis for this is a broadly-based two-step Delphi study on the spatial effectiveness of digital transformation. In an online survey, the members of the professional associations from Switzerland of the three disciplines were asked to assess the changes in space caused by digital transformation. The survey was carried out as part of a research project at the HSR University of Applied Sciences in Rapperswil (Switzerland) with the aim of assessing future developments (Engelke et al., 2019). The research project deals with the benefits of digital transformation for sustainable spatial development and represents a research focus of the Institute for Spatial Development and the Institute for Landscape and Open Space at the HSR. The disciplinary differences and similarities are not in the foreground of the research. In retrospect of the survey, however, interesting and particularly important aspects for goal-oriented, joint planning can be identified, on which this paper focuses on. Topics such as the future of public space, spatial data usage and the role of public authorities were surveyed and are discussed in this article.

The aim of this publication is to elicit common and different assessments of the three professional groups concerning future space due to digital transformation. Using the mixed-methods approach, the survey results are compared quantitatively on the one hand and questions and comments are semantically analysed on the other. This methodological triangulation is necessary for a better understanding and comparison of different questions on a topic (Johnson et al., 2007).

Based on this, the paper shows how the estimations of spatial, landscape and transport planners diverge and how they see the future to change due to the digital transformation. The analysis identifies the greatest common challenges. It can be stated that there are different levels of knowledge and various visions of the future between the professional groups. Finally, proposals are made as to how the challenges can be tackled using the principles of transdisciplinary research and where the focus can be advantageously placed.

Keywords: integrated planning, future space, transdisciplinarity, digital transformation, sustainability

2 INTRODUCTION

The human habitat is confronted with more and more changes. Megatrends such as climate change, digital transformation but also globalisation or individualisation are changing spatial development. Thus, demographic change also brings additional and increased demands on living space (Wehrli-Schindler and Widmer Pham, 2019). However, the development and spatial impact of these megatrends in the future are subject to a number of uncertainties, which poses major challenges for spatial planning. This happens because the planning system requires that the course has to be set early on. In order to achieve or maintain a high quality of life despite the increasing demands and an uncertain future, different disciplines of planning must work towards common goals, which in the end must lead to sustainable development. In order to meet challenges in complex systems, several disciplines need to work together in research and be ready for practical application. The problem-oriented approach of transdisciplinary research is suitable for this (Hirsch Hadorn et al., 2005). This paper examines whether the prerequisites for transdisciplinary research in spatial planning are given and whether it is suitable for tackling future planning challenges.

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The research question pursued in this paper is: What are the different expectations for the future development of space within planning disciplines and how can transdisciplinary research contribute to finding common solutions?

This question will be examined using the example of one megatrend in spatial development – digital transformation.

The basis of this study is a survey on the spatial effectiveness of digital transformation in Switzerland. The survey was part of a larger, still ongoing research project at the University of Applied Sciences in Rapperswil, Switzerland, which examines the benefits of digital transformation for sustainable spatial development (Engelke et al., 2019). The survey ran simultaneously in three different variants (see details in chapter 4 Methodology). A comparison of the results of the three professional groups was not the aim of the study but in retrospect appears to be worth an interesting analysis. Therefore, this paper shows additional insights to the role of planners in addressing future challenges. Three relevant thematic areas were selected and analysed to see how the questions, answers and comments of three planning disciplines differ. Thus, it can be worked out what the difficulties of transdisciplinary research are. The paper provides answers on how the participants of the professional associations assess the developments on spatial data usage, future of public space and role of public authorities in the future. Furthermore, the question could come up about whether these three planning disciplines need to be analyzed together, since each of these professions requires clear conceptual definitions. But as it comes to shaping future space, those three space relevant disciplines need to work together and therefore need a common base of knowledge and an understandig for different definitions and aims to succeed in this transdisciplinary work for shaping a sustainable future (Hirsch Hadorn, 2006).

Therefore, the first part of the paper analyses and presents the approach of transdisciplinarity in more detail and elaborates its role for planning.

Afterwards, the methodology and research design of data collection and data analysis will be discussed. The results of the analysis of the questionnaires as well as the survey results and comments are presented in the following part to finally discuss the results and to answer the research question in the context of transdisciplinarity.

3 TRANSDISCIPLINARITY

Transdisciplinary research is a type of research where researchers from different fields are integrated and work together at an issue, which has to be solved. Transdisciplinary research can be defined as a research that meets four features. First, it has to take into account the complexity of issues. Second, the diversity of different perceptions of issues in science and society will be addressed (Pohl, 2005; Pohl & Hirsch Hadorn, 2006). Third, the idealised context is not as important as practically relevant knowledge (Pohl, 2005). Or to put it mildly: abstracting science and relevant knowledge specific to the case are combined (Pohl & Hirsch Hadorn, 2006). Fourth, the knowledge contributes to a solution of a problem of common interest (Pohl, 2005; Pohl & Hirsch Hadorn, 2006). It has to be told that this is only one of many possible definitions. Regardless of the definition, it always "includes the transformation of attitudes, the development of personal competences and ownership along with capacity building […]" (Hirsch Hadorn et al., 2006: 121). This suggests that researchers have an important role in the transdisciplinary process. An investigation of transdisciplinary research processes showed that researchers need several years to accept the culture of the other disciplines and to be able to work out together concepts with additional benefits. In addition, transdisciplinary teams tend to division labour at times with more pressure instead of working things out together (Pohl, 2005). This bears the risk that the advantages of transdisciplinary research will not be fully exploited and that towards the end of the research project only individual results will be put together instead of being able to present a common result.

In order to avoid this, Pohl and Hirsch Hadorn (2006) set out principles on how to make a transdisciplinary process successful. 1st principle: reduction of complexity by locating knowledge needs and participants. In complex systems, not everything can be captured, so the relevant links to resolve the issue must be worked out. 2nd principle: effectiveness by embedding in the environment. This means that an impact model is to be worked out which shows how the solution is to be implemented in practice. It also requires a target group-oriented processing of the results so that the results are effective in implementation. 3rd principle: integration

through open-mindedness. The third principle is the supreme principle for cooperation between disciplines. One's own point of view must be relativized as one among several and others must be accepted as equally relevant. 4th principle: reflexivity through recursivity. Project steps must be run through several times if necessary. To meet all the requirements for transdisciplinary research (see above) is not easy and the quality of the research project could suffer. Running through project phases several times, if necessary, and thus correcting the conditions for the development of knowledge can reduce this risk (Pohl & Hirsch Hadorn, 2006). However, through many uncertainties and this trying-out, there is the risk that "such models lack the explanatory power of basic and applied research" (Hirsch Hadorn et al., 2005: 125). As a consequence, the knowledge achieved from transdisciplinary research is not an ideal scientific knowledge which is universal, explanatory and proven. But the generalization of knowledge is nevertheless important, which can be achieved by transferring the models and methods to other settings and/or other issues (Hirsch Hadorn et al., 2005). Those principles are important to be kept throughout the entire research process stages that are identification and structuring of the issue, handling of the issue and setting in value (Pohl & Hirsch Hadorn, 2006). Another definition of the process stages could be abstraction (shared insight), realisation (problem solving) and translation (formulation of results and transfer) (Verhein-Jarren et al., 2015).

4 METHODOLOGY

The data being used for this paper is provided from an online survey, which was the first part of a two-step Delphi study of the larger research project (see chapter 2 Introduction).The research group is composed of three main areas of expertise: spatial development, landscape planning and transport (traffic, mobility) planning. Each of this group was conducting an own survey with different themes and questions. Members of the professional associations from Switzerland (FSU, SVI, BSLA) were being invited to participate in the survey. 88 spatial planners as well as 126 landscape planners filled out the questionnaire. 107 participants completed the survey for traffic planners. The participants were German or French speaking and the answers were anonymized.

The data analysis for this paper goes beyond the analysis of the original research project because another goal is being pursued. A more differentiated analysis must be carried out to answer the research question (see chapter 2 Introduction). Relying on a mixed-methods approach, in addition to the quantitative evaluation of the answers, a qualitative content analysis of comments as well as the questions was carried out. The goal and big advantage of mixed methods is not to replace either the quantitative or qualitative approach "[…] but rather to draw from the strengths and minimize the weaknesses of both in single research studies […]"(Johnson and Onwuegbuzie, 2004: 14-15). This methodological triangulation allows a more differentiated analysis and conclusions can be drawn about the impact of the type of question (Johnson et al., 2007). Therefore, it is crucial to analyse the questions qualitatively because they are not exactly the same in the survey groups and they were asked from members of the corresponding professional associations. This is the only way to compare the statements and answers of survey participants from different planning disciplines on the same topics. The qualitative content analysis is conducted after the approach from Mayring's structuring. The codes for the coding system were deductively derived in the first round of analysis and enriched with inductive codes in the second. This interrelation of codes from preliminary investigations and the corresponding material allows a systematic structuring (Mayring, 2010).

5 CASE STUDY: SPATIAL, TRAFFIC AND LANDSCAPE PLANNERS CONCERNING DIGITAL TRANSFORMATION

In the following, the questions, answers and comments of the three professional groups of the Delphi study, as case study, are analysed and compared on the three topics of spatial data usage, future public space and the role of public authorities. The structure of the text will always be the same: first, the qualitative analysis of the questions, second, the quantitative analysis of the answers and third, the qualitative analysis of the comments are presented. After every topic, there is a short summary and conclusion drawn.

It can already be said here that the way the questions were asked differs in all the topics discussed later. The questions in the questionnaire of and for spatial planners were asked in a form of hypotheses. Which means there was a statement (p.ex.: "With data about the use and the user of space analyses become more precise.") and the question "Do you agree or not?". The questions of and for landscape planners were formulated in the same manner as the questions for the spatial planners. Compared to the other two questionnaires, the

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questions of and for traffic planners were asked in a different form. They did not hypothesize but were asking mostly W-Questions (What, When, Why etc).

5.1 Future of public space

5.1.1 Qualitative analysis of questions

Codesystem	Questions_Spatial Development	Questions_Landscape Planning	Questions_Traffic Planning	SUMME
public space		●		4
irrelevance				0
need for action	●		●	2
uncertainty				0
change	●			3
negative association		●	●	5
positive association		●	●	5
SUMME	4	9	6	19

Table 1: In which questionnaire the term “public space” or its meaning is mentioned, and in which form it is described (“Public space” above means in a neutral way). How to read the matrix: The bigger the point the more often the code is being coded in the corresponding questionnaire and code (relative size to line and column). The number is indicated with the sum at the end of the column and line. Example: The code “negative association” is coded five times, twice in the questionnaire of the landscape planners and three times in the one of transport planners.

As can be seen on the matrix above, public space is an issue in all three questionnaires. In the one about spatial development, public space is addressed in relation to autonomous driving and especially autonomous parking. The matrix makes visible that there are differences about how the questions have been formulated (see table 1). As for spatial planners, the questions ask more about whether there will be a change or not and whether there has to be done something about it. Even though the questionnaire about landscape planning was focusing on landscape outside of settlement, some sub-questions are also relevant to public open space within settlements. The questions in landscape planning as well as in traffic planning are more about evaluating the changes. The questions for landscape planners are more often formulated in a positive manner and the traffic planners' questions are more often asked negatively. An example for a positive thesis: "Social media can be used to guide visitors e.g. by providing information on good routes, attractive activities etc.". One example for a negatively formulated thesis: "High costs due to refitting of the transport infrastructure will be a negative consequence of fully autonomous vehicles." There are only a few questions on public space in the questionnaire of transport planners but many questions indirectly concern public space. For example, whether the importance of bicycle traffic will increase, or pedestrian traffic will decrease due to Mobility as a Service.

5.1.2 Quantitative analysis of answers

77% of the respondent spatial planners estimate that autonomous parking will change public space and there will be new requirements like entry and exit zones in central locations. A smaller majority thinks that the road space needs to be reconstructed due to the changed traffic flow. Another phenomenon emerging from digitalisation are micro-hubs, which are changing public space. More than 80% of all responding spatial planners think those will be part of a new infrastructure in city/town districts.

More than half of the participating landscape planners think that there will be new forms of local recreational use in the future. In the opinion of a majority, the requirements will also change due to changes in the composition of user groups. However, only 28% think that this will be smart workspaces and almost half of the participants think that augmented reality could influence the visitor management. 77% estimate that social media could have an effect for controlling visitors of recreational areas. Half of the responding landscape planners think that innovative municipalities will provide digital retreats in future as it will going to be a need.

The questions whether the importance of bicycle traffic will increase and whether pedestrian traffic will decrease due to Mobility as a Service did not get agreement of many participating traffic planners. However, about half of the participants think that there will be fewer parking spaces in central areas and that more space will be needed for transfers. Therefore, structural measures are needed to ensure that AVs (autonomous vehicles) can contribute to sustainable mobility (56% agreement).

5.1.3 Qualitative analysis of comments

Codesystem	Comments_Survey_Spatial Developments	Comments_Survey_Landscape Planning	Comments_Survey_Traffic Planning	SUMME
public space		1		1
irrelevance	4			4
need for action		1	1	2
uncertainty	2			2
change	3	3	1	7
negative association	1	3	6	10
positive association	2		2	4
SUMME	12	9	9	30

Table 2: In which comments in the survey the term “public space” or its meaning is mentioned, and in which form it is described (“Public space” above means in a neutral way).

The frequencies in the code system show that there were comments on public space in all three questionnaires. However, the corresponding associations are different (see Table 2). While landscape planners often simply note that there will be changes, spatial and transport planners more often evaluate the possible changes. For example, this was one positive comment of a spatial planner: “Public space will become much more important!” or an example for irrelevance: “In the short and medium term, these scenarios change the road space and its design only marginally.” Most comments of transport planners show the concern of a negative development through AVs. For example this one: “There will be more pressure to expand infrastructure when individual mobility increases and empty runs are made possible through autonomous vehicles.”

5.1.4 Conclusion to the analysis concerning future public space

The questions in the questionnaire for spatial planners were asked in a more neutral way. Nevertheless, many comments are evaluating. Most comments show either the irrelevance that there will be a change and that it probably will be positive for public space. Therefore, comments reinforce the answers given, except for the expression of irrelevance in certain comments.

Even though a small majority of the questions for landscape planners are either positively or negatively formulated, the comments are not very evaluating. This supports the answers the landscape planners gave. They estimate that there will be a change, but they do not dare to make a statement in one direction. They rather say that the digital transformation does not change much in public space concerning the scope of duties of landscape planners.

Transport planners, in contrast, seem to have a clearer opinion about how public space will change in future especially through fully autonomous vehicles. In a commentary, many participants underline that there could be capacity bottlenecks and that public space could become less attractive due to heavy traffic on the roads. Comments that there will be fewer parking lots needed in centres were considered a positive statement. This in fact is mostly the reason that spatial planners evaluate the development of future space as positive.

In conclusion, it can be said that the three disciplines do not have the same opinions on whether and how public space will change, as they are all having another focus on how to look at this topic.

5.2 Spatial data

5.2.1 Qualitative analysis of questions

Codesystem	Questions_Spatial Development	Questions_Landscape Planning	Questions_Traffic Planning	SUMME
Data	1	4		5
irrelevance		1		1
need for action				0
uncertainty		1		1
challenge		2	1	3
negative association	1			1
concerns		2	2	4
positive association	2			2
added value	1	2	2	5
hope	1	2		3
SUMME	6	14	5	25

Table 3: In which questionnaire the term “data” or its meaning is mentioned, and in which form it is described (“Data” above means in a neutral way).

As you can see on the matrix above (Table 3), the content analysis makes apparent that the subject “data” is of concern in any planning discipline studied. However, if only the graph is considered, the wrong

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conclusion could be drawn that the subject of data did not play a major role in the spatial planners' questionnaire. However, an entire block of questions (1 out of 8 with 3 sub-questions) was devoted to this topic. This is also the case at the questionnaire of the landscape planners. Nevertheless, the topic of data also appeared repeatedly in the other question blocks, which is why most mentions were made there. In the case of the questionnaire for traffic planners, the subject “data” is only mentioned in other thematic question blocks.

The analysis of the hypotheses and questions makes obvious different formulations. It is noticeable that the questions asked by the spatial planners are positively formulated (example: “With these data, analyses become more accurate.”). The formulations of the landscape planners are more widely spread. It is perceptible that neutral formulations (code “data”) are also chosen rather than in the other two disciplines. An example for a neutral formulated thesis is: “Data on the use and the users of the landscape will become considerably more important in future for the control and steering of landscape use.” The questions asked by traffic planners were more evenly formulated. There appear positive or negative formulations as well as indications of challenges.

Overall, most questions are asked with the positive association of added value or in a neutral manner. Concern was expressed on four questions (see Table 3).

5.2.2 Quantitative analysis of answers

Concerning spatial data, 88% of responding spatial planners estimate that analyses become more precise (“I strongly agree” or “I tend to agree”). Even 93% evaluate that these data will be the basis for simulations and design. The last of those three questions was about usage-based control. So, 73% of respondents think that data about use and users are enabling a usage-based control system. But it is to be noticed that the majority of the respondents said “I tend to agree” to this last hypothesis which is therefore more reluctant than euphoric.

88% of the surveyed landscape planners tend to estimate that the data about use and users will become more important in future. An interesting aspect is that there is hardly any majority at the question about the current significance of data in landscape planning. The same ambivalent distribution of answers is shown to the question if the accessibility of data is sufficient today. The current situation concerning options for evaluation of the data is estimated as insufficient from 62% of the respondents. Those answers are showing that the landscape planners are thinking more unitedly concerning the future but not about the present. 75% of the respondent landscape planners agree that digital data on the use and the users of the landscape will become more important in future for control and steering of landscape use. A majority of those estimates that there will be new technologies used for usage-data collection in recreational areas. Almost 50% also think that augmented reality will influence the management of the visitors in recreational areas.

To the question “What do you associate with digital transformation in the field of mobility and transport planning?”, 93% of the respondent traffic planners were choosing the answer “broader data for traffic planning”. Some questions about fully autonomous vehicles included questions about data. So, 52% of respondent traffic planners estimate a positive effect namely a more efficient traffic system on the basis of personal user data. But there is also concern expressed regarding the Data Protection Act.

5.2.3 Qualitative analysis of comments

Codesystem	Comments_Survey_Spatial Developments	Comments_Survey_Landscape Planning	Comments_Survey_Traffic Planning	SUMME
Data				4
irrelevance				5
need for action				12
uncertainty				5
challenge				5
negative association				0
concerns				14
positive association				2
added value				7
hope				4
SUMME	21	34	3	58

Table 4: In which comments in the survey the term “data” or its meaning is mentioned, and in which form it is described (“Data” above means in a neutral way).

As well as in the questions the subject “data” (especially spatial data on the use and the users of space) is mentioned in the comments of the surveys of each group. However, it is noticeable that there are hardly any

comments to data from the respondents of the survey for mobility planners. However, it seems to be of interests for the spatial and landscape planners, as they mention the topic in many comments. Concerning the survey for landscape planning, there are comments with a positive association as well as with concerns about the future or present. But it also shows that there is a certain uncertainty about the topic and especially a need for action (as it is not always specified from whom). It seems interesting that data is mentioned in various forms from the spatial planners, especially as the questions are mostly formulated in a positive manner.

In comparison to the formulations in the questionnaires, a difference can be observed in the frequency of the different associations. In the questionnaires, more questions were coded with the tag “added value” or “data” (neutral) than expressing concern. On the other hand, twice as many comments were made expressing concern than those that see an additional benefit in user-based data.

5.2.4 Conclusion to the analysis of spatial data in planning

In conclusion to the subject “data” in the group of spatial planners, there can be said that the questions are positively formulated. Most planners see an additional benefit from usage-based data especially for analyses and an added value of usage-based control (more reluctant though). Contrary, in many of the comments, uncertainty is expressed (p. ex. “I don't know if it's reluctance or impossibility”) or irrelevance (p. ex. “Having data is one thing. Changing behaviour is the other, best examples are climate change or biodiversity!”). The reasons for this difference between answers and comments are various. First, there could have been a “priming” through the positive formulations of the questions. In methodological research, the influence of the question formulation on the answers has already been investigated and proven several times (e.g. Strack, 1994 or Diekmann, 2014). Second, it could be that people who fully agree with the hypothesis do not feel the urge to make an own comment, but people who do not agree like to tell their opinion. Another explanation is that only people with a very clear opinion like to share it, and people who are unsure will not tell. This corresponds to possible sources of error which Martin (1984) already described in the analysis and evaluation of the empirical research method of the survey. An explanation could also be that they think positively about the future use of usage-based data but nevertheless show some uncertainty.

Among the landscape planners, there is no clear majority showing in answers concerning the current situation about data in landscape planning. The only clear majority gets the thesis that the options for evaluation are insufficient. This shows a clear uncertainty about the present situation. Questions about the future (especially usage-based data for steering landscape use) get more agreement. In comparison to the other questions about the present, this shows some hope for a better situation in future concerning spatial data. This confirms that there were many comments contributed in the survey for landscape planners and those are associated with a large variety of feelings (see Table 4). This is another indication that there is no common opinion among landscape planners concerning the additional benefits of usage-based spatial data in future.

Traffic planners chose a clearer way of asking than the other two questionnaires, consequently, there were more options to choose from. The answers of the surveyed transport planners show that data for them seems just to come along with digital transformation and the majority believes that data will be necessary for influencing routing for a better traffic situation in future. There were hardly any comments added to the subject of spatial data in the survey. Reasons for that could be different: First, this could be a result of the type of questions and options to choose (e.g. Strack, 1994). Second, data could be seen simply as a matter of fact and a means to an end for traffic planners. It seems that there is no need to question the future relevance of usage-based spatial data, which has already been investigated in many studies in different countries (e.g. Anda et al., 2016; Friso et al., 2018; Zannat and Choudhury, 2019). Or, in the discipline of traffic and mobility planning other subjects and problems are more of interest. This is illustrated by the number of comments which are contributed to the topic of selfdriving cars. However, the emotional factor to this topic should not be underestimated (Maurer et al., 2015).

Nevertheless, there were different questions asked in the three surveys, considering the analysis of the questions and comments, one can tell that there are different estimations and feelings concerning future planning about data among planners from the different disciplines. Spatial and landscape planners seem to share a certain uncertainty about the additional benefits and the usefulness of usage-based spatial data. The way of asking in the questionnaire of the transport planners makes it harder to interpret the estimation of the participants, but it seems that they are having a clearer opinion about the subject.

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5.3 Role of public authorities

5.3.1 Qualitative analysis of questions

Codesystem	Questions_Spatial Development	Questions_Landscape Planning	Questions_Traffic Planning	SUMME
authorities				0
missing power/competences				0
no need for action				3
need for action				2
active role				13
going with the trend				6
reluctant				3
overstrained				0
SUMME	10	10	7	27

Table 5: In which questionnaire in the survey the term “public authorities” or its meaning is mentioned, and in which form it is described.

The matrix above (Table 5) shows that the role of public authorities in addressing the digital transformation to a sustainable development is an issue in every questionnaire of the survey. Also, the orientation of how the questions were asked is not completely different. Whereas the questionnaire of landscape and traffic planning is more asking about whether or not public authorities have or will have to take an active role to shape future space, the questionnaire of spatial development is more asking whether public authorities already are or will have to be going with the trend and adapt the digital transformation. One example for the code “going with the trend” would be: “Technological developments should be taken more into account by the municipalities.” For comparison one example for the code “active role”: “The players in spatial planning will be the drivers of digital transformation.” It is assumed here that the public authority is one of the players in spatial planning. One block in the questionnaire for spatial planners was used to ask directly about the current and future role of the actors. Questions about the role of the public authorities were asked by the transport planners only in the form of which complementary measures were necessary for sustainable mobility (which entails action by public authorities).

5.3.2 Quantitative analysis of answers

It is noticeable that the clear answer options “strongly agree” or “strongly disagree” were never chosen by the majority of spatial planners to the question whether the actors in spatial planning are reticent, adaptive or driving. This could be an indication that they are not sure about their own role. It is interesting to see that 37% of the participants tend to agree that actors are reluctant and exactly 37% as well tend to disagree about this. The same scheme is showing on the question whether actors are adaptive or not. In both questions, almost 20% strongly disagree. There is a larger part that denies the thesis that actors in spatial planning are drivers of digital transformation. The majority's rejection of each option underlines the fact that actors of spatial planning (including public authorities) are unsure of their current and future role in digital transformation. When the questions come to certain facts, the answers become clearer. The majority of the actors say that a smart home does not influence their professional activities (which involves public administration tasks) and therefore does not entail any actions in spatial planning. The same tendency can be seen with micro-hubs. However, the answers there are not so clear, and it is therefore not clear whether micro-hubs will have significance in spatial planning or not.

88% of landscape planners feel that authorities and decision-makers should increasingly include new technologies in planning and control. However, in detailed questions he majority concedes the authority only a passive role. Thus, most think that technological developments must be taken into account by municipalities and that emerging technologies must be pursued. Only minorities think that decision makers should actively improve the availability of data or use social media to guide visitors. Even though, almost 78% of the participants think that social media could be used to guide visitors and can be used for participation and communication. On the other hand, 18% only think that social media specialist units should be created within government agencies.

The majority of transport planners think that road or mobility pricing should be introduced, structural measures are needed, data to influence navigation systems must be provided and/or intelligent infrastructure should be introduced. Not much support was given to the options of a necessary reduction of the maximum speed permitted and a ban on vehicles that are not fully autonomous. All those measures entail action by public authorities.

5.3.3 Qualitative analysis of comments

Codesystem	Comments_Survey_Spatial Developments	Comments_Survey_Landscape Planning	Comments_Survey_Traffic Planning	SUMME
authorities				0
missing power/competences		5		5
no need for action	3			3
need for action	11	14	6	14
active role		5		5
going with the trend	4			4
reluctant	5			5
overstrained		2		2
Σ SUMME	11	21	6	38

Table 6: In which comments in the survey the term “public authorities” or its meaning is mentioned, and in which form it is described.

The role of the authorities is quite often mentioned in comments of landscape planners, but hardly any comments appear in the survey of transport planners. Some transport planners mention that the authorities need to do something in an active role, mostly they plead for regulation by the state. In all three surveys, the participants demand authorities in their comments to do something about this topic. This need is particularly pronounced among landscape planners. As well, only landscape planners state that public authorities especially municipalities often do not have the power or the competences to influence the current or future situation. They also claim that authorities are too reluctant and often overstrained with new technologies concerning landscape planning. Spatial planners mostly claim that actors (including public authorities) more often would like to use new data and technologies, but they often do not have access to these means.

5.3.4 Conclusion to the analysis of the role of public authorities

To conclude, it can be said that most planners see a need for action but not all the time in an active role of the public authorities. The variation of answers can be interpreted as uncertainty about what the role of actors like the authorities should be at the moment regarding digital transformation in planning. And also, about what their role should be in future. Comparing the three planning disciplines, it can be said that transport planners show the least uncertainty. The answers given mostly illustrate a quite clear agreement and many of the few additional comments made were about the same issue namely regulations. Furthermore, the answers of spatial planners show many uncertainties as there is hardly ever a majority achieved. Landscape planners show unsteadiness in their comments. Many of the landscape planners think that there is a need for action, a few of them think that the authorities are already in an active role, whereas some others think that the authorities are overstrained with the topic and quite a few think that there is not enough power or competence in public authorities to address the issue. None of the spatial or traffic planners made a statement in this direction. This could be an indication that the authorities give more weight to urban and traffic issues in connection with digital transformation than landscape issues.

6 CONCLUSION

According to the analysis of the topic data, spatial planners see additional benefits of data but nevertheless show some uncertainties. These uncertainties can also be determined in the answers and comments of the landscape planners about the current situation. But they show some hope for clearence and benefits of data in future. Transport planners seem to have a clearer estimation of the topic of data. There does not seem much to be discussed although usage-based data is said to be of use for mobility planning (i.a. Schmitt and Männel, 2017; Antoniou, 2019). A similar pattern can be seen regarding the theme of future public space. Landscape planners think that there will be new forms of recreation in future and that requirements for public open space will change. However, there can hardly any indications be identified about what will change and whether the development will be positive or negative. Whereas spatial planners mostly think that public space will change in a positive way. Comments indicate that public space could become more important and "better". A majority of transport planners show an opposite view to this estimation. They do not think that public space will change fundamentally and that there will rather be a negative development with more traffic due to the digital transformation. Concerning the role of public authorities, traffic planners seem to be most certain again. Nonetheless, every professional group analysed illustrates some uncertainties about what role the public authorities have to take, but they agree that there is a need for action. Landscape planners also think that public authorities are overstrained regarding digital transformation and landscape.

Overall, transport planners seem to have a clear view about how future space will develop. This could be based on the fact that many studies are already conducted on the topic. In contrast, landscape planners show

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many uncertainties. They estimate that there will be a change due to digital transformation but cannot say what and how it will change. Spatial planners seem to be a bit less unsure than landscape planners but do not have such a straight vision as mobility planners.

These results of the analyses show that transdisciplinarity seems to be a suitable approach to study the subject of digital transformation, as a transfer to practitioners is of great importance concerning future challenges. One finding of the analysis is that within the research project there are different visions of the future among researches. Although the disciplines are used to work together, they still show another way of thinking. This is enriching for research but nevertheless a challenge for the research process. The different levels of knowledge among the professional groups were another major challenge identified, as some of them have a clear idea of the development and others show uncertainty and disagreement. This will make the transfer of the research results challenging. As mentioned previously, there are some principles in transdisciplinary research which must be respected and all of them are important. Through the analysis described here, however, it can be said that three of the four principles seem particularly important for the issue of digital transformation in space and the role of planners. First, the target-group oriented processing seems to be of much importance, as there is a different level of knowledge among practitioners. An impact model which shows how to implement the solution could be helpful for this. Second, the principle for open-mindedness is particularly important as there are other foci and yet still different visions from researchers as well as from the professional groups. Third, the last principle of reflexivity through recursivity has to be fulfilled. By running through project steps several times, knowledge levels can be adjusted and common visions can be developed. If these points can be successfully applied, then transdisciplinary research could help to resolve uncertainties of development in the practice of planners and to develop common visions so that the digital transformation can ultimately make a real contribution to sustainable development.

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🏆 *reviewed paper*

Unlocking "Kasi Wealth": Perceptions of Transformations through Spatial Planning and Local Economic Development in Soshanguve

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1 ABSTRACT

The buzz concept of inclusive economic growth has been receiving great emphasis in both academic and industry dialogues, thus placing the socio-economic transformation agenda on the spotlight not only in South African cities but also in cities across the African continent. Drawing from the urgent need to restructure the South African economy as well as the relevant institutions that support the economy as a whole; this study investigates the role of spatial planning and local economic development strategies in Kasi wealth transformation, using Soshanguve Township as the case study. It can be argued that, as an empowering strategy, effective strategic spatial plans need to be clearly expressed in LED policies. Using the social capital and the Right to the City theoretical lenses, the paper assesses the perceptions of black business owners in Soshanguve on spatial planning and the way it has shaped, or not, the viability of their businesses. The transformation of small-scale informal and semi-formal businesses into successful enterprises that have a fair share in the national economic space is investigated through perceptions. The paper also interrogates the influence of the interplay among spatial, economic and social dynamics in socio-spatial and economic transformation. A qualitative research approach was applied where data was gathered from twelve (12) small scale and informal business owners in Soshanguve using semi-structured interviews. Qualitative data was also gathered from four (4) key informants; who are professionals that actively participate in spatial planning and local economic development of Soshanguve Township. Content analysis was used to analyse the data, where categories were deciphered and used to create themes and GIS maps were produced to visualise the spatiality of the small businesses in Soshanguve. The paper argues that despite the City of Tshwane having LED initiatives, the clear and explicit relationship and expression between strategic spatial planning and LED remains blurred. In order to achieve inclusive and transformative growth, LED should find clear and precise expression in strategic spatial planning and property management to support township entrepreneurs. Pursuant to that, strategic spatial planning should be simplified in order to accommodate the informal economy and place emphasis on strong community relation networks between local authorities and planning policies. It is recommended that economic transformation needs to begin epistemologically and ideologically through the advancement of human development through sustainable planning practice and community building efforts. The study concludes that this can also be achieved through the development of stronger community networks (internal and external) that ensure township residents and business owners equally participate in the national economy and contribute to shaping its planning practice. From this perspective, the City of Tshwane has ground to cover in the coproduction of planning epistemologies and practice towards a platform for inclusive and transformative growth and social and economic justice.

Keywords : Inclusive economic growth; Economic transformation; Social Capital; City of Tshwane; Spatial Planning

2 INTRODUCTION

South African cities are dynamic and planning theory and practices are under pressure to respond to urgent challenges. The socio-economic transformation agenda has been on the spotlight in planning policy and practice particularly in South Africa and across the African continent. The planning of previously socio-spatially and economically marginalised areas like South African townships into sustainable entities remains a challenge. With the current emphasis of inclusive growth and transformation, governing policies and implementation strategies should align accordingly. Small, medium and micro enterprises (SMMEs) are crucial to economic development and growth in South Africa. Inclusive growth and socio-economic justice are intrinsically tied. The right to the city concept and social capital imaginings should be used more often as planning tools for planning theory and practice lined to spatial planning and LED. The paper urges for the clear expression of strategic spatial planning in LED policies in order to achieve the objectives of the transformation agenda. There is an urgent need to strengthen South Africa's economy and the country's

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government institutions that support the economy and to effect change in its dismal economic growth. South Africa's total economic growth rate was 1.8 percent in 2018 plunging to 1.3 percent in 2019, with a record high in unemployment rate at 27 percent in 2018 and 28 percent in 2019 – equating to about 16.5 million jobless people, in the country.[1] The South African economy is part of the five largest and emerging economies in Sub-Saharan Africa with a stagnant and stifled 0,4% economic growth compared to its sister Sub-Saharan African countries i.e. Angola, Nigeria, Sudan and Ghana with growth averages of 2% (World Bank, 2020); thus the economic growth agenda is intensified. An urgent need also exists to implement mechanisms that restructure the country's failing economy, and which this paper addresses. Entrepreneurial activity mainly takes place in SMMEs which generate 35% of the country's GDP (Nieuwenhuizen and Nieman, 2009). Meanwhile, SMMEs have been promoted since 1995 to boost economic growth and sustainability in areas where government has fallen short to create employment for citizens (Berry et al., 2002:1-2 and Rogerson, 2006:38). Alongside physical infrastructure investment in South African Townships such as Soshanguve, chosen case study, economic vitality is equally important. Musakwa (2008:24) highlights tangible and intangible locational factors such as access to roads and markets and quality of life which are invaluable to local economic development (LED) and important to generate business, 'kasi' [township], wealth.

The extent to which spatial planning, LED strategies, and encouragement of SMMEs as grassroots interventions, have enhanced the circumstances of black entrepreneurs and distribution of wealth in townships has been a subject of debate. It can be argued that, as an empowering strategy, effective strategic spatial plans need to be clearly expressed in local economic development (LED) policies. Using the social capital and the Right to the City lenses, the paper assesses the perception of black business owners in Soshanguve on spatial planning and the way it has shaped (or not) the viability of their businesses. The first section of this paper discusses the emergence and current status and debates of spatial planning and LED in South African cities. In addition, it discusses the role that spatial planning and LED plays in the spatial reengineering of the township space economy which are viewed as a vehicle and a viable mechanism to spur economic growth and strengthen South Africa's economy by restructuring the country's socio-economic development, and which is centred on a Kasi wealth transformation approach in the Soshanguve Township in the City of Tshwane of the Gauteng Province, South Africa. Second, the theoretical lenses adopted, i.e. social capital and the right to the city concept in the research and their integration with planning theory and practice are elucidated. It will continue to expand on the methodological approach adopted and the presentation and discussion of the four emerging themes namely; rethinking of functional business environment and local governance, business advancement and capacity building, socio-economic hardships and land and infrastructure investment as well as presentation, analysis, discussion of findings. We argue that despite the City of Tshwane having local economic development (LED) initiatives, the clear and explicit relationship and expression between strategic spatial planning and LED remains blurred. This paper, therefore, recommends that economic transformation ought to draw on both epistemological and ideological factors to advancing human development through a culture of sustainable planning practice. In concluding the paper, it is argued that the transformation agenda of socio-economic development of town planning, which is used as a vehicle can be achieved within a holistic approach that include: rigorous development of building stronger community networks with a view to ensuring that township residents and business owners equally participate in, and contribute to, the shaping and planning practice of strengthening the national economy towards restructuring of socio-economic development within township planning for inclusive economic growth.

3 LITERATURE REVIEW

Literature surrounding local economic development (LED) and spatial planning is broad and multidisciplinary. This section provides an overview of scholarly work on the township space economy and to understand various factors involved in the possible transformation of black-owned business in South African townships. In addition, it conceptualises the background of South African townships with regards to spatial planning and LED. It carries on by discussing the theoretical integration of social capital and the right

[1] See Trading Economics data on South Africa's economic disposition including growth rates and unemployment outlook <https://tradingeconomics.com/south-africa/gdp-growth>; and, <https://tradingeconomics.com/south-africa/unemployment-rate>, accessed 27 March 2019.

to the city concepts as pro-poor and sustainable planning tools towards LED and socio-spatial justice. The emergence and current status on spatial planning and LED in South African townships has evolved from segregationist tools to inclusive domains (van Wyk and Oranje, 2014). The planning theory shift warrants a focus towards the integration of both economic development and spatial planning mechanisms. Gumede (2018:4) outlines that a renewed socio-economic development approach is warranted, especially in African cities and currently and previously distressed areas. Similarly, Walby (2018:45) posits that the rethinking of a new approach for economic growth is largely dependent on a sound and just socially inclusive strategy. With the current emphasis on economic progress of cities and regions according to the Global Entrepreneurship Monitor (GEM) (2016:6), South Africa's entrepreneurial activity compared to other developing countries like Ghana, Nigeria, Uganda, Ethiopia, Malawi, Zambia, Namibia and Botswana is worryingly low where low economic growth is almost impossible to achieve. The literature argues that South African townships are in desperate need to be economic growth engines (Mahajan, 2014). The creation of industries as a form of entrepreneurship is the backbone of economic growth and township economy (Nieman and Nieuwenhuizen, 2009).

Emerging economies in Africa such as Ghana where linkages between spatial planning and LED have been explored prove the need for sustainability and economic vitality. In England, Morphet (2010:16) emphasises that the economic role of spatial planning has not been adequately supported to have land identified for economic growth. The conceptual approaches of social capital and the right to the city can be juxtaposed to spatial planning and LED planning theories and practice. Social capital is a vital instrument in considering cooperative and collective ways in which economic enhancement can occur. Social capital, as a policy analysis tool, examines at its core, social relationships between people and how they generate positive outcomes (Szreter, 2000 and Solow in Dasgupta and Serageldin, 2001: 6-7). Abrahams (2003:196) agrees with the latter by stressing the fact that no matter how big or small, rich or depressed a community is, partnerships between role-players are essential in the LED process. Similarly could be said for, Healy (2002) where Social Capital is regarded useful in poverty reduction and sustainable development.

Knorringa and van Staveren (2007) in the attempt to unpack social capital employing a social economic approach, stress the fact that there are three mainstream perceptions to social capital such as first, utility function; second, an individual resource (Bourdieu), owned by firms and individuals and third, an instrument to reduce risks. Furthermore, social capital can be divided into two notions, firstly, bonding capital where strong social ties are based on a social identity such as organisational culture, ethnicity, religion, gender, and family whereas bridging social capital is described as weak social ties across society in which individual and organisational behaviour is held together by diverse group members who share common values. The complex economic, political and social processes that shape urban spaces and inform urban transformations can be understood through the Right to the City concept. The Right to the City concept has its foundations in Lefebvre's (1991: 27-28) ideas on the production of space where social actions are incorporated in a representational social space where social networks come into play. Agreeably so, Harvey (2008: 23) is of the opinion that the collective power of individuals to reshape and remake their cities and social space is the most neglected right. The Right to the City impetus came about not simply because of intellectual inquiry but through urban revolutions and demands of oppressed people desperate to change their socio-economic circumstances (Harvey, 2012: xiii). Linked to this, one can note that social and support networks as economic tools have been key to grant access to economic opportunities and active participation. Putnam suggests that social capital is lost when community networks decline and an individualistic agenda trumps (OECD), 2001: 102-105).

With regard to neighbourhoods in the City of Tshwane, Horn (2004:329) concluded that community consensus and social relations in both black and white areas was weak in the early 2000s. However, more needs to be understood about how social capital in this regard can be mobilised and linked to spatial planning and socio-economic livelihood initiatives. The effective use of land, understanding and cooperation between LED planning and black entrepreneurs in Soshanguve can create possible solutions for the current challenges black-owned businesses face and towards an inclusively owned township space economy.

4 OBJECTIVES /RESEARCH QUESTIONS

The paper has twin objectives and these are;

(i) To assess the perceptions of business owners in Soshanguve on spatial planning efforts

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(ii) To examine how they view the role of spatial planning in shaping (or lack of it in) the viability of their businesses.

5 APPROACH AND METHODOLOGY

Data was collected from 3 main sources: interviews, policy documents and visual mapping. A qualitative research approach was employed to gather data from twelve (12) small scale and informal business owners in Soshanguve using semi-structured interviews. The small scale and informal business owners were purposively selected from the City of Tshwane's SMMEs and Informal Traders database. The business owners were categorised to produce a mix of young and older, and male and female business owners. Small scale business owners were chosen from prevalent economic sector activities in South African townships like Soshanguve. The economic sector activities include construction and services, manufacturing applied to industrial production and retail amongst, agriculture with links to agro-processing, retail can also include spaza shops, services linked to business process outsourcing (BPO) and ICT, business services such as lawyers and medical practitioners, personal and household services such as plumbing and mechanics, transport and tourism. Geographical Information Systems (GIS) data was collected from the Geoinformatics department at the CTMM in order to produce high quality maps of the study area and geo-political factors using ArcGIS 10.2, a GIS computer programme for desktop analysis and mapping.

Merrel and Tisdell (2015:164) state that the use of this information emanates from the researchers industriousness – which will geographically display business land parcels and location of business owners. Qualitative data was also gathered from four (4) key informants; who are professionals that actively participate in spatial planning and local economic development of Soshanguve Township. Content analysis using ATLAS.ti 8.0 was used to analyse the data where a code system was built and codes were assigned to transcriptions. Assigned codes were further categorised into code families and categories were deciphered and used to create themes. In addition, GIS maps were produced to visualise the spatiality of small businesses with relation to mixed use vacant land parcels in Soshanguve earmarked for mixed land uses and strategic investment. The City of Tshwane Metropolitan Municipality's (CTMM's) Integrated Development Plan (IDP) and the Regional Spatial Development Frameworks (RSDFs) for Region 1, where Soshanguve is situated, the Spatial Planning and Land Use Management Act (SPLUMA), By-laws and LED policies such as the National Small Business Act have been reviewed to gain a sense of the status quo of LED policies in Soshanguve integration of LED and spatial planning policy and practice.

6 RESEARCH ANALYSIS AND FINDINGS / RESULTS

An inductive approach was used with the transcriptions where the data was first level and open coded using ATLAS.ti 8.0. From the long list of codes produced, categories were constructed and were named and given definitions. The process where the researcher prepares the data and conducting different analyses, classifying and the interpretation of linguistic or visual material and moving into a deeper understanding and representing the data to inference larger meaning of data is called data analysis (Creswell, 2013 and Merriam and Tisdell, 2015). A total of 79 codes were generated and sorted and categorised into 9 categories which were given definitions and scaled down to four emerging themes. Code groups were created and further reduced to the overarching emerging theme. Figure 1 below depict the first level codes that were in the abstract level which were analysed and lifted into their respective categories (i.e. SUPP Calls for effective business support structures) and generated emerging themes as listed in Table 1 further below (i.e. Theme: Business advancement and capacity building and other emerging themes that are rethinking the functional business environment and governance, land and infrastructure investment and socio-economic hardships). Figure 1 below, is an example of how themes were derived from categories subsequent to derived codes from transcriptions.[2]

The study area map provided in Figure 2 below, illustrates the location of participant business owners in the 'Soshanguve Crossing node' along Ruth first Road, and Aubrey Matlala Street. This specific location is a node with activity streets and proposed specialised activity areas. According to the RSDF (2013) this node should stimulate strategic investment not only for retail developments but for commercial areas which will

[2] A total of 79 codes were generated and sorted and categorised into 9 categories which were given definitions and scaled down to four emerging themes.

stimulate the local economy. The vacant land parcels across Soshanguve crossing mall, south, belongs to private developers where the location of informal business owners trade. Across the Soshanguve crossing mall, east, land is zoned for medium-high residential developments but along the activity street (Aubrey Matlala), small scale and informal businesses are booming, also where the location of participant informal business owners trade. To the north of the shopping mall is the research, education and technology centre for Soshanguve, the Tshwane University of Technology (TUT), primary and secondary schools; these institutions are described as strategic investment areas and need integration with a view to achieving inclusive cities and economies (RSDF, 2013: 15, 39-40). Befittingly so, this is where most businesses locate themselves – close to the community and infrastructure which will be discussed in depth in section 9.4.

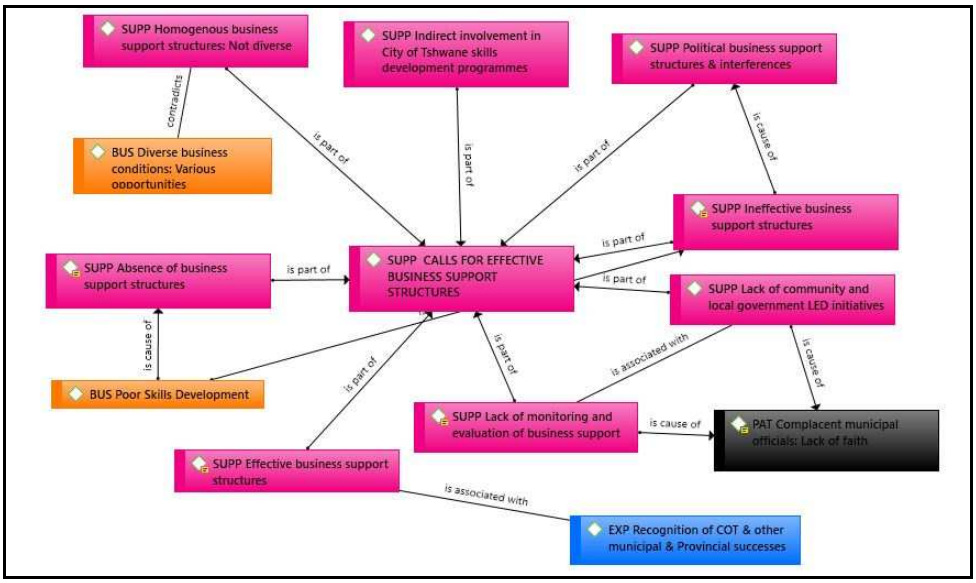

Figure 1: Example of deriving themes from first code levels and categories

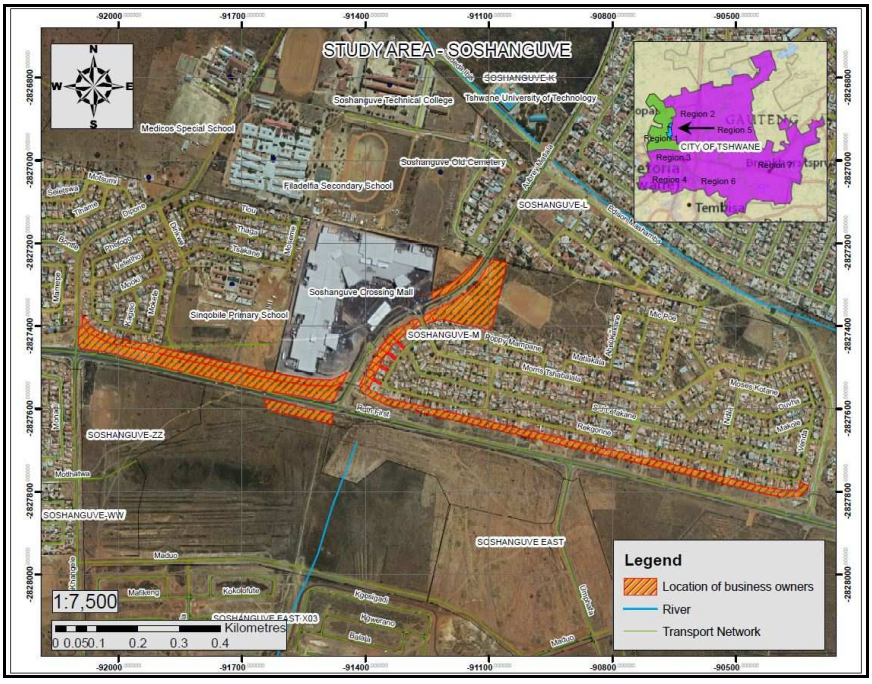

Figure 2: Study area depicting location of business owners – Soshanguve crossing node

The RSDF (2013) does cater for non-residential land uses like small scale business by means of the rezoning of the properties. However the properties to be rezoned should meet the minimum requirement of measuring 500m2 in extent as indicated by the town planner of the ward. The average property size in Soshanguve and most townships in South Africa ranges between 200 m2 and 250 m2 (COT Soshanguve, Approved township layouts – average property size). This clearly indicates that the local spatial and economic development not only do they not speak to each other but frustrate and are a hindrance to the development of small black

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enterprises. In addition, such hindrances places much needed spotlight on the inability to secure tenure through private or public funded (e.g., lease to own, alienation of council property or the sale/purchase of council property) means. Local development proposals and projects are often frustrated by land requisition processes, which further heightens the current land debate in South Africa. Local business owners struggle to submit, finalise and pay towards land development applications because of cash flow issues coupled with lack of planning policy information, guidelines and processes. Metropolitan and local municipalities like City of Tshwane and City of Johannesburg are now challenged to align their planning and enforcement by-laws with the proposed enactment of the Township Economic Development Act by provincial government. The Act is a piece of legislation that is set to unblock many of the business enterprises’ developmental and growth challenges.

The map overleaf, Figure 3 (mixed used vacant land parcels), was created through desktop analysis of strategic land parcels and their respective ownership. The land parcels abuts the R80 Mabopane Highway to the east and intersects with mobility roads Ruth First road, to the north, Umphafa road, to the west, and Hebron road to the south. The vacant land parcels are largely owned by both local and provincial government. This also illustrates the need for co-operative governance in the realisation of transformation goals. This is evident in the majority of business owner participants having a clear expectation from the City of Tshwane Metropolitan Municipality to create a conducive business environment, which emerged strongly in the study. The alignment of national, provincial and local government capital projects has always been a point of contention where implementation is concerned. National development goals such as the three highlighted in the National Development Plan (NDP) namely 1. Eradication of poverty 2. Inclusive and accelerated economic growth and 3. Sustainable communities should ultimately trickle down to local implementation projects through the government hierarchy. One the one hand, the importance of business sites and location are associated with co-operative governance and on the other hand, is contradicted as well because of the precarious position informal business owners find themselves in operating their businesses along road reserves between 5 to 15 metres from the main mobility roads.

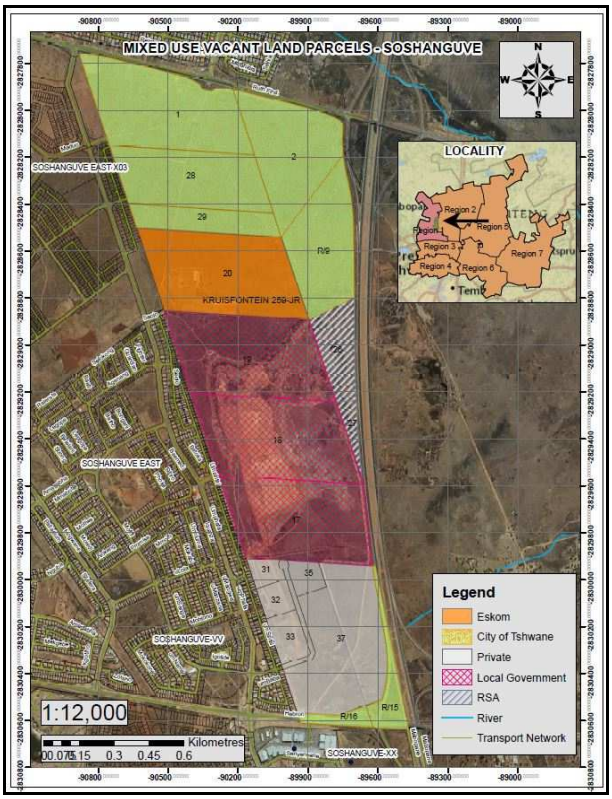

Figure 3: Map depicting ownership of mixed use vacant land parcels in emerging node

This heightens and deepens the urgent need to access to land which is visible as well as close to social and physical infrastructure. Proposed residential township developments are largely owned by private developers as private investment projects and in some instances in collaboration for the Department of Human Settlements through the Reconstruction Development Programme (RDP) houses. Local government is under

pressure to plan for and implement for economic centres and activities for areas that were previously excluded like Soshanguve, a predominantly black residential township. What are the economic trade-offs and land use negotiations between private developers, communities and local government. The desktop analysis of Figure 3 (mixed used vacant land parcels), was inspired by the possible implementation of one of the sustainability principles of the Spatial Planning and Land Use Management Act (SPLUMA), the optimal use of existing infrastructure towards the transformation of our cities for inclusive growth. Below is an extract from the City of Tshwane's RSDF, 2013, Figure 4, where the north-western vacant land parcel owned by the City of Tshwane (Portion 1 of the farm Kruisfontein 259-JR) as de.picted in Figure 3 (mixed-use vacant land parcels) is a cemetery which constitutes only 21% of the land. In addition, it illustrates the current development trajectories informed by the City of Tshwane's spatial development strategy where economic development and growth are crucial. Figure 5 is a replica of Figure 4 only illustrating the future development strategy where the land parcels that are blue notated which abut the Mabopane Highway (R80) are earmarked for mixed land uses specifically commercial uses associated with promoting businesses.

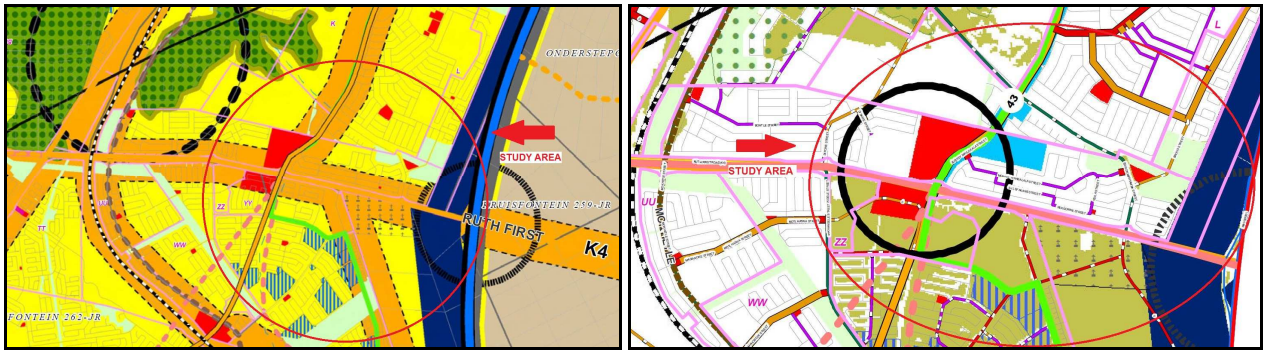

Figure 4 (left): RSDF map depicting allowable land uses in emerging and current nodes (RSDF, 2013). Figure 5 (right): Future, local and community nodes and corridors (Draft RSDF, 2017)

The manner in which participant business locate themselves was found to be influenced by close proximity to infrastructure such as: roads, shopping centres, social amenities, housing developments, and among others and to be equally visible to community members, pedestrians and motorists. The importance of business sites are found to be a cause of the potential for businesses to grow economically. In addition, it is able to stimulate healthy competition among business which can result in economic growth. Notwithstanding the presence of retail developments, which are perceived as mixed positive and negative outlooks and where some participants interviewed in the case study, concerns with their presence while others had not. The importance of business sites and location, and the urgent need to access to land are key findings discussed later on in this paper.

The categories derived from codes and translated into emerging themes are tabulated below with the category definitions. It links with Figure 1 described earlier. The four main emerging themes include: i) rethinking of functional business environment and local governance; ii) business advancement and capacity building; iii) socio-economic hardships; and iv) land and infrastructure investment.

7 RESEARCH CONTRIBUTION

Inclusive growth and socio-economic justice are intrinsically tied. The right to the city concept and social capital imaginings should be used more often as planning tools for planning theory and practice lined to spatial planning and LED. It will also urge for the clear expression of strategic spatial planning in LED policies in order to achieve the objectives of the transformation agenda.

8 RESEARCH LIMITATIONS

This paper is a glimpse of a master's dissertation. The use of Computer assisted qualitative data analysis (CAQDAS) requires more technical support. The study ensured trustworthiness through triangulation where multiple data sources were used to build a complete picture of a phenomemenon. Opoku, Ahmed and Akotia (2016:40) proffer that the usage of multiple data collection methods grants the researcher the opportunity to 'triangulate their findings to provide more solid evidence and a better representation of the social world'.

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9 DISCUSSIONS AND CONCLUDING REMARKS

The findings are based on the perceptions of business owners in Soshanguve of how they view spatial planning efforts and the way it has shaped (or not) the viability of their businesses and discussed and expanded below.

1. Theme: Rethinking of functional business environment and local governance
Categories: Expressions about relations between business and government **Definition:** Opinions on relationship between business owners and municipal officials. Patronage in local governance **Definition:** General comments about municipal official corruption and impacts on business development. Need for more localised and community based planning **Definition:** Common views about the need to include the community when drafting planning policy.
2. Theme: Business advancement & capacity building
Categories: Calls for effective business support systems **Definition:** General remarks concerning business education and management. Positive and negative business trajectories **Definition:** General comments about business potential. Business inputs and social impacts **Definition:** Range of comments about social ills affecting labour force and business performance.
3. Theme: Socio-economic hardships
Categories References to poverty **Definition:** Overall complaints about current economic conditions.
4. Theme: Land and infrastructure investment
Categories Land and infrastructure availability **Definition:** Overall **c**omments about accessing space and infrastructure for business activities.

Table. 1 Findings themes and categories – Research Study Findings

9.1 Rethinking of functional business enviorment and local govrenance

As part of policy document analysis, it is only natural to consult the regional spatial development framework (RSDF) as the strategic spatial planning tool for South African municipalities. This is also true for the integrated development plan (IDP) as a local economic development (LED) tool for economic growth. The location of business owners was imperative at the outset for the holistic approach adopted in the paper. Businesses of interest were ones that were along economic activity streets and informally along mobility roads as well as around strategic land uses. Soshanguve is a historically black residential area where economic activities lacked and had limited social services (Naidoo, 2011; Mngadi, 2013). With the current emphasis on sustainable development and self-sufficient communities, transforming the economy and spatial challenges is at the forefront. The township economy is dynamic and boasts a plethora of black-owned businesses. Small scale and informal businesses are the heart of the township economy and are faced with numerous challenges that stifle growth. Figure 5.2 is a map depicting the location of the 12 small scale and informal business owners. The businesses are located within the 'Soshanguve Crossing" node which is shown as the study area and are located south and east of the "Soshanguve Crossing Mall" shown on Figure 5.2. The study area is strategically located to strategic land uses such as the Tshwane University of Technology (TUT) (RSDF, 2013). Businesses should locate within nodes where mixed uses, retail and offices are envisioned along activity streets, in specialised areas for strategic investment (ibid). Figure 5.3 is a map that tells a story of the investment potential for vacant land parcels with respective stakeholder ownership. The perceptions of the business owners that seek for a transparent and effective government system emerge strongly from the study. Example of need for community cohesion:

"The thing is we don't get invited to such things, yah you know the schooled people will tell you that it is above your pay grade as they put it. But we don't get invited to such things even when it comes to the town planning of this area, it would be nice for the City of Tshwane to engage with people who will be buying and selling and staying in those areas; even the town planners to be honest they failed to plan for this area, the VV's. Because there is too much congestion at the traffic lights."[3]

In addition, not only is the relationship between business owners and local government important but more so between the business owners as a community. This was linked and associated with a form of community support as co-operation between business owners in the sights and hopes to create possible consortiums.

[3] Confidential interview

Community cohesion is also largely dependent on strong networks and links where the lack of planning policy information can be attributed to weak active citizenry and participation. These effects can also be strongly felt with political inferences impacting service delivery with the change in political leadership in the city. This has been also evident in the importance and functioning of municipal customer care centres, which form part of business support structures on the one hand but contradicts lack of information about land parcels (business premises) on the other hand. Haferburg (2013) argues that African cities should be premised on relational webs and that development should be steered by the shared role of government and local institutions as well as businesses where trust and social consensus are present. An example of ground covered include the Townships Economic Development Act (National Treasury, 2017) where the act will nullify municipal planning by-laws, which are bureaucratic "red tape" in nature and hinder economic growth and prioritise business enterprises to grow in the local economic an industrial space. With that said community transformation cannot occur in isolation in cities and regions, it has to be accompanied by institutional transformation. Institutional transformation with one of the pressing issues is the synchronicity, alignment and effectiveness of all South African government spheres: national, provincial and local through where Pereira et al (2017) posit that cities globally are positioned to identify, adopt and implement transformational solutions. This paper argues that deepened community-based and collaborative planning is essential in the planning and implementation of planning policy and theory.

9.2 Business advancement and capacity building

The overall outlook on business trajectories was found to be largely positive. The factors affecting business advancement and transformation could be attributed to low education levels and lack of skills development training especially for the youth. While on the one hand, this may be attributed to the lack of community and local government LED initiatives and more so the lack of information dissemination and it doesn't get filtered down the right channels. On the other end, local government has been recognised for the business programmes they do roll out but the lack of monitoring and evaluation of business also emerged. With that being the case, the overall impediment to business advancement and growth was found to be the urgent need for access to land where sentiments of land ownership were shared to better equip business owners with resources by means of financial institutions. The other side affecting business outputs are the actual inputs (labour) affected by social impacts such as prevalent youth substance abuse which can be attributed to aggravated unemployment conditions and the unskilled youth. Other social aspects that emerged were references to oversupply of similar businesses by foreign nationals which warranted a negative outlook on the future and stimulated feelings of worthlessness. The potential for business growth was unwavered by the presence of retail developments while other business owners felt retail developments have competitive pricing models due to their large scale existence. While the business support structures were criticised to lack diversity but diverse business opportunities were perceived. Example of business inputs (labour) affected by lack of business management skills:

"The thing is when it comes to looking for funds my challenge mostly is that there are a lot requirements. They want a lot of things you end up being confused, they want business plans, financial statements and reports. Everything should be in order, and you remember I told you that if your management skills are lacking you won't be able to compile all of this you see. So now when you read there you see they want this and that you can't comprehend and you see which means I have to fix my business plan, when it comes to financial projections you can't do them."[4]

This need for a conducive environment and support systems for local businesses is clear where local businesses should capacitate themselves if they are to transform, grow and eventually build wealth. They need to be cognisant of various development opportunities through education and support of local government. What do we mean by wealth creation, Kelly, McKingley and Duncan (2016) state that 'wealth' is building an economy that is inclusive and locally held by the community. Friedmann (2007) agrees with the latter and continues to state that the true wealth of a city-region vests in 'human, social, cultural, intellectual, natural, environmental and urban assets'. This would enable a sustainable city where a region is able to invest in tangible assets and reduce dependency on outside capital. Social capital of black communities is paramount in the realisation of community building goals. Social capital can only work and be efficient when collaborations are sound and mutual trust exists and the ability to depend on each other.

[4] Confidential interview

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The development of cultural capital is paramount which is equally as important as social capital. This paper argues that black communities see no value in unity and thus lack individual agency as well as collective agency to change and ultimately build wealth for their communities. In addition, the value system amongst black communities has diminished where intangible qualities such as integrity, organisational skills, individual agency and trust, which are central to community and wealth building, are absent or difficult to find. The continued absence and overlooking of the latter community characteristics will see the continued impoverishment of black communities and no real or tangible transformation.

9.3 Socio-economic hardships

The reference to persistent poverty emerges strongly from the situation on the ground where there are a proliferation of informal businesses and informal settlements who somewhat possesses an individualistic agenda purely because of they are survivalists in nature. The unemployed labour force, all ages, become precarious to social ills such as prevalent youth and substance abuse linked to reduced business inputs in the advancement of businesses. The current socio-economic hardships experienced may be linked to perceived lack of tangible improvement since democracy. This is supported by Naidoo (2011) she revealed that small portions of people in one of her selected areas in Tshwane, Soshanguve claimed that their lives became in the socio-political transition of those areas. An example of perception on tangible improvement since democracy:

"You see that there's nothing that the government is really doing to assist us, count from the year 1996 till now 2018, 22 years of nothing."[5]

In addition it emerged that the false pretence of hardship and poverty could be attributed to the precarious business environment, informal business owners find themselves in. As well, the lack of community and local government LED initiatives espoused feelings of abandonment by the municipality whose sole mandate, they believe, is service delivery to previously disadvantaged areas. The latter coupled with the presence of foreign nationals creating competition evoked perceptions of worthlessness. Arendse and Patel (2014:10) provide insight on the importance for the strong and ongoing support from local government to further strengthen community efforts as well as develop clear local-local and local-external connections. In the urgent need for poverty eradication and growth of local business, communities should learn from each other. This spirit of efficient networks should be instilled in a way a business is run as well collaborations with various local government departments as well as community members.

9.4 Land and infrastructure investment

Some parts of Soshanguve's vacant land parcels are undevelopable because they are underlain by wetlands. The trend to create parks for residential areas is prominent and proof of that. A few of the land parcels earmarked for mixed uses are categorised as ecological support areas but still largely transformable to mixed land uses. The mixed use potential vacant land parcels owned by the City of Tshwane illustrated in Figure 5.3, the north-western part at the intersection of Ruth First and Umphafa roads are currently used and shown in the future RSDF, Figure 5.4 (RSDF, 2013) and 5.5 (RSDF, 2017), as a cemetery for Soshanguve. One can also note that although this land is currently used for a cemetery, it only constitutes 21% of the vacant 105 hectares owned by the local authority. Figure 5.4 and 5.5 illustrate the current development trajectories of Region 1 of the city. It is a result of strategic investment efforts in the area through bulk infrastructure services and retail opportunities through private investment. The overall consenus emerging from the analysis is that there indeed is an urgent need for access to land and infrastructure for business activities. This is justified by the willingness of the participants to rent municipal or private land:

"The most important thing is a shelter and/or storage, even if they say we should rent from them but I know Tshwane they won't charge us rent of more than R100, it normally would be R100 or less around R80 especially there around Mabopane Station, the storage there, they pay around R80 and in Ga-Rankuwa there is storage there as well for the same price. If it is expensive and maybe the price has gone up, I don't think the rent would be more than R120."[6]

[5] Confidential interview
[6] Confidential interview

Although the willingness of business to acquire municipal or private owned land is justified, the tendency for both private and the municipality to retain land and not lease or sell emerged during the research undertaken for this paper. This then, in turn contradicts the urgency of access to land and the expectation from business owners to the city to provide a conducive environment towards an inclusive economy. The fact that the city is more likely to sell prime land to private developers for capital injection in the city's budget is paradoxical towards community building efforts. The informal businesses are located along street reserves, Ruth First road and Aubrey Matlala Street and the uncertainty of conducting business is daunting although a 85% positive outlook on the future. This could also be related to the capacity building and advancement of businesses where they are required to comply but hold negative views about having access to land. As strong as the perceptions of the land question, the fact that the majority of strategic land parcels available for development and are privately owned. This study is showcasing the potential for the efficient use of relational webs and social networks through the right to the city concept and, social capital respectively to achieve inclusive growth on the transformation agenda. Our urban centres are tasked to be resilient in undertaking urban challenges through the optimal use of infrastructure and through investment in order to install the necessary infrastructure required to support local businesses. Development paradoxes appear visibly when businesses are expected to comply with municipal by-laws and maintain safety and order yet there is a clear indication of the perceived lack of business premises and inability to acquire such premises as a result of strained finances and lack of institutional support:

"I can say maybe due to financial issues because if I can get that land, I won't be able to build or develop the land."[7]

Space is a place or an area where things can happen. In the absence of space, there is a multitude of hindering factors to the growth of a business. The average residential property size in Soshanguve is 200 m2 where favourable business sites are expected to larger than 500 m2. One would argue that spatial planning hasn't been robust enough to see the rectification of historical imbalances in society. In addition, one may argue that although there are blurred lines between theoretical socially just planning policies versus the implementation thereof; perhaps, spatial planning has been given a new façade. The urge to challenge the current status quo exist as well as pushing new knowledge frontiers. Growth in the Sub-Saharan African region is expected to firm to 2.9 percent in 2020, and accelerate further to an average of 3.2 percent in 2021-22; In South Africa, growth is expected to firm to 0.9 percent in 2020, before strengthening to an average of 1.4 percent in 2021-22 (World Bank, 2020: 143). With cities, regions and municipalities as engines for economic growth, the investment potential of such regions/spaces have to align themselves accordingly. Types of investment in Soshanguve are largely residential and retail developments and industrial and/or manufacturing developments take a backseat. Surrounding the currently ongoing and heated South African land debate, it is befitting that this was the most expressed theme. The paper has highlighted the importance of economic infrastructure, access to land and investment in township economies and their symbiotic relationships.

This paper has provided an understanding of the perceptions that black business owners possess in Soshanguve towards the possible transformation of the township economic space local businesses operate in. It drew a picture of the current phenomenon unravelling in the 'Soshanguve Crossing node' surrounded by the latest extensions of Soshanguve have inefficient economic investment to diversify economic opportunities (RSDF, 2017: 15-34). The scarcity, therefore, inhibits the adequate development of informal township economies to enhance entrepreneurial development towards wealth creation and self-reliant communities. Stronger community networks should be fostered and conscious effort in strengthening those networks by various stakeholders especially the community themselves is possible. The most pertinent issue black communities need to realise is that there are far greater and more powerful external forces such as market forces where the export momentum is forecasted to be hindered by weak external (global) demand for products and goods (World Bank, 2020: 144-5). The internal forces thus need to be significantly reduced through trust, collective agency, pooling of financial, and human resources to create a conducive business environment. Notwithstanding the role and responsibility of local government and institutions to facilitate such an environment through the relief of frustrated business processes. The transformation of township space economies has yet to be ticked off as one of the transformation and economic growth agendas. The

[7] Confidential interview

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paper concludes that significant strides have been taken, from policy perspective, for township economies to grow but the implementation and robustness lacks. In addition, participant business owners have revealed that spatial planning efforts haven't catered for the viability of their businesses to grow or transform and ultimately generate wealth. The paper further concludes by urging the City of Tshwane (local government) to realise that they have ground to cover in the coproduction of planning epistemologies and practice towards a platform for inclusive and transformative growth and social and economic justice. From this perspective, the City of Tshwane has ground to cover in the coproduction of town planning epistemologies and practice towards a platform of achieving inclusive and transformative growth and social and economic justice.

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🏆 *reviewed paper*

Urban Area Development as an Expansive Learning Process: the Relevance of Monitoring and Evaluation

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1 ABSTRACT

Disciplinary professionals in the field of urban area development deal with the task of preparing the (urban) world that is not yet there. In times of increasing complexity and the invariably rise of contradictions, we propose that continuous learning between actors involved can make the urban area development process more resilient: less susceptible to crisis and more responsive to changing demand. In this paper, we build on our REAL CORP 2019 contribution (Peek & Stam, 2019) and further substantiate the idea of learning as a foundational principle of urban area development and examine whether Engeström's (1987) Activity Theory and expansive learning may be a useful conceptual framework to mobilise learning. We highlight the opportunities of expansive learning through monitoring and evaluation and use primarily outcomes of the monitoring and evaluation tool we designed for Merwe-Vierhavens, a transforming port-industrial area in Rotterdam, to analyse opportunities for expansive learning in the urban area development process.

Keywords: urban area development, expansive learning, monitoring and evaluation

2 LEARNING IN URBAN AREA DEVELOPMENT

Now that the Dutch real estate market is at its peak since the financial crisis of 2008, and supply cannot meet demand, there is a need to combine the strength of pre-crisis integrated urban area development and the openness of organic development during the crisis (Buitelaar et al., 2012) for an after-crisis new reference frame of urban area development, which should include a learning strategy (Peek & Stam, 2019). However, learning theory has never been extensively introduced in the field of urban planning. In this section, we examine the introduction of a learning paradigm next to existing paradigms of planning and production (see e.g. De Hoog & Daamen, 2013), resulting in a more resilient urban area development process (Bertolini, 2011).

2.1 The need for learning in urban area development

Peek and Stam (2019) advocate that continuous learning between all actors involved in an urban area development process could make this process more resilient: less susceptible to crisis and more responsive to changing demand. A resilient development process is more iterative and able to deal with a far more dynamic environment, transitional challenges, ambitions of multiple value creation, while not being able to turn to off-the-shelf solutions, and where multiple learning-loops entail involving a much wider set of stakeholders. Development strategies may no longer be prescriptive, but rather emergent and organic. In order to grasp the challenge of marrying the vast body of literature on learning with the urban area development process, we frame the latter as a network of interacting activity systems. In doing so, we may draw on the theory of expansive learning as initiated by Yrjö Engeström (1987), developed within the framework of cultural-historical Activity Theory (Vygotsky, 1978).

2.2 Urban development as a network of activity systems

Learning theory has largely focused on the individual or an organisation (e.g. the 'learning school' of Mintzberg et al., 1998) as subject. An urban area development process goes beyond this framing. Although the work is done by people in organisations, learning in an urban area development process involves learning across multiple organisations and professional disciplines, which is not always done in a coordinated manner. An urban area development process is better described as a heterogenous actor-network (Latour, 1987; 1996) that is made up of all kinds of human and non-human actors involved and their numerous and often conflicting relations. Thus, there is a need to capture learning as a complex process at hand enrolling

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all sorts of properties and contradictions within an actor (e.g. an organisation) while at the same time navigating through the complexities of institutional arrangements and other 'rules of the game'.

Given such complexities, Engeström's (1987) third generation of Activity Theory provides a conceptual repertoire that can account for multiple perspectives, and networks of multiple interacting activity systems to examine dialectical practices of detecting and dealing with inherent tensions in the activity system. In Expansive Learning at Work Engeström (2001) summarises Activity Theory with the help of five principles, referring to his earlier work:

(1) The prime unit of analysis is a collective, artefact-mediated and object-orientated activity system, seen in its network relations to other activity systems. All actions are only understood when interpreted against the background of entire activity systems. Activity systems realise and reproduce themselves by generating actions and operations.

(2) Activity systems are multi-voiced. An activity system is always a community of multiple points of view, traditions and interests. The multivocality is amplified in networks of interacting activity systems. It is a source of trouble and a source of change and innovation, demanding actions of translation and negotiation.

(3) Activity systems take shape and get transformed over lengthy periods of time. Their problems and potentials can only be understood against their own history.

(4) In activity systems contradictions are the source of change and development. Contradictions are not the same as problems or conflicts. Contradictions are historically accumulating structural tensions within and between activity systems. When an activity system adopts a new element from the outside – for example, a new technology, new object or a new player – it often leads to an aggravated secondary contradiction where some old elements collide with the new one. Such contradictions generate disturbances and conflicts, but also innovative attempts to change the activity.

(5) Activity systems may undergo expansive transformations. As the contradictions of an activity system are aggravated, some individual participants begin to question and deviate from its established norms. In some cases, this escalates into collaborative envisioning and a deliberate collective change effort.

Taken together, Engeström's elaboration of expansive learning in interacting activity systems offers an appropriate conceptual framework to examine how transformative change (Peek & Stam, 2019) can be brought about in urban area development.

2.3 Expansive learning in urban area development

There has been recent interest in framing urban area development in terms of expansive learning. For example, Larsson and Homberg (2018) reflected on the Challenge Lab at Chalmers University of Technology Goteborg Sweden to evaluate how students in this laboratory created value by facilitating a dialogue that integrated actors from different sectors – some of whom are not familiar with working with one another – to produce innovation solutions. Through specific cases of electromobility, addressing stormwater pollution and flooding, and low-carbon transitions, Larsson and Homberg's account of the Challenge Lab showed how contradictions between local needs and global concerns, and between current problems and future visions can be addressed discursively through the process of expansive learning.

Expansive learning is, however, not unproblematic. Galvin and Simmie (2017), for example, examined an urban regeneration partnership in the Republic of Ireland to show how such partnerships are complex sites of discursive struggle. They unpacked several emerging contradictions in the partnership, including tensions between local communities wanting to be kept intact and policy visions of transforming neighbourhoods. While expansive learning to deal with these discursive struggles has led to what Galvin and Simmie termed as 'expansive participation' on the one hand, they also captured how the rhetoric of empowerment in the context of neoliberal democracy is reinforced on the other hand. Their analysis lay open the power asymmetries between the stakeholders involved and show how expansive learning is also an arena for communities – and community-based knowledge – to resist and counteract professional knowledge.

A number of key points can be drawn from studies that mobilise expansive learning in urban area development. First, the transformation of urban areas implies the necessary condition of broadening participation, especially with new actors who are not already involved in and familiar with the urban area development process. Thus, the inclusion of new players invariably raises the potential for tensions and

contradictions, which in turn means that parties must engage in expansive learning to learn from one another. Second, while contradictions have often been regarded as a negative thing to be avoided, expansive learning requires contradictions to be worked through, since these tensions are the basis for propelling novel actions. Third, the transformation of urban areas also means that maintaining the status quo is no longer an option. This means that existing processes and the assumptions that underpin these will need to be reformed. Thus, following current practices and planning prescriptions should give way to radical ways of transforming the activity system. Engeström's Activity Theory and expansive learning provides a useful framework to systematically examine and influence the activity systems of urban area development so that transformative outcomes can form the focal point for addressing transitional challenges and change.

2.4 Expansive learning as a strategy

Conceptualising the urban area development process as a network of interacting activity systems, involving multiple actor groups or communities and numerous professional disciplines all dealing with transitional challenges, means that in order to come to some sort of effective collective action boundaries must be spanned or even crossed. This involves higher levels of learning. What can my professional knowledge or asset bring to someone from another disciplinary field? Why is it that my behaviour is not interpreted as I would have expected by someone from a different community? These are questions that only come to mind in situations involving conflicts, dilemmas, disturbances and local innovations. These are the kind of contradictions, as Engeström calls them, that may become actual driving forces of expansive learning in urban area development. In successful expansive learning, this eventually leads to a qualitative transformation of all components in the activity system (Engeström, 2001).

Traditionally, we expect that learning is manifested as changes in the subject, i.e. in the behaviour and cognition of the learners. In urban area development we must learn new patterns and forms of activity (objects) which are not yet there. They are literally learned when they are created and there is no competent teacher. Standard learning theories have little to offer if one wants to understand these processes: "boundary crossing entails stepping into unfamiliar domains. It is essentially a creative endeavour which requires new conceptual resources. In this sense, boundary crossing involves collective concept formation" (Engeström, 1995, p. 133). In other words, expansive learning is manifested in a trichotomy: 1) expanded patterns and forms of activity, 2) corresponding theoretical concepts, and 3) new types of agencies (Engeström & Sannino, 2010).

Expansive learning leads to the formation of new or expanded patterns and forms of activity oriented to the object. This involves the formation of a new theoretical concept of the new activity, giving rise to those new activities. This formation of complex concepts is not just internalisation of culturally given concepts but above all externalisation or generation of culturally new concepts – which also need to be internalised in use. This requires collective and distributed agency, questioning and breaking away from the constraints of the existing activity and embarking a journey across uncharted terrain (Engeström, 2015). For example, designers may see the resemblances with their work – although here we may rather speak of collective designing – not so much of artefacts but rather of actions or interventions. As such, agency or the participants' ability and will to shape their activity systems is the most important outcome of expansive learning.

2.5 Expansive learning through monitoring and evaluation

In our case, the entire network of activity systems in which learners are engaged – the urban area development process – is subject of expansive learning. What we aim at in the end is to entail cultural and institutional change and new patterns and forms of activity, leading us to novel actions in the network of interacting activity systems and transformative change in urban area development processes. We need to design and develop new tools and situations that may mobilise expansive learning, being aware that this needs to occur in a changing mosaic of interacting activity systems which are energised by their own inner contradictions (Engeström, 2001). Peek and Stam (2019) advocated monitoring and evaluation as a potential tool to foster continuous learning including recurring strategy-checking, although not yet embedded in a conceptual framework of Activity Theory and expansive learning.

Last year, we introduced monitoring and evaluation to the complex network of interacting activity systems in the redevelopment process of Merwe-Vierhavens (shortly M4H), a transforming port-industrial area in

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Rotterdam. Although not initially thought of or designed as a tool to mobilise expansive learning, in this paper we examine its potential as such. In line with the theory of expansive learning, we may question ourselves:

(1) Does the design of the M4H-monitor lead to new patterns of activity?

(2) Does the design of the M4H-monitor involve a new theoretical concept?

(3) Does the design of the M4H-monitor bring about a new type of agency?

Although we can only build on primarily findings, we will use the first lessons learned in the design and execution of the M4H-monitor to further examine the opportunities for expansive learning in urban area development through monitoring and evaluation.

3 MONITORING AND EVALUATION IN URBAN AREA DEVELOPMENT

In section 2 we have described a conceptual framework to systematically examine and influence the activity systems of urban area development processes, which we found in Engeström's Activity Theory and expansive learning. In this section we highlight the professional debate amongst scholars, urban planners, policymakers and data-scientists on the relevance of monitoring and evaluation and the use of data in urban area development processes. Several arguments raised by disciplinary professionals complement our conceptual propositions on the relevance of monitoring and evaluation.

3.1 Increasing complexity of urban area development

The first argument lies in the increasing complexity of urban area development. Today, technology, demography, economy, climate and mobility increasingly determine the physical design of our urban areas. Our current planning instruments seem unable to forecast the appearance of our living and working environments in ten, twenty or thirty years (Verhoeven, 2019). Often, an urban area development process takes decades, making it almost impossible to design blueprint plans that capture the future of our urban areas: there is simply too much uncertainty. However, capturing future designs and linked business cases in blueprint plans is at the heart of the Dutch planning tradition (Peek, 2015). In this classic planning process, the role of monitoring and evaluation is restricted to checking implementations of pre-designed plans (Peek & Stam, 2019).

The increasing complexity of urban area development requires adaptive planning processes, including flexible plans: we can decide on goals and ambitions for an area, not yet on concrete functions and activities that contribute to those goals and ambitions. Monitoring and evaluation – and so data-collection – then provide insight in the effectivity of actions, interventions and strategies, and offer urban planners and policymakers up-to-date information to respond to changing demand (Verhoeven, 2019). In action, this means actors act on the one hand, and on the other monitor and evaluate whether it brings the expected results (Verdaas et al., 2018). Potentially, data help urban planners and policymakers to make better decisions and with monitoring and evaluation we embrace the current uncertainty in urban area development.

3.2 Participation of local actors

Complexity increases even more since urban area development today is largely about transformations of inner-city (port)industrial areas, in which living and working is mixed in high densities. In the Netherlands we are not yet familiar with such a form of urbanity (Alkemade et al., 2019). In transformations, disciplinary professionals must collaborate with current residents, entrepreneurs and other users in an area, who may value their neighbourhood differently and may have their own ideas on future plans. Therefore, disciplinary professionals and local actors must collectively operationalise multiple value creation. With new actors who are not already involved in and familiar with urban area development processes, the potential for tensions and contradictions within and between activity systems invariably raises.

Verdaas et al. (2018) argue, in complex planning processes, it pays off to invest in a shared foundation: joint fact finding. With a decent empirical foundation all stakeholders involved in the planning process may develop a common vision on challenges and urgency. When such a foundation is missing, later on this will result in tensions, process delay and additional costs. Monitoring may provide an empirical foundation and evaluation may facilitate joint fact finding among disciplinary professionals and local actors. Continuous monitoring then provides insight in ongoing trends and may substantiate the need to adjust or design new

actions, interventions and strategies. Monitoring and evaluation provide a foundation for an adaptive and collective development process. The Dutch Council of State (2018) rightfully underlines the importance of traceability and transparency in data-collection and decision-making.

3.3 Introduction of a new Environmental and Planning Act

The arguments as described above – increasing complexity of urban area development and participation of local actors – merge in the new Environmental and Planning Act (Omgevingswet) which is envisioned to simplify regulations on the physical environment in the Netherlands. The Environmental and Planning Act obligates governmental and municipal institutions to adopt adaptive planning processes in urban area development. As we have seen, adaptive planning processes cannot without effective monitoring and evaluation. Moreover, the Environmental and Planning Act advocates a transparent development process in which decisions are made based on information that is available for everyone: open data. With this, the Environmental and Planning Act aims to create a level playing-field for every actor involved in the development process. The forthcoming introduction of the Environmental and Planning Act in 2021 will result in a legal obligation to put monitoring and evaluation at the heart of development processes.

However, despite all opportunities seen by scholars and professionals, data is anything but a foundational principle in urban area development (Janse, 2019). A primarily example of monitoring and evaluation – in relation to the Environmental and Planning Act – is the Haven-Stad project in the Dutch capital city of Amsterdam. Here, the main goals of monitoring and evaluation are to make sure the Environmental Impact Assessment is up-to-date and to make sure the goals and ambitions of the development strategy are realised (Dolman, 2019). By generating data during the development process, urban planners and policymakers always have an up-to-data image of the physical environment. A biennially monitoring report evaluates whether it is necessary to adjust or design new actions, interventions and strategies (Verhoeven, 2019).

3.4 Data-supported or data-driven development processes

We conclude this section with a critical note: data do not tell us everything. Data do not simply generate the perfect answer and might overlook stories that are hard to quantify. Without any knowledge and input from the local activity system, data-driven decisions deliver unfeasible solutions. And, the simple argument ‘the data tells us so’ kills every fruitful discussion. Data are input to the decision-making process and not the decision-making process itself. Therefore, we embrace the point of view that advocates a data-supported development and decision-making process rather than a data-driven process (Van den Berg, 2019; Vermeulen, 2019). In other words, monitoring and evaluation may be useful, it can never be the one and only tool or situation that is used to mobilise expansive learning.

4 LEARNING IN THE ROTTERDAM MAKERS DISTRICT

We illustrate our conceptual framework of urban area development process as an expansive learning process with the development of Rotterdam Makers District, our object of research over the last five years. In 2019 we – the Research Centre for Sustainable Port Cities in close collaboration with City and Port authorities – designed a monitoring and evaluation tool for the development process of Merwe-Vierhavens (in short M4H). M4H is a transforming port-industrial area situated approximately four kilometres from Rotterdam’s city-centre and is part of Rotterdam Makers District. In this section we describe the development process of the Rotterdam Makers District and introduce our prior explorations of learning in the transformation of M4H.

4.1 Developing the Rotterdam Makers District

The city of Rotterdam has a long history is urban waterfront redevelopment projects. In 2004, the City and Port authorities announced the new major Stadshavens (City-Ports) project: 1600 hectares of waterfront development along the Meuse river (see figure 1). However, it soon became clear that this area was too large and too diverse to develop simultaneously (Daamen, 2010), as various port areas in the Stadshavens project still made a significant contribution to the port’s operations. In recent years, the focus of the City and Port authorities has been on the redevelopment of RDM, the 30-hectares former shipyard of the Rotterdam Drydock Company, and M4H, a 120-hectares transforming port-industrial area specialised in storage and trans-shipment of fruit and juices.

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In 2015, RDM and M4H were collectively branded as the Rotterdam Innovation District, and in 2017 rebranded as the Rotterdam Makers District. The Makers District is envisioned as an attractive business location for innovative manufacturing companies and young entrepreneurs, characterised by additive manufacturing, robotisation and material science, simply described as 'makers'. Instead of a 'port out-city in' approach, in RDM and M4H the City and Port authorities apply a joint 'port-city' approach, creating crossover areas where the economies of port and city merge. The redevelopment of RDM is nearly finished, the transformation of M4H has just started. After years of strategy-formation and community-building, the very first projects (e.g. transformation of historical buildings and infrastructural interventions) in the new port-city approach are now underway.

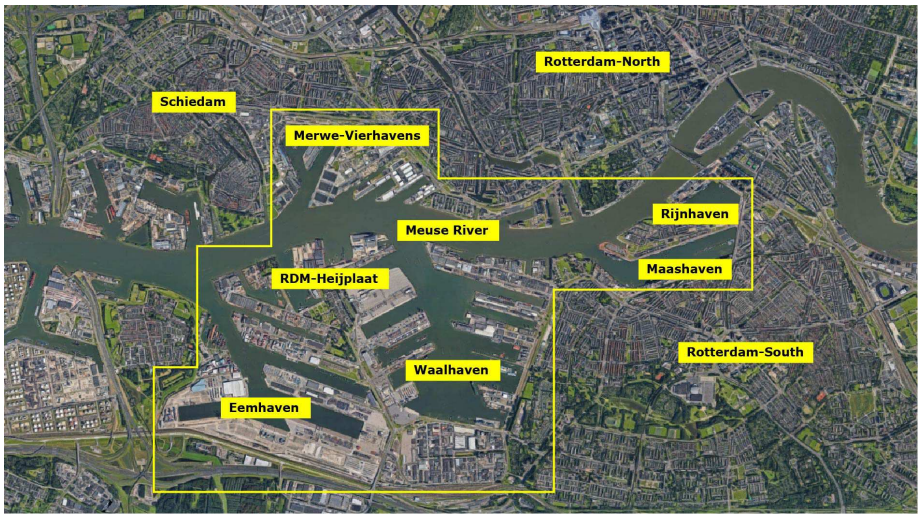

Fig. 1. The Stadshavens project area in Rotterdam. Recent focus has been on the development of RDM and Merwe-Vierhavens, branded as Rotterdam Makers District. Heijplaat refers to the village that was built for the Rotterdam Drydock Company workforce.

4.2 Multiple changing sociotechnical systems

A joint governance process between City and Port authorities in port-city planning as found in Rotterdam is the exception rather than the rule (Daamen & Vries, 2013). The involvement of the Rotterdam Port Authority in urban area development is the result of the transitional context wherein the port operates. A changing energy system and growing societal pressure are leading the port of Rotterdam into transition to low-carbon activities (Bosman et al., 2018). The Rotterdam Port Authority increasingly focuses on economic development and renewal through innovation and entrepreneurship and hence developed special interest in crossover areas in the realm of city and port. In this new port governance, RDM was developed to accommodate large companies, young entrepreneurs, students and researchers who collaborate on innovations that contribute to smart and low-carbon port operations.

With the branding of Rotterdam Innovation District in 2015, the innovation-oriented strategy skipped over to M4H on the north bank of the Meuse river. From the onset of the Stadshavens project, major urban waterfront redevelopment was planned for M4H. However, as a result of the financial crisis of 2008 those ambitions came to a halt. In 2015, the City and Port authorities presented a new development strategy that was not so much a plan with a linked business case, but rather an open invitation to local actors to participate in the development process (Peek, 2015). This organic and bottom-up approach of urban area development resulted in an emerging living lab environment, not just for innovative companies and entrepreneurs but for disciplinary professionals and policymakers also. Over the years, an active and committed M4H-community developed, including disciplinary professionals and policymakers, local architects, designers and craftsmen, innovative start-ups and local research institutions.

We take M4H as a single case-study because it provides a unique and timely example of simultaneously changing sociotechnical systems like port-city planning, housing, economic development, energy transition and urban mobility including numerous professional disciplines. Those simultaneously changing sociotechnical systems are in M4H married with an organic and bottom-up approach of urban area development (see table 1). In M4H, the City and Port authorities experiment with new roles, new coalitions and new business models (Peek, 2015). We observe elements that may foster learning in the complex

network of activity systems in the development process of M4H, potentially leading us to transformative changes in urban area development (Peek & Stam, 2019).

Variable	RDM	M4H
Location	South bank	North bank
Land area	30 hectares	120 hectares
Properties	Industrial heritage	All sorts
Ownership	Port Authority	City and Port authorities
Strategy	Integrated	Organic
Approach	Top-down	Bottom-up
Management	Project	Process
Innovation	Triple-Helix	Quadruple-Helix
Result	Campus	Living lab

Table 1: Different approaches to urban area development in RDM and M4H

4.3 Single and double loop learning

In our prior explorations of learning in M4H (see Peek & Meijer, 2016 and Peek & Stam, 2019) we drew on the theory of 'single and double loop learning' as initiated by Chris Argyris (1977). In those explorations we view innovation in RDM and M4H as a first loop of learning. In RDM, innovation is based on the Triple-Helix of university-industry-government relations as initiated by Etzkowitz and Leydesdorff (1996). In M4H, local actors are involved in innovation. Here, we observe elements of the Quadruple-Helix as initiated by Carayannis and Campbell (2009). The pre-planned and top-down redevelopment of RDM did not bring major additional opportunities for learning. In the organic and bottom-up transformation of M4H this is different. The development process is open for local actors to step in and actively participate in this process. Here, the first learning-loop of innovation blends with the learning-loop that co-exists with an organic and bottom-up approach to urban area development: a second loop of learning. It is about the 'makers in the district' as well as about 'making the district'. The transformation of M4H is part of the innovation process itself.

The theory of single and double loop learning allowed us to describe the distinctly different approaches to urban area development of City and Port authorities, and to explain the different opportunities for learning and innovation in RDM and M4H. Peek and Meijer (2016) argued it is the challenge of Rotterdam Makers District to further explore the potential of double loop learning in M4H. In addition, Peek and Stam (2019) focused on several conditions that may foster learning in the development process. In this paper, we view the development process of M4H as a network of interacting activity systems – including multiple actor-groups and numerous professional disciplines– and examine whether Engeström's (1987) Activity Theory and 'expansive learning' may be more useful in order to introduce learning theory to the field of urban area development.

5 DESIGNING A MONITORING AND EVALUATION TOOL FOR M4H

In 2019 we designed and executed a monitoring and evaluation tool for the organic development process of M4H. Initially, this tool was meant to strengthen the 'story of M4H' with recent facts and figures and to provide insight in the development process to politicians, administrative clients and other stakeholders. Although not initially thought of or designed as a tool to mobilise expansive learning, we were aware of its transitional potential (Peek & Stam, 2019) but did not see it in the perspective of expansive learning as we do now. In this section we elaborate on the design and first execution of the M4H-monitor.

5.1 Ambitions, subjects and Key Performance Indicators

As we explained in section 4, the City and Port authorities apply an organic and bottom-up approach to urban area development of M4H, meaning there is no blueprint future plan for the area. Instead, the ambitions as captured in the Vision and Strategy for Rotterdam Makers District in 2017 are the starting point of the development process. This envisioning document proposes five overarching ambitions for RDM and M4H:

(1) Rotterdam Makers District attracts and facilitates innovative companies and entrepreneurs with an accent on companies and entrepreneurs characterised by additive manufacturing, robotisation and material science.

(2) Rotterdam Makers District creates jobs for the breadth of the population of Rotterdam, not just for higher-educated but for lower-educated and vulnerable citizens with less or no education also.

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(3) Rotterdam Makers District is an open innovation environment in which companies and entrepreneurs intensively collaborate with each other as well as with students and local knowledge institutions.

(4) Rotterdam Makers District contributes to the housing programme of the Rotterdam region and so develops an urban living and working environment which must be realised in M4H.

(5) Rotterdam Makers District develops as a living lab and showcase for the circular future of city and port in which innovations are invented, designed, tested and applied.

For monitoring, these ambitions must be translated into measurable Key Performance Indicators (KPIs). However, the ambitions are rather envisioning and therewith relatively abstract. To overcome the gap between ambitions on the one hand and KPIs on the other, we first translated the ambitions into so-called subjects in the development process of M4H. For example, below the ambition of developing an urban living and working environment are subjects like housing, amenities and public space. For every subject we proposed several KPIs. The KPIs are constructed upon measurement data. For example, to construct the KPI average company size we had to know the total number of companies and the total number of jobs in M4H, whereby the latter are measurement data.

The KPIs then provide insight in the development of every subject and allow disciplinary professionals and policymakers – and the authors as embedded researchers – to evaluate how subjects develop in relation to overarching ambitions. It is crucial not to just evaluate whether we are underway, but also whether it is still the best and desirable way: recurring strategy-checking (Peek & Stam, 2019). Herein lies the potential of monitoring and evaluation as a tool to mobilise expansive learning. Yet, the entire M4H-monitor covers almost twenty subjects in the development process of M4H. To prevent an enormous workload, we chose to organically develop the M4H-monitor, and construct KPIs per subject step-by-step. In 2019 we explicated economic activities in M4H and further examined the subjects companies and jobs.

5.2 Limitations to monitoring and evaluation

In designing a monitoring and evaluation tool for M4H, we were confronted by several limitations. First, to start monitoring one of the first steps is to define a reference point, in which it may be tempting to look back in time as far as possible. However, in our case we were limited by an administrative boundary correction of the project area, and as a result, measurement data of before 2014 were not comparable with measurement data of after 2014. This forced us to choose 2014 as the reference point of monitoring, which is, in the end, a natural reference point since the focus of City and Port authorities has been on the transformation of M4H from 2014-2015 onwards.

Second, we discovered that several subjects we defined based on ambitions, are not easily traceable using KPIs. For example, subjects like companies and jobs are perfectly measurable in KPIs, which is very different from measuring subjects like inclusivity or collaboration. These latter subjects are hard to quantify, making it difficult to capture them in KPIs. Further and in-depth research – both quantitative and qualitative – is needed to construct appropriate KPIs for those subjects. Moreover, since M4H is still largely a port-industrial area, many data that is available for the city's living neighbourhoods is not yet available for a working-area like M4H.

For the construction of KPIs we largely built upon measurement data from external resources. Then a third limitation is that we are depending on time-paths of those external resources. Therefore, the measurement data of several KPIs in the M4H-monitor are not as recent as intended. For example, economic data of 2018 were only available in the last months of 2019. After analysing and evaluating the data, we were able to present outcomes of the 2019-execution of the M4H-monitor no sooner than February 2020, while the facts and figures in the publication are of 2018. Hence, recent projects and developments are not reflected in the 2019-execution of the M4H-monitor. We tackled this issue by including a qualitative overview of projects and developments that took place in 2019 and noted that these projects and developments will be reflected in future executions of the M4H-monitor.

Fourth and finally, we must discuss accuracy and reliability of available data. Many data, and particularly economic data, are appropriate for macro-level analyses (e.g. on the level of cities or regions) but contain inaccuracies at the micro-level, the level we are looking at in urban area development. Only a small amount of inaccuracies may have large impact on the data and so on conclusions drawn from evaluation. In the case of M4H, we manually corrected prominent inaccuracies in the data. Our experiences underline the

importance of sufficient contextual knowledge to turn raw data into useful information (Van den Berg, 2019) and effectively execute monitoring and evaluation in urban area development processes.

5.3 Outcomes of the M4H-monitor

The contentive outcomes of the M4H-monitor are, off course, particularly relevant for actors involved in the development process of M4H. In this paper, we are particularly interested in the opportunities for expansive learning in the development process through monitoring and evaluation, which we will further discuss in section 6. The design and execution of the M4H-monitor has resulted in an extensive database including approximately fifty KPIs organised into subjects. A corresponding monitoring and evaluation plan captured the construction of every KPI so that the database can be updated annually with recent measurement data. In the first execution of the M4H-monitor we further examined the subjects companies and jobs (see figure 2). These additional research efforts significantly increased the accuracy and reliability of KPIs under these subjects. In the coming years, we aim to further design the M4H-monitor and conduct additional research efforts on different subjects. To share outcomes with politicians, administrative clients and the whole M4H-community, we designed a printed flyer that summarises both the design and the outcomes of the first execution of the M4H-monitor.

Fig. 2. An example of an infographic as presented in the printed flyer. The infographic is created by creative agency Friends For Brands and shows the number of jobs per economic industry, from left to right: 1) innovative manufacturing industries, 2) traditional port operations, and 3) other industries. The rather simple conclusion based on this infographic may be that M4H indeed creates jobs in innovative manufacturing industries – as envisioned in the ambitions – without reducing the number of jobs in traditional industries.

6 CONCLUSION AND DISCUSSION

In this paper, we frame an urban area development process as a complex network of interacting activity systems and introduce Engeström's (1987) Activity Theory and expansive learning in this process. In doing so, we build upon Peek and Stam (2019) who advocate that continuous learning between all actors involved can make urban area development processes more resilient. We highlight the opportunities of expansive learning through monitoring and evaluation and use Merwe-Vierhavens (shortly M4H), a transforming port-industrial area in Rotterdam, as a single case-study. In this section we reflect on our findings and discuss the potential of expansive learning through monitoring and evaluation.

6.1 Potential of expansive learning in urban area development

Recently, expansive learning has been introduced in the urban context (see e.g. Galvin & Simmie, 2017 and Larsson & Holmberg, 2018). Engeström's elaboration on expansive learning in interacting activity systems offers an appropriate conceptual framework to examine how transformative change (Peek & Stam, 2019) can be brought about in urban area development. Peek and Stam (2019) advocate monitoring and evaluation as tool that potentially may foster continuous learning, although not yet embedded in the conceptual framework of Activity Theory and expansive learning. In 2019 we – the Research Centre for Sustainable Port Cities – designed a monitoring and evaluation tool for the development process of M4H. Although not initially designed as a tool to initiate expansive learning, we were aware of its transitional potential.

When actors in an urban area development process both act and monitor and evaluate what it brings (Verdaas et al., 2018), we may observe a learning-loop. Through monitoring and evaluation, we learn what works (or not) and learn when it is time to design new actions, interventions or strategies. Monitoring and evaluation provide answers, but also raise new questions that will deepen and strengthen the development process. Thus, monitoring and evaluation may foster learning in urban area development, and we may recognise

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learning in urban area development then in actions, interventions and strategies whereof the focus or goals have clearly changed (De Hoog & Daamen, 2013).

With new actors who are not already involved in and familiar with urban area development processes, the potential for tensions and contradictions within and between activity systems invariably raises. And, while contradictions are often regarded as a negative thing to be avoided (Verdaas et al., 2018), expansive learning requires contradictions to be worked through, since contradictions are the source of change and innovation in activity systems (Engeström, 2001). Hence, an active and committed local community is indispensable in a network of interacting activity systems to come to transformative change in urban area development. In the end, resilient cities do not develop by brilliant plans but rather through evolutionary processes of expansive learning with all different actors of what are common challenges and urgencies in urban areas (Bertolini, 2011; Peek & Stam, 2019).

Towards expansive learning through monitoring and evaluation

We may reflect on expansive learning through the M4H-monitor, but these are rather preliminary findings and need to be interpreted carefully. However, we observe elements that potentially mobilise expansive learning in the complex network of interacting activity systems, potentially leading us to transformative change in urban area development. To start with, the design of the M4H-monitor may be thought of as being a new form of activity. Both the City and Port authorities executed monitoring and evaluation before, however not yet in the context of a complex urban area development process as found in a transforming port-industrial area like M4H. Building on prior experiences within both activity systems, the City and Port authorities took the initiative to intensively collaborate with a local research institution to design a M4H-monitor since they recognise the relevance of monitoring and evaluation.

In some sense, the same is done in the Haven-Stad project in Amsterdam. Potentially, the monitoring and evaluation tools designed for M4H and Haven-Stad enable the exchange knowledge in a more coordinated manner instead of the fragmented collaboration today. Here, two very different networks of interacting activity systems may be connected through monitoring and evaluation in order to learn mutually from the two networks of activity systems. What makes the M4H-monitor a potentially valuable tool to mobilise expansive learning is that it covers the full breadth and thus a wide variety of subjects in the development process, including multiple simultaneously changing sociotechnical systems. Hence, through the M4H-monitor we learn when to adjust or design new actions, interventions and strategies. The relatedness between subjects in the development process – which is reflected in the monitor – provides detailed insight in the interdependence of subjects in such a complex urban area development process.

We also found a contradiction that may (potentially) lead to a new theoretical concept. The outcomes of the M4H-monitor increased discussions between City and Port authorities on what kind of companies must be seen as ‘makers’. RDM attracts and facilitates port-related companies while M4H due to the larger land area may accommodate a wide variety of companies. However, the design of the monitor fuelled discussions whether innovative start-ups in, for example, the life sciences and health sector must be seen as makers, since this economic sector is well represented in M4H. In addition, the design of the monitor showed that innovative and fast-growing start-ups are not the ones that make a major contribution to jobs for local and lower-educated citizens. Those findings expose a contradiction between the ambition to attract and facilitate innovative (manufacturing) companies on the one hand and create jobs for the breadth of the population of Rotterdam on the other hand. Potentially, those outcomes of the monitor may lead to a change in acquisition-policy and marketing strategy of theCity and Port authorities, which may be developed into a new theoretical concept.

6.2 Conclusion and future research ambitions

In analysing outcomes and initial impact of the M4H-monitor we found some elements for (potential) expansive learning in the development process of M4H. Engeström’s Activity Theory and expansive learning thus may be a useful conceptual framework to mobilise expansive learning in urban area development processes, although we are aware that these are preliminary findings and therefore rather precarious. Moreover, in the future we may challenge monitoring and evaluation as a lagging performance management practice to one that shows how monitoring and evaluation of outcomes can be more proactive and prospective rather than reactive and retrospective. Here, expansive learning may be particularly applicable. By expanding participation to stakeholders who are not familiar with the urban development

process, this raises the opportunities for expanding on what are valuable outcomes, which in turn creates the impetus for change.

In this paper we introduced a conceptual framework from the learning theory in an urban area development process, which is rarely done before. This paper builds on our earlier explorations of learning in urban area development but may mark a next phase in our work at the same time, since we aim to further explore learning in urban area development in the future in order to reach transformative change. A promising start is made with the approval of a new consortium-based and subsidised project in collaboration with Delft University of Technology and the University of Amsterdam which focuses on accelerating deep transdisciplinary and interprofessional learning for innovative actions, interventions and strategies of deep sustainable transitions in port area development.

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🏆 *reviewed paper*

Urban Governance as a Tool for Enhancing Resilient Urban Form: Case Study Alexandria, Egypt

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1 ABSTRACT

Cities are continually changing in an adaptation process to overcome a diverse range of natural and man-made pressures. Natural disaster, political upheavals or economic crisis are examples of stresses that cities face and try to overcome in different ways by developing mechanisms for handling continues changes. Most of these stresses and pressures are interrelated, complicated and hard to predict in the future time. As a result of the wide range of shocks and stresses, cities may decay or collapse, affecting the lives of millions of people living within the urban areas. Therefore, to a certain extent, urban resilience is considered as one of the most essential topics within the discourses of the sustainable development as it tackles issues as risk reduction and disaster prevention. Accordingly, it was essential to develop and plan cities in ways that allow them to foster resilience to the uncertainty of the environmental, socio-economic and political changes overtime. Subsequently, the theory of resilience gained an attention within the urban field leading to the notion of urban resilience.

In the last decades, Egypt as -a developing country- has witnessed several stresses due to major shifts in its political situation. Started at the 1950s with a shift from a monarchy to a socialist republic, followed by an open market system at the late 1970s, to reach a capitalist system in the early 1980s. All these major political shifts brought a wide range of urban governance forms, which in turn had significant effects on the urban form of the cities' designed and built environment. In this context, urban governance changes in Egypt are frequent and consequent over a short period of time demonstrating the importance of tackling the issue of urban resilience.

Designing and planning cities are profoundly political activities; therefore, politics should be prioritized in managing cities. Broadly, the research aims to explore the interplay between the urban governance and the resilience of the urban form over time. The research focuses on urban resilience in terms of long-term urban governance through studying the effect of the urban legislation of the different consequent systems on the city resilience. Accordingly, the research worked on developing a resilience index to measure the resilience of the urban form of a neighbourhood area in Alexandria through a time line while analysing the urban building laws that shaped this form. The study reaches a conclusion of identifying the legislation that formed the most resilient urban from over time.

Keywords: Case study Alexandria, Urban Legislation, Urban Governance, Resilience Index, Urban Resilience

2 INTRODUCTION

Any city's resilience to external shock relies primarily on effective institutions, governance, urban planning and infrastructure (UN-Habitat, 2016). Resilience can to some extent be defined in terms of urban form, while urban form in a way is shaped by urban governance powers. Thus, the resilience of the urban form is indirectly influenced by the complex interrelations between different aspects of governance. According to Slack and Côté (2014:7), urban governance plays a critical role in shaping the physical and social character of urban regions (Avis, 2016). Accordingly, discussing the urban form conditions separately while ignoring the power dynamics that control and govern their existence, maintenance and quality gives an incomplete view of the situation.

A number of approaches developed to navigate the politicized nature of development may be applicable to urban contexts. Upon reviewing the previous discourses on the governance powers shaping the urban form, several different approaches had been found. A. Sorensen and J. Okata in their book Mega cities studied the urban governance forces that shapes the urban form taking London and Tehran as a case studies. In their study urban governance was approached by analysing the institutional and regularity frame work while studying the planning process separately (A. Sorensen, J. Okata, 2010). In 2013 London School of Economics and Political Science in its publication evolving cities argued that 3 forces of urban governance

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shapes urban form: land ownership, planning and financing (Juliet Davis et al., 2013). On the other hand, Jeroen Van der Heijden in his research Governance for Urban Sustainability and Resilience focused only on the regulations framework as the governance power for tackling the resilience issues (Van der Heijden, 2014). In this research the urban governance is approached through the study of the urban legislation.

In response to the research aims, the study starts by a literature review investigating two main principle lines. First, the research begins by defining urban governance while focusing mainly on studying the urban legislation to explore how urban laws work on shaping the urban form. After that, the research will be introducing the concept of resilience, and discussing it more deeply in terms of urban studies for a better understating of the concept of urban resilience. Through the exploring of the theoretical discourses and previous literature on urban resilience, the research worked on identifying the dimension and sub-dimensions that could contribute to the resilience of the urban form. Following that, a drafted index with indicators is created for the evaluation of the resilience of the urban form of the selected area for study.

Following, an area was selected upon set criteria –discussed in case study section- and data was collected accordingly. Due to the lack of data, some modifications were made to the drafted index to be more localized and matching the needs and availability of the data for the selected case study. The constructed modified index was used for the assessment of the case study at three time intervals representing the major shifts in the urban governance forms in Egypt. Following that, the results drawn from the index were analysed and evaluated in terms of the urban legislation shaping the urban form at these time intervals. Finally, a conclusion of the outcomes and findings will be showing the effect of the different types of urban governance on the resilience of the urban form.

3 URBAN GOVERNANCE

Urban governance is defined as the different ways in which several stakeholders of the public sector, private sector and civil society with their conflict and diverse interests manage the city affairs (UN-Habitat, 2000). In 2015, the UN-Habitat III in its issue papers re-defined urban governance as the software that enables the urban hardware to function (UN-HABITAT, 2015). M. Raco. elaborates that Urban governance is concerned with the processes through which government is organized and delivered in urban areas and the relationships between state agencies and civil society (Raco, 2009). Moreover, according to Avis in 2016, Urban governance is the process by which governments (local, regional and national) and stakeholders collectively decide how to plan, finance and manage urban areas through a continuous process of negotiation and contestation over the allocation of social and material resources and political power (Avis, 2016).

There is no single, universally applicable model of good urban governance. Different people, organizations, governments and city authorities will define “good governance” according to their own experience and interest. The Governance and Social Development Resource Centre states that effective urban governance involves the city-national interface, municipal capacity, the role of the private sector, and political systems and institutions (Avis, 2016). On the other hand, the UN-Habitat endorsed the “enabling approach” as an approach to good urban governance. Enabling approach is characterized by several strategies as decentralization, participation, partnerships, building capacity and networking (UN-Habitat, 2000). The enabling environment requires the adequate legal frameworks, efficient political, managerial and administrative processes, as well as strong and capable local institutions able to respond to the citizens’ needs (UN-HABITAT, 2015).

Summing up the pervious definitions, good governance could be described as the hierarchal processes of policymaking and implementation. National governments establish the parameters and empower local authorities as primary agents of implementation while establishing enabling frameworks for partnerships and civil society engagement through appropriate legislation and various support measures such as capacity building and training. Thus, the government is responsible of establishing legislative, institutional and financial frameworks that will enable the private sector, nongovernmental organizations and community groups to be fully engaged in decision making and implementation process.

3.1 Urban Law

Urban laws are essential as they work on defining the urban governance framework from laying out rules for planning and decision-making, setting to the conditions for formal/informal access to land infrastructure, housing, and basic services … etc. Good quality urban law provides balance and stability within urban

development in the different aspects of spatial, societal, economic and environmental fields (UN-HABITAT, 2015). Subsequently, analysing the urban laws is essential as it works on shaping the urban environment which in turns is reflected on the resilience of the urban form.

In the consensus that the government is seen as an enabler and not a provider, the government is responsible for setting the institutional and legal enabling frameworks with well adopted urban laws that can respond to the continues process of urbanization and its challenges for sustainable development. Those urban laws should work on enabling the participation of the different stakeholders of the private sector, public sector and civil society. Legal reforms must be based on the notion of human rights and developed by engaging the civil society and consolidating the public interest. An essential norm for successful legal reform is credibility which is enhanced when laws are culturally resonant and enforceable while the population has a higher sense of ownership. On the contrary, where legal provisions hold no sway, and government cannot enforce compliance, enacting such laws can only be counterproductive (UN-Habitat, 2016).

Also, urban laws should work on defining mechanisms for implementing decentralization while empowering local governments and building capacities. Effective urban legislation should take into consideration a holistic view of the institutional, financial and social factors in addition to the different technical objectives that should not be viewed in isolation. This requires creative locally relevant urban law frameworks that are able to overcome the scare within the institutional and financial resources (UN-Habitat, 2016).

In brief, the urban laws that reflect good urban governance should first work on providing an institutional framework allowing decentralization and support to local governments while also allowing the participation of the different stakeholders in decision making and implementation process. Secondly, urban laws guarantee transparency and accountability through monitoring and evaluation to ensure the enforcement of law and its efficiency. The below diagram illustrates the framework of the different aspects and how they integrate together as concluded from the literature review.

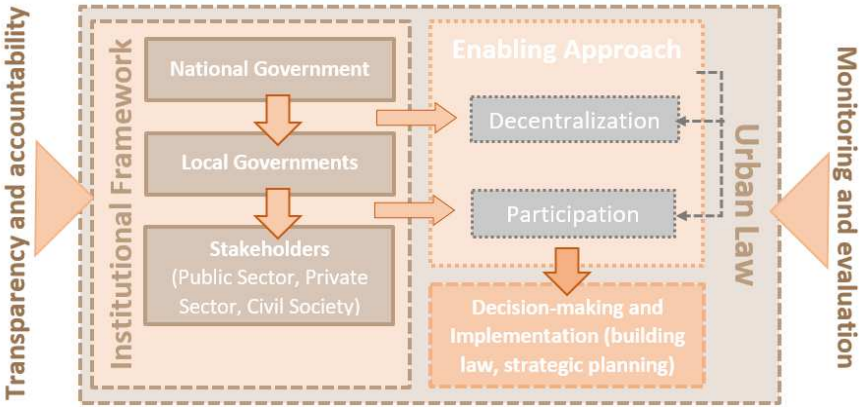

Fig. 1: Good urban Governance Diagram. Source: Author

In 2015, The UN-Habitat in its report on urban legislative for city planning and extension in Egypt analysed the urban law through investigating 6 pillars which are (urban planning framework, Land Acquisition, Public spaces, Plotting Regulation, development of rights and building Law). This research is focusing mainly on the building Laws and not other pillars as we are concerned by studying an already developed neighbourhood where many existing buildings are demolished and rebuilt. The research will be investigating the aspects of the urban governance of decentralization, participation and effectiveness reflected in the building laws.

4 RESILIENT URBAN FORM

Over the last decade, the notion of resilience has been evolving with a debate on the subject and the way it should be embedded within the urban sphere. Since its origin, the concept of resilience within the urban environment has undergone various changes as the disturbance that cities face manifest in different ways, in addition to shifts in the notions of the urban environment itself (Helene Fourniere et al., 2017). In 2014, ARUP international development defined urban resilience as “the ability of a community, business or city, for example, to continue to function and achieve its purpose, to the fullest possible extent in the face of stress” (Jo da Silva et al., 2014). In 2018, the UN-Habitat defined the urban resilience as “the measurable

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ability of any urban system, with its inhabitants, to maintain continuity through all shocks and stresses, while positively adapting and transforming toward sustainability" (City resilience profiling tool, 2018).

Accordingly, for developing a conceptual framework assessing the resilience of the urban form, it was essential to respond to three main aspects. First, is the different ways the previous literature had approached the concept of resilience within the urban form. Secondly, is identifying the elements of the urban from; and finally, is studying the different types of hazards that would threaten the resilience of the urban form.

4.1 Approaches of resilient urban form

In 2013, London School of Economics and Political Science listed four key 'measures' for assessing the urban resilience which are physical, environmental, social and economic (Juliet Davis et al., 2013). On the other hand the UN-Habitat presented a framework for studying the resilience concept in the urban system through five critical and interdependent dimensions; Spatial, Organizational, Physical, Functional attributes and time (UN-Habitat, 2015).

Various works on resilience in relation to livelihoods have identified a range of different asset types both physical or intangible. The intangible assests like (social, human, political and economic); while the physical assests can be divided into man-made like (infrastructure, buildings.. etc) and natural like (reivers, gardens .. etc) (Jo da Silva et al., 2014). Previous discourses usually discussed the presence of the resilience in the urban environment through the assessment of the urban assets or the urban systems. Both assets and systems contribute with each other for their existence, therefore studying only one of them individually will not be reflecting a holistic image of the real situation. Accordingly the research is concerned with studying in parallel the urban system reflected in the urban governance and the urban physical assests reflected in the urban form.

4.2 Elements of the Urban form

Broadly, the urban environment is defined by the UN-Habitat in its publication CRPT as "an integrated and complex system of systems, comprised of sectors, people and hazards, and managed through effective governance mechanisms". With a more focus in the same report, the urban form is considered as one of four layers of the city built environment where the three others are the land tenure, the housing and the built assets (City resilience profiling tool, 2018). The urban form as a part of the urban environment is usually defined in terms of scale and hierarchy of levels as a part of a whole. Those levels of the urban form begin from the city level down to community/neighborhood, household and individual levels (Jo da Silva et al., 2014). This hierarchic system and helps gain a better understanding of the spatial distribution of elements, their location related to each other, and how they influence one another (Sharifi, 2018). Characteristics therefore range from, at a much-localized scale, features such as building materials, façades and fenestration, to a broader scale, residential type, streets design and their spatial arrangement and layout (Sharifi, 2018).

Issues critical to resilient urban form is too difficult to be addressed at the broad city or regional scale, which will be covering almost all of the urban elements - physical and non- physical. This is due to the huge number of small details and wide range of data that will be needed to tackle the issue of resilience on urban form on a large scale of a city. Accordingly, this research is concerned with the study of the urban form on the scale of a neighborhood area to be able to addressee the elements of the urban form.

In the context of neighborhood scale, Sharifi in his paper divided the urban form elements into three major scale-based categories, namely macro-, meso-, and micro-scales. The meso scale which is the concern of the study, includes (Structure and shape of neighborhoods/districts, Diversity/Heterogeneity, Typology of transportation network and Open and green space) (Sharifi, 2018). Nicole Dempsey et al. relate elements of urban form to some major features that can be categorized into five broad groups namely, density, housing/building type, transport infrastructure, layout, and land use as shown in the below figure (Nicola Dempsey, 2009). On the other hand, in 2013, London School of Economics and Political Science in its report on resilience, defined the physical measure of the urban form in terms of the density of population, the density of the built-up area and the adaptabilities of street layouts and built assets. In 2016, the UN-Habitat in its report "MEASUREMENT OF CITY PROSPERITY: Methodology and Metadata" classified the physical urban form index into Street Intersection Density, Street Density and Land Allocated to Streets Streets (UN-HABITAT, 2016). Later, the UN-Habitat, 2018, in its report CRPT The layer of the urban form

of the built environment was translated into several dimensions of land consumption and expansion, open areas, public open space and street layout (City resilience profiling tool, 2018).

In an effort to introduce a more comprehensive categorization of urban form in the context of resilience that takes cross-scale dynamics into account, the urban form was divided into the following dimensions and sub-dimensions shown in the below diagram.

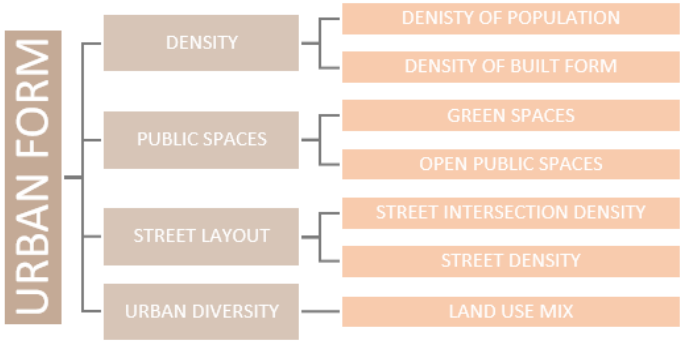

Fig. 2: Elements of the urban form. Source: Author

4.3 Hazards to urban resilience

Studies on urban resilience tend to be divided between two major concepts. The first focus on drastic change in the form of sudden shocks such as earthquakes, hurricanes, or terrorist attacks. While the second focuses on those which explore slower processes of transformation in economic, social, and environmental fields. Researches focusing on traumatic events aim to learn the way cities can survive future shocks, while those focusing on gradual transformation concentrate on the aspects that enable cities to maintain stability over long term (Juliet Davis et al., 2013). Responding to the research aim, the paper try to identify how the elements of the urban form manage the relation between change and stability as a dynamic process.

The UN-Habitat in its publication CRPT described that hazards to resilience can be sudden and slow burning, natural or human-made, rare or regular, foreseen or not; and divided them into three categories as follows:

- Shocks are defined as potential uncertain abrupt or long-onset events, whose main consequence is shifting the city from its current state to a disturbed one.
- Stresses, on the other hand, are defined as chronic and ongoing dynamic pressures originated within the urban system, whose cumulative impacts undermines city's capacity for sustainability and resilience and renders it fragile and vulnerable.
- Challenges, such as long-term contextual changes, pressures originated outside of the urban system or climate change impacts, also undermine the city's capacity for sustainability and resilience (City resilience profiling tool, 2018).

5 RESILIENCE INDEX

Since cities are considered as complex, dynamic environment made multiple inter-related systems, measurement is essential to monitor, benchmark, and manage performance within these systems. Based on the principle that you cannot manage what you do not measure, assessing urban resilience was critical for the adaptation of the cities for the future stresses and shocks. Resilience within the urban form is considered challenging and is not visible by itself as it is the system response to future events. Subsequently, resilience in order to be assessed, it must be related to other properties that can be realized through observation. Upon previous literature, urban resilience cannot be readily measured, therefore -to be better understood- a framework that can organize data to create concise views and interrelationships is needed. (Jo da Silva et al., 2014). Therefore, proxy indicators were used in this research for assessing the resilience of the urban form.

Understanding the purpose of the research is essential to defining an appropriate framework and indicators to assess the resilience within the urban form. This research motive is to understand deeply and diagnose the performance of a selected urban area over time rather than ranking. Accordingly, this implies variables can incorporate different aspects, but need to be in standardized figure.

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5.1 Compution

The resilience index of the urban form is constituted of four dimensions. Each dimension is integrated by a series of indicators that allow for the calculation of the specific index. In this sense, the index produces four sub-indices related to the four dimensions of the urban form: Density, Open Spaces, Street layout and urban diversity. The aggregation of these four sub-indices generates a consolidated value that represents the urban form resilience index. The computation of the index is done through the following tasks:

- Variable standardization

Variable standardization is needed as the urban form resilience index is constructed of a broad and varied range of variables with proxy indicators that are different in units and scales. This step transfers a variable from its original measurement unit into a dimensionless measure that ranges between 0 and 100 where the higher value of the variable indicates a better performance. The table below includes standardization equations for each indicator.

- The construction of a weighting scheme

This research follows the assumption of the City Prosperity Index made by the UN-Habitat that all dimensions have an equal effect in determining the urban form resilience index, while also this applies to sub-dimensions within each dimension. This assumption of equal weighting scheme relies on the following:

(1) The resilience of the urban form depends on the equilibrium between its elements, which form the dimensions and sub dimensions of the index.

(2) Equal weighting scheme is a common practice for indices with multiple dimensions and indicators.

(3) The elements of the urban form, which construct the dimensions of the index integrate and connect together in a way that they effect each other directly or indirectly (UN-HABITAT, 2016).

- Aggregation of the composite index

5.2 Dimensions, sub-dimensions and indicators

Dimension	Indicator	Methodology	Benchmark	Weight
Density	Density of Population	Population/Urban area= People/ km2 Standardisation= $100\left(1-\left\lvert\frac{Population\ Density-15{,}000}{15{,}000}\right\rvert\right)$	15,000 /km2	0.125
	Density of regular Built Form	(Regular Buildings/Total buildings)x100=% Standardisation= Not Required	Min= 0% Max=100%	0.125
Open Spaces	Green area per capita	Total green area/ Population = m2/ inhabitant standardisation= $100\left(1-\left\lvert\frac{Green\ area\ per\ capita-15}{15}\right\rvert\right)$	15 m2/hab	0.125
	Accessibility to open public Spaces	(urban area less than 400 away from open public spaces / Total urban area)x100= % Standardisation: Not Required	Min= 0% Max=100%	0.125
Street Layout	Street Intersection Density	Verify the topology by connecting all segments of the area on a map Collect events from start and ends Exclude points with less than 3 events Count the remaining points and divide by the urban area. = number/ km2 Standardisation= $100\left(1-\left\lvert\frac{Street\ intersection\ density-100}{100}\right\rvert\right)$	100 intersections/km 2	0.0833
	Street Density	Total length of urban streets/ Total urban area= km / km2 Standardisation= $100\left(1-\left\lvert\frac{Street\ density-20}{20}\right\rvert\right)$	20 Km of urban streets per km2	0.0833
	Land Allocated to Streets	(Total surface area of streets /Total urban area) x100 =% Standardisation= $100\left[\frac{Land\ allocated\ to\ streets\ -6}{36-6}\right]$	Min= 6% Max= 36%	0.0833
Urban Diversity	Land Use Mix	Calculate de Shannon-Wienner diversity index for each cell j as follows: $Shannon-Wienner\ \ index=\ -\sum_i P_i * \ln(P_i)$ Land use mix = - [p_house * ln (p_house) + p_work * ln (p_work) +…] = Unitless Standardisation= $100\left[\frac{Land\ use\ mix}{1.61}\right]$	Min = 0 Max = 1.61	0.25

Table 1: Resilient urban form index. Source: Author.

6 CASE STUDY: ALEXANDRIA, EGYPT

For investigating the case study, this section is divided into 2 parts. First is illustrating the building laws that had been shaped by the different urban governance forms while the second will be applying the resilience index and summaries the process, challenges and outcomes of the fieldwork of the selected case study and provides an analysis of key findings.

6.1 Urban governance legislation

Since the Egyptian revolution in 1952, Egypt has witnessed several changes in its building laws as shown in figure 4. This part of the research will be illustrating briefly the urban governance reflected in the building laws of three main periods (the socialist era, the capitalist era and the current era). The first law after 1952 revolution was law (344/1956), at this period the ruling system in Egypt has changed from kingdom to republic under the rule of the president Gamal Abd El Naser with a socialist system. The law (344/1956) was followed by some amendments up till the year 1964. In 1964 under the same socialist ruling system the new building law (6/1964) was published followed by some amendments and a decree by the minister of housing. In 1976, Egypt was shifting to a new era in its governance system under the rule of the Mohamed Anwar El Sadat, where the ruling system shifted from a socialist to a capitalist system. At this time, the new building law (106/1976) was publish followed by some amendments and several decrees till the year 2008. The building law (119/2008) published in 2008 with its amendments in the following years is considered the final building law up till the current moment (Alamiria, 2019).

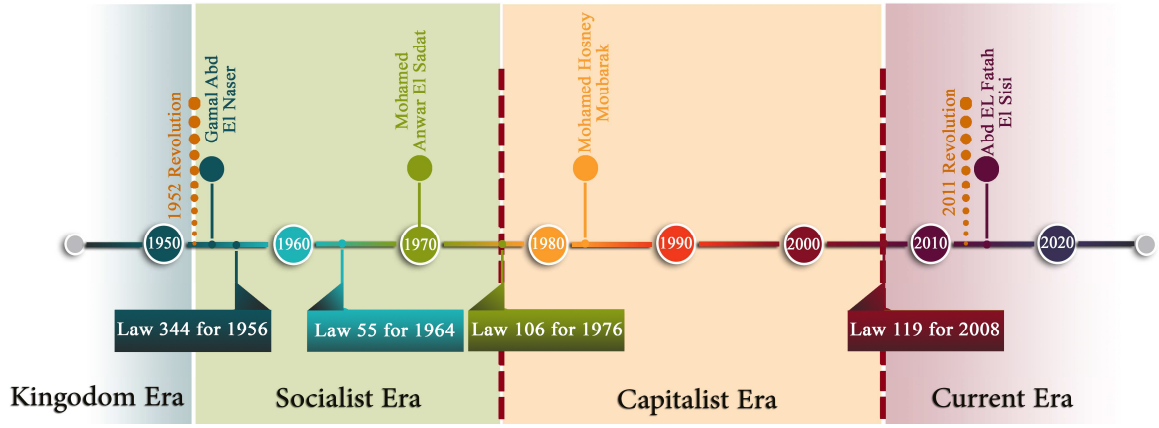

Fig. 3: Egypt ruling systems and Building Laws timeline. Source: Author

6.1.1 Building Law (344/1956)

The law 344/1956 was the first building law promulgated after the 1952 revolution. This law was simple and short formed law which consisted of 12 articles. The first four articles were concerned with the process of approval of construction, modifying or restoring existing buildings. The law states that a committee formed by the Minister of Municipal and Rural Affairs is responsible of the process of approval of the construction, modifying or restoring an existing building that exceed 500 LE after the fulfilment of the required documents. While the authority regulating municipal councils is prohibited from granting licenses for construction, modification or restoration without the committee approval. Article 5 is concerned with the process of approving the demolishing of existing buildings. The demolishing approval required the approval of the committee and the Minister of Municipal and Rural Affairs. The final articles were concerned with the Penalties for whoever violates the previous articles within this law (Alamira, 1956).

6.1.2 Building Law (6/1964)

The building law (6/1964) was the second law after the 1952 revolution while Egypt was still under the socialist rule with the president Gamal Abd El Nasr. This law was simple and short formed consisting of 12 articles as the previous law but it was accompanied with a decree by the Minister of Housing and Utilities for further details. This law didn't abolish the previous law (344/1956) but was for completing the missing needs that wasn't mentioned previously.

Article 2 in this law forms the legal basis for the series of Egyptian codes developed by the Housing and Building National Research Centre (HBRC). While article 4 of this law requires the different institutions

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with their partners to work according to the design and implementation essentials specified in the decisions of the Minister of Housing, Article 5, exempt the to the buildings and structures of the armed forces from working with the requirements of this law (Alamiria, 1964).

6.1.3 Building Law (106/1976)

The law 106/1976 was promulgated at the late 70s with the beginning of the open market system and changing from socialism to capitalism under the rule of president El Sadat. This law abolished the previous law (6/1964) completely as mentioned in its article 35. Although the country was shifting to a new system but still the laws at this time showed centralized decision making process. The first article of this law was similar to that of law (344/1956). It stats that a committee formed by the Minister of Municipal and Rural Affairs is responsible of the process of approval of the construction, modifying or restoring an existing building but not with the cost of 500 LE as previously mention but which cost 5000 LE due to the inflation.

The second part of this law delegated the authority of decision making and all other details regarding construction, modifying or restoring an existing building which is less than 5000 LE to the local governments. The third part of the law is concerned with the penalties for whoever violates the articles within this law. In the final part of this law the local governments were delegated the suggestion of exceptions for certain buildings if it's in the favor of the public while the final aproval is made by the minister of housing after the revision of a selected committee (Alamiria, 1976).

6.1.4 Building Law (119/2008)

The law 119/2008 accompained with its list of excuative regulations was promulgated during the rule of president Mobarak and was still valid after the 2011 revolution till the current moment. This law abolished the previous law (106/1976) completely as mentioned in its third article. The law 119/2008 consists of 4 parts where the third part is concerned about the regulations of the building works. This law moved a little for more decentralization as it delegated the authority of decision making and all other details regarding construction, modifying or restoring an existing building to the local governments.

In addition, the article 44 of this law, the governer of the city is delegated the authority to prohibit the provision of the licences for construction works in the city or any of its parts after the aproval of the local council if that was in the favour of the public. Also the governer of the city is responisble for specifing the fees for the provision any type of licenes (Alamiria, 2008).

6.2 Applying the urban resilience index

The assessment of the case study went through three-stage process summed up below.

6.2.1 Timeline

For applying the urban form resilience index in the aim of comparison between the different building laws produced by the different ruling systems, it was essential to follow up the building laws gradation against the ruling systems which is shown in figure 4. Accordingly, the selected points for assessment starts with the year 1976 when a new building law (106/1976) published overtaking the laws of the previous era. The assessment of this year will reflect the resilience index of the preceding period of the socialist system. The following building law (119/2008) was published in 2008. While the second assessment should have been made for the year 2008 but as the detailed data used for the assessment is produced every 10 years so the year 2006 will be taken instead to reflect the preceding period of the capitalist system. The final year for the assessment is 2017, which reflects the current situation that is shaped after the law (119/2008).

6.2.2 Urban area selection

Alexandria is considered as the second capital of Egypt and is one of its four urban governorates. The city is divided into 17 precincts and those precincts are divided into smaller areas of 137 localities. The area selected for the study was chosen according to two main criteria:

- Spatial scale: the case study is a region in Alexandria city of between 0.5 - 2.5 km² in area. This is both small enough to enable close focus on patterns of use and specificities of urban form, but large enough to denote neighborhoods, small administrative areas and urban landholdings.

- Temporal range: the selected region of the city began to be developed more than hundred years ago and can thus be evaluated in terms of processes of evolution over at least this period.

Accordingly, the locality of Mostafa Kamel and Bolkly was selected which is Located in Sidi Gaber precincts and is about 0.8 km² in area and ages more than 100 years as shown in the below figure.

1976 2006 2017

Fig. 4: selected area for the study. Source: Google earth and Egyptian General Authority of Survey

6.2.3 Assessment

After the selection of the urban area and the years for the assessment, and based on the drafted index, data was collected according through different sources. Due to the lack of data available online site visits were made for different governmental institutes in Alexandria and Cairo mainly which reflects the issues of centralization. One of the limitations was the total absence of data especially for the previous years, which led to modifications to the indicators used in the index. Data collected from maps and the Central Agency for Public Mobilization and Statistics

Indicator	1976	2006	2017
Density of Population	10450/0.8=13062 hab/km2 Standardisation:87 Weight:87x0.125=10.88	15943/0.8=19928 hab/km2 Standardisation:67 Weight:67x0.125=8.38	14481/0.8=18101 hab/km2 Standardisation:80 Weight:80x0.125= 10
Density of Regular Built Form	(515/515)x100=100% Standardisation:100 Weight:100x0.125=12.5	(529/646)x100=82% Standardisation:82 Weight:82x0.125=10.25	(465/599)x100=77% Standardisation:77 Weight:77x0.125= 9.63
Green area per capita	92500/10450=8.85m2/hab Standardisation:59 Weight:59x0.125=7.38	119375/15943= 7.48m2/hab Standardisation:50 Weight:50x0.125=6.25	111250/14481=7.68m2/hab Standardisation:51 Weight:51x0.125=6.38
Accessibility to open public Spaces	(0.429747/0.8)x100=53% Standardisation:53 Weight:53x0.125=6.63	(0.792/0.8)x100=99% Standardisation:99 Weight:99x0.125=12.38	(0.792/0.8)x100=99% Standardisation:99 Weight:99x0.125=12.38
Street Intersection Density	91/0.8= 113.75/ km2 Standardisation:86 Weight:86x0.0833=7.16	124/0.8=155/ km2 Standardisation:45 Weight:45x0.0833=3.75	124/0.8=155/ km2 Standardisation:45 Weight:45x0.0833=3.75
Street Density	13.940/0.8=17.43 km/km2 Standardisation:87 Weight:87x0.0833=7.25	17.485/0.8=21.86 km/km2 Standardisation: 91 Weight:91x0.0833=7.58	17.485/0.8=21.86 km/km2 Standardisation: 91 Weight:91x0.0833=7.58
Land Allocated to Streets	(0.198745/0.8)x100=25% Standardisation: 63 Weight:63x0.0833=5.25	(0.236305/0.8)x100=30% Standardisation:80 Weight:80x0.0833=6.66	(0.236305/0.8)x100=30% Standardisation:80 Weight:80x0.0833=6.66
Land Use Mix	0.56 Standardisation:35 Weight:35x0.25=8.7	1.15 Standardisation:71 Weight:71x0.25=17.75	1.23 Standardisation: 76 Weight:76x0.25=19
Total	65.75	73	75.38

Table 2: Computiton of Resilience index

7 CONCLUSION

Studying the building laws in the context of decentralization, participation and functional effectiveness of law showed different gradation in the three aspects over time. The building laws showed a progress within the decentralization decision making process. While the building law (344/1956) offered a very strong centralized decision-making process as only one committee is in charge for the issuing license for the whole country, the following law (106/1976) delegated the local units a little more authority. The final law (119/2008) offered a wider range of decentralized decision making process as the local units and the governor of the city is delegated the authority of the provision or prohibiting the building license. The law (344/1956) offered no building regulations at the local level while the law (6/1964) and the law (106/1976) offered National building code that establishes rules for the whole country but no local adaptation is possible.

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As for the aspect of participation of the private sector and the civil society in the decision making process, none of the building laws at any time offered provisions for the inclusion of the different stakeholders.

Studying the effects of these consequent building laws on the resilience of the urban form showed changes in the conducted index over time. The final index result shows progress in the resilience of the urban form overtime where the index showed a total result of 65.75 in the year 1976 and increased to 73 in the year 2006 and a final smaller increase till 75.38 in 2017. In the aim of identifying the exact changes leading to the final results, each dimension had to be viewed separately. The density of population showed a better performance in 1976, then a degradation in 2006 with a slight increase again in 2017. The density of the regular built form had the best performance in 1976 with degradation in 2006 and more degradation 2017. While the green area per capita also showed a slight degradation over time the accessibility to open public spaces was made better over time with almost double the result. As for the dimensions of the street layouts the street intersection density had better performance in 1976 with big degradation in 2006 and 2017. The street density shows a steady result over time with no much changes while the land allocated to the streets shows very slight progress in performance. The land use mix indicator for the urban diversity dimension shows a much better performance over time where 2017 has the best index of almost double that of 1976.

Finally, it could be noticed the better performance results made in the year 2017 was mainly depending on the increase in the open public spaces and the increase in the urban diversity, while most of the other indicators showed degradation. One of the indicators that made a decrease in 2017 final index is the density of the regular built form. This indicates that although there had been a little better formulation of the building law regarding decentralization but the percentage of the built buildings in violation of law had increased. This can lead to the conclusion that the missing aspect of the participation of the civil society and private sector in the decision making process decreased the sense of the ownership. While also this increase in the percentage of the built forms in violation of law indicates that legal provisions hold no sway and government cannot enforce compliance leading to decrease in credibility and more violations.

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reviewed paper

Urban Governance Toolbox for a Climate-Friendly Smart City

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1 ABSTRACT

While many European cities have integrated climate protection into plans and processes and are aware of the dramatic effects of the climate change for the urban space, the integration of climate adaptation remains limited. However, even if the defined climate goals are reached, cities will have to adapt their structures and processes to deal with increased risks. That is why climate protection must be supplemented by climate adaptation measures in order to preserve attractive, liveable and safe living space.

The paper builds on activities within the project SMARTilience funded by the federal Ministry of Education and Research. The Institute of Human Factors and Technology Management (IAT) of the University of Stuttgart, the HafenCity University Hamburg, Drees&Sommer, the Malik Management GmbH and the German cities Mannheim and Halle (Saale) are developing an integrated, socio-technical control model, the so-called urban governance toolbox, to support decision-makers and other actors in municipalities to promote effective climate action. This toolbox should include smart tools which helps to increase the resilience of a city and integrates climate change and climate adaptation.

This paper discusses the justification of its development, possible content and the concept behind the urban governance toolbox. Furthermore, the paper will present two concrete use cases (Mannheim and Halle) with their urgent pressure to act on climate adaptation and how those two urban laboratories with real experiments will contribute to the development of the toolbox. Furthermore, the paper explains the peer-to-peer learning which is strongly emphasized in the project as one part of the urban toolbox.

Keywords: resilience, climate adaptation, urban governance, peer-to-peer, real laboratories

2 GENERAL PROBLEMS DUE TO CLIMATE CHANGE

2.1 Effects of the climate changed

Increasing extreme weather events such as heavy precipitation or storms endanger lives and public and private assets with considerable potential costs. The following figure shows the potential impacts of climate change on the German gross domestic product:

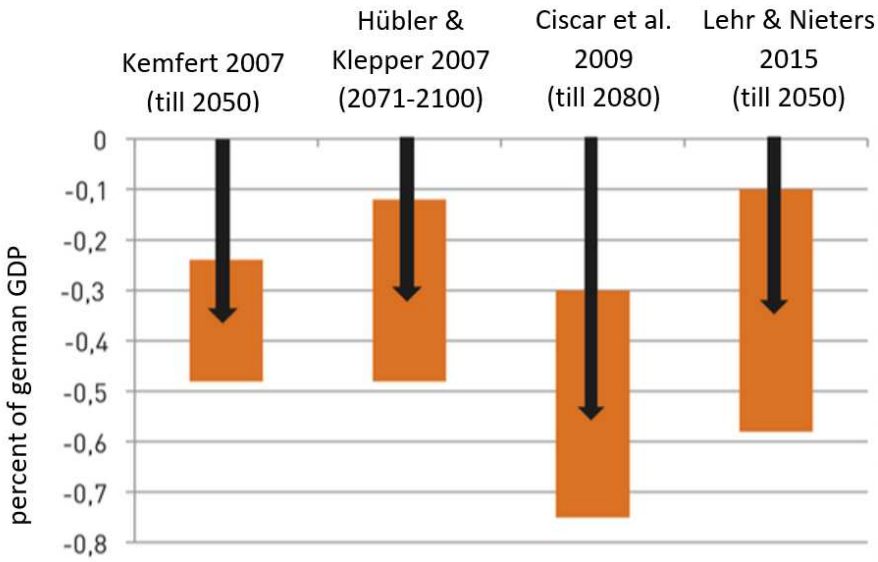

Fig. 1: Overview for estimating the reduction of the German gross domestic product due to the consequences of climate change (source: Hirschfeld/Schulze 2015:8)

Furthermore, heat islands in cities burden the health of their inhabitants and reduce the attractiveness and value of a city. Climate protection and adaptation measures are therefore becoming increasingly important to

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prepare cities for the challenges of tomorrow or today. The measures cover a wide range of topics: from climate-friendly construction and sustainable mobility to urban greening, sustainable agriculture and forestry, nature conservation, biodiversity and renewable energies to health protection, education and public involvement. In order to increase the adaptive capacity of a city and initiate suitable climate protection and adaptation measures, it is necessary to analyse concrete needs and facilitate integrated planning, sustainable financing and adequate implementation at an early stage. However, this poses a significant challenge for many municipalities, due to factors such as the complexity of the political structure of a city (keyword: multilevel governance), the lengthy decision-making and planning processes, the thinking and acting in departmental structures and the problematic financial situation of German municipalities (see Knieling 2016).

2.2 Conditions in cities and urban governance

In recent years, a range of handbooks, guidelines and good practise approaches concerning climate adaptation have emerged, along with increased awareness of the relevance for climate adaptation is seems to be improving in the minds of the civil society, local politicians and local municipalities. In many cases, climate protection monitoring centres have been set up which follow an integrated approach and coordinate and integrate various measures. Two examples are the cities of Mannheim and Halle (Saale). There are numerous synergies between the measures and initiatives of climate protection and climate adaptation such as the use of green infrastructure (keyword: multifunctional green spaces, roof greening). However, the conflicting objectives between climate protection and climate adaptation, which arise, for example, when areas are used for competing measures such as flood protection or the production of renewable energies for electric mobility, have so far received less attention.

Secondly, climate protection and adaptation are subject to a multitude of framework conditions and requirements. In 2013, for example, the European Union adopted the EU Strategy for Adaptation to Climate Change. In addition, national strategies have been developed. For Germany, these included the German Adaptation Strategy to Climate Change of 2008 and the subsequent Action Plan Adaptation of the German Adaptation Strategy to Climate Change of 2011. Furthermore, strategies have been drawn up at state level and local climate protection plans. Consequently, the multitude of recommendations for action and specifications create a complex institutional environment for municipalities to negotiate effective paths toward integrated climate adaptation and protection (vgl. Cormont/Frank 2010: 8ff).

Thirdly, work in municipal administrations is often strongly influenced by thinking in terms of departmental structures (Engels et al 2018: 14 and Schüle 2016: 18). This presents an important barrier for effective integrated planning and implementation of climate protection and adaptation measures. Resilience effects the different departments as city development and urban planning, mobility, green areas, social affairs, disaster management etc and so far there are no established working structures within the administration for such a cross-sectional issue. There is a lack of resources for interdepartmental, project-related cooperation or for established processes within and outside the city administration. Climate change control centres, which have been set up in many places for interdepartmental work on the challenges of climate change, are also reaching their limits and those of the affected departments. The interdepartmental use of collected municipal data is also affected. Particularly in the case of municipal geodata the use for integrated action has significant potential for improvement.

3 URBAN GOVERNANCE TOOLBOX

3.1 Description of the project

The project SMARTilience sets itself the goal of designing a municipal control model for a climate-resilient urban development through an iterative process engaging the two German cities Halle and Mannheim to applicate tools of this model within a living lab. During the definition phase from March 2017 to April 2018, the consortium accomplished important preliminary work and established partnerships between research, industry partners and city partners. This phase also include a review process to identify and analyse existing research results on climate resilience in cities, as well as related management models. Based on the obtained results, we designed the full project, analysing needs, urban challenges and relevant legislation. The research and development phase started in February 2019 and will last until January 2022.

The project is called SMARTilience as smart tools and the resilience of a city are the focuses.

The SMARTilience project aims to design a municipal governance model for climate-resilient urban development and to implement this in the two major German cities of Halle and Mannheim. The governance model should cover all process steps of planning, implementation and evaluation, and support municipal decision-makers and stakeholders in foresighted, efficient climate action. In this process, innovative governance formats for integrated municipal management are to be brought together with concrete fields of action within climate-resilient city (e.g. databased planning procedures, innovative citizen participation formats, investment in ecosystem services and networked technologies, etc.) and tested in the model cities.

We use a “wide” definition of the governance term (see Mayntz 2004; Benz et al 2007 and Zürn 2008) and explain it as Stoy 2015:

"While the concept of control explicitly targets the control actions of political actors, the governance perspective deals with the institutional structure and its effects on the actions of the addresses (Trute et al 2008: 177)" (Stoy 2015: 34).

In addition, political recommendations for action will be developed for the federal government, the states, and the EU with the aim of integrating municipal climate resilience into the existing regulatory framework. In a further step, new financing models are to be identified to ensure adequate participation of the private sector in investments in climate resilience. Therefore there are six work packages shown in the following graph.

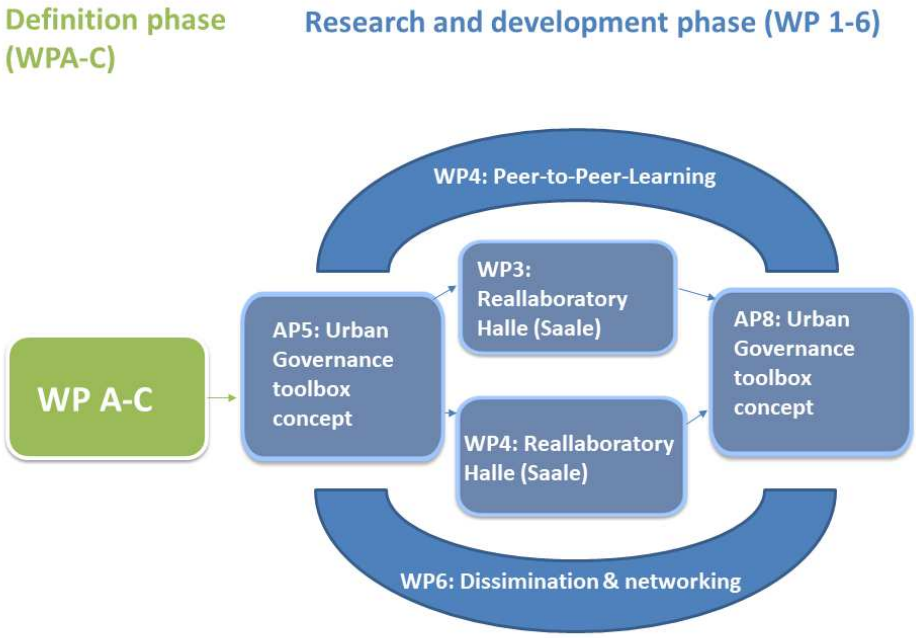

Fig. 2: Work plan for the project SMARTilience

As mentioned, before there are many existing platforms, guidelines and best practises, which should be integrated into our toolbox, as we do not want to reinvent the wheel.

Overall, the project is highly transdisciplinary and application-oriented. Since the systematic exchange of knowledge between the project partners and especially between the real laboratories plays a central role in the project, a separate work package is dedicated to this (Peer-to-Peer-Learning). In this work package the strategy for the integration of the different technical, social and scientific strengths of the partners and their knowledge levels is developed.

3.2 Conception of the toolbox

A first step in the project was the collection and systematisation of the the state of knowledge on management practices and on planning, implementation and assessment instruments for collective climate mitigation and adaptation in cities. Therefore, the IAT and HCU executed a desktop research and several

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surveys. In the research period it became clear that there are already exisiting a lot of toolboxes and guidelines in Germany, but nervertheless there is a lack of an easily operable toolbox for administrative staff members combining the knowledge of climate protection as well as climate adaptation and giving practical insight advices.

The other project partners and external experts also contributed their knowledge to the control model. For example, Drees&Sommer conducted a survey concerning the use of geo data within German cities and introduced different GIS tools in order to visualize the dangers of climate warming.

Another very creative method in order to gain input for the toolbox and as a tool itself was the Syntegration method. From the 16th until 19th of June 2019 over 40 experts from cities, industry and academia met in Mannheim to discuss the opening question: How can we govern integrated climate change mitigation and adaptation in cities?. Supported by the innovative Malik Syntegration® method – a word combination of synergy and integration – integrated actions and policy recommendations have been formulated for 12 central topic areas. The IAT operationalised the Syntegration results and used them as a basis for further research and implementation activities.

Parts of the toolbox will be the method of real laboratory (described in 4.3) and peer-to-peer learning (described in 5). Those two among others will be applied in the model cities of Halle (Saale) and Mannheim, taking into account the specific requirements based on geodata. Based on the resulting practical experience, the governance model will be further developed into a prototype.

4 USE CASES MANNHEIM AND HALLE

In the definition phase the cities Halle (Saale) and Mannheim has been chosen as project partners as they have different climate conditions and political circumstances, but suffer from similar climate effects. Tools of the toolbox should be applicable in different German cities.

4.1 Halle (Saale)

Halle (Saale) is the most populous city in Saxony-Anhalt and is one of the most densely populated areas in Central Germany. Since 2010, Halle has demographically undergone a trend reversal towards a (slightly) growing city. Due to the age structure and the birth rate, however, the positive trend is permanently dependent on a favourable migration balance, while at the same time there is strong competition within the major cities of Central German. The average age of the population is beginning to level off, with the number of younger senior citizens will even decrease, while the sharp increase in the number of the very elderly aged 80 and over represents a major challenge.

In principle, the climate region in which the city of Halle (Saale) is located can adapt to rising air temperatures and a reduction in precipitation frequency, primarily in the summer months. However, since a reduction in precipitation is not expected, an increase in extreme weather events is predicted. The flood event in 2013, among other things, has shown susceptibility or concern. Older thermographic aerial photographs also prove the existence of heat islands in the inner city area.

Since February 2013, the city of Halle (Saale) has had an Integrated Municipal Climate Protection Concept in place and has consistently implemented it in practice. At the same time, the Climate Protection Service Centre was set up as a link and coordinator for this crosscutting municipal task and the Climate Protection Steering Group, which comprises of selected actors from the city administration, was founded (integrating municipal utilities, housing industry, transport companies, real estate, etc.). Since 2014, the German Weather Service has been investigating the urban climate of the Saalestadt in a multi-year measurement programme. In December 2015, the political will was anchored in the energy and climate policy vision of the city of Halle (Saale) by a decision of the city council. The revision of the climate protection concept, which is to be completed in 2018, is currently underway.

The effects of climate change and thus the need for climate adaptation must be prepared and made visible for urban society. From this, in turn, necessary measures must be derived which are incorporated into the integrated concepts (e.g. into the climate protection concept). It is very important to create a link to the existing plans and concepts of the municipality and to harmonise the resulting synergies or conflicts.

4.2 Mannheim

Mannheim is the third largest independent city in the state of Baden-Württemberg. Mannheim has 336,368 inhabitants, 316,265 of whom have their main residence (as at 31.12.2016). The proportion of foreigners in relation to the main residence is approx. 25 %. 43% of the population has a migration background. The population forecast up to 2036 assumes a population increase of 8%.

Mannheim has a very mild climate by Central European standards. When considering areas with a problematic urban climate, the main problem areas of the city of Mannheim are increased temperature, increased air pollutants and a lack of cold air supply. The overheating of inner city areas towards heat islands shows the lack of elementary green spaces. Thermal environmental conditions have deteriorated in recent decades, especially due to increased construction activity. The high traffic intensity within the city is an immense obstacle to a further reduction in CO2 emissions.

In 2009, there was the creation of the climate protection control centre/foundation of the climate protection agency Mannheim. One year later, an urban climate analysis and climate protection concept 2020 was prepared. Furthermore, there is a city communication campaign "MANNHEIM AUF KLIMAKURS" with various preliminary projects (since 2012). Moreover, programmes for energetic renovation of private houses and greening of roofs, facades and unsealing areas are supporting the citizens and there is an evaluation/analysis of 30 properties of the City of Mannheim. Additionally, Mannheim serves as a multiplier in regional, national and international networks.

Climate adaptation measures have so far only been pursued/implemented to a limited extent. Another point is that Mannheim is a growing city and therefore there are strong construction activities. Additionally the integration of various population groups in the creation/implementation of climate protection/adaptation measures (in particular also migrants) is a huge challenge as well as the involvement of young adults, adolescents and children in the creation of concepts/implementation of climate protection and adaptation measures. Thematic focuses in Mannheim, which must be further differentiated within the framework of the real laboratory on the basis of previous work packages of the definition and R&D phases, are: Heat island/heat effect (in particular impact in densely populated inner city districts), heavy rainfall events (e.g. flooding of the sewerage system) and invasive species (fungal attack, impairment of flora/fauna, economic damage due to additional expenditure).

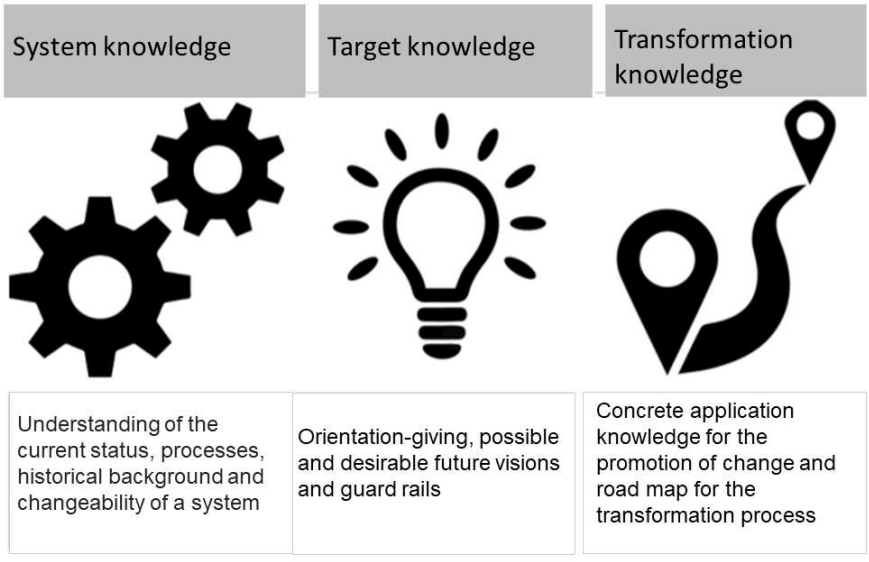

Fig. 3: Different types of knowledge (Source: ProClim 1997) Work plan for the project SMARTilience

4.3 Real laboratories

In order to ensure the practical and application relevance of the integrated control model, it is developed and tested in these real laboratories along the specific needs of two sample municipalities - the real laboratories in Halle (Saale) and Mannheim. The sample municipalities are already introducing ongoing pilot projects in the field of climate-resilient urban and infrastructure development, and supplementing them in control, planning and implementation, as well as evaluation, with innovative measures and practices from the

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building block of the control model in order to measurably contribute to improving the climate resilience of their city. The selection of specific measures and practices takes place according to need and according to the respective level of development of climate resilience on site. Legal framework conditions and regional strategies are taken into account. The laboratories Halle and Mannheim will start in January 2020 and lasts about 18 months.

We follow this definition of a real laboratory:

„A real laboratory is a social context in which researchers carry out interventions in the sense of real experiments‘ in order to learn about social dynamics and processes. The idea of the real laboratory transfers the scientific concept of the laboratory into the analysis of social and political processes. It ties in with the experimental turn in the social and economic sciences. There are close links to concepts of field and action research.“ (Schneidewind 2014)

Therefore, in the two laboratories there are three objectives: a) test of parts of the developed urban governance toolbox, b) development of a laboratory conception with the local administration and civil society and c) concrete measures e.g. geodata strategy development or heat plan.

These ideas are planned for the laboratory in Halle:

- Consolidation and optimization of existing data in the partner consortium and model cities (studies, projects, geodata, ...)
- Update and implementation of the integrated climate protection concept and interlinking with existing plans in the city
- Communicating and addressing the need for adaptation to climate change for urban society
- Testing transferability to other municipalities / learning from each other (peer-to-peer)
- Interdisciplinary exchange and networking activities
- These measures are planned in Mannheim:
- Analysis of the available (geo-) data and development of a strategy for the use of data for climate protection and adaption
- Consideration of climate protection and climate change adaption in current projects of urban development or planning and approval procedures as well as cross departmental work
- Implementation of the “Urban Governance Toolbox” to analyse the concrete need for action and to select suitable planning and implementation measures taking into consideration the specific problem in Mannheim
- Increased communication and citizen participation in climate change mitigation and adaption to show specific needs, identify consternation and profit from available synergies
- Action plan 2030 for climate protection and climate change adaption to support integrated sustainable urban development
- Peer-to-Peer: systematic promotion of exchange and learning between project partners (mentoring, studying, shadowing).

The conception of the transformation arena as well as the concrete agenda (see DeFila et al 2019) shall remain flexible and open for new ideas during the process of the real laboratory. The first ideas consist of one to three real experiments and different participation methods with the civil society. One fix point is that in March 2020 there will be a co-creative workshop in each of the cities where those ideas will be discussed in more detail in order to fix a concrete roadmap for both laboratories. The IAT will evaluate together with the HCU the laboratories parallel.

5 PEER-TO-PEER-LEARNING

In order to systematically promote the exchange of sample municipalities with each other and between the participating science and practice partners, to recognize and analyze common challenges, to identify best practices and working solutions and to learn from each other, SMARTilience follows the approach of peer-to-peer learning. The development status of the respective projects in the real laboratories, challenges and

risks are assessed in three cycles using an adequate survey tool. The status reports form the basis for the targeted exchange and co-creation of solutions in three peer-to-peer workshops. The first peer-to-peer workshop took place in November of 2019. All workshops are directed towards the needs of the urban actors respectively the urban project partners Mannheim and Halle. Through a qualitative query of the requirements, the first contents and the rough conception of the process could be determined. The results showed that cities have different needs in the context of climate protection and climate change adaptation. Among other things, marketing campaigns, technical aspects (for example sensors) and data management were important to the cities. In addition, the aim is to find out how participation is also used internally in public administrations to support rethinking and acceptance in the context of the climate. Only the project consortium took part in the first workshop. Every city has the opportunity to integrate itself into the peer-to-peer process and thus learn more about other topics and cities. As other workshops and conference calls will take place with other cities on additional topics. Furthermore, the process of peer-to-peer learning is presented transparently and can be used by other cities via the toolbox from SMARTilience.

In addition, minor challenges in everyday project work at the real laboratories are discussed in regular learning sessions by telephone with the project partners in order to jointly identify possible solutions. It is envisaged that each project partner will experience the project reality in the real laboratories through participatory observation according to the principle of shadowing

6 CONCLUSION

Since SMARTilience is an ongoing project there will be more results and discussion points which shall be presented at a later point. The real laboratory will be flexibly executed and an adaptation of the planned activities is possible at any time of the 18-month long process within the cities. Therefore, a reflection workshop in December 2020 is planned as each partner should learn and contribute with their own perspective during the real laboratories.

After the laboratories, the collected experiences will enter in the redevelopment of the urban governance toolbox. As an example the tested governance practises, such as the real laboratory approach will be adapted and uploaded in the toolbox. The evaluation of the real laboratories and the learning process will be a great challenge for the consortia. As well as, the dissemination of the results and the toolbox.

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🏆 *reviewed paper*

Urban Regional Social Community Detection Using Location Based Social Network Big Data

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1 ABSTRACT

In this paper, we propose a methodology of applying location based social network (LBSN) Big Data to detect urban regional social communities (URSCs) and analyze their activation levels. For this, we first construct a social spatial network (SSN) based on the LBSN Big Data of a city. Then, by applying a modularity optimization algorithm to the SSN constructed, where modularity is a measure to check the strength of clustered networks, we detect the boundaries of the URSCs. The activation level of each detected URSC is further analyzed based on a diversity index, i.e., Shannon entropy. For experiments, we apply the proposed methodology to the city of Seoul where the LBSN Big Data is collected from Foursquare social networks. Through the experimental results, we observe that the detected URSCs match well with the URSCs known by the Seoul citizen from which we can confirm the effectiveness of our proposed methodology in detecting USRCs and analyzing their activation levels.

Keywords: location based social network big data, modularity analysis, shannon entropy, socio-spatial network, urban regional social community

2 INTRODUCTION

The world's urban population [29] reached 55% in 2017 and this por- tion is expected to reach 68% in 2050 (UN, 2018). As a result of urban- ization, social and environmental problems in cities have attracted great attention [4, 22, 25, 26, 34]. In general, the urban environment is analyzed with three aspects: physical-, social-, and economic- environment [5]. In the research category of socio-economic en- vironment, through quantitatively assessing the activation level of urban areas, it is possible to check the environmental changes timely and establish policies for solving the urban problems such as urban decline. There have been several indexes for assessing the activation level of urban areas such as Indices of Multiple Depriva- tion (IMD) in UK and Socio-Economic Indexes for Area in Australia (SEIFA) in Australia [19].

Over the past few decades, cities have been faced severe social and economic problems, which have induced unbalance in the urban environment. For instance, the most deprived households are concentrated in the worst urban neighbourhoods [24]. The UK Governments have attempted to tackle the physical, social and economic consequences of these problems through a variety of mechanisms and policy initiatives [17]. The primary goal of the above trials is to reclaim the urban regional social communities (URSCs) in urban decline regions [17]. In particular, in order to reactivate the urban decline areas, it is important to identify the unique properties of the URSCs and establish customized policies for urban regeneration. Therefore, an accurate detection of URSCs should be conducted first to ensure the effective of the policies.

In general, URSCs are formed primarily from the interconnec- tions among people. In the past, such people's interconnections were mostly happened within certain physical locations nearby. On the other hand, along with the popularity of Internet and advanced information technologies, the methods that people communicate have been introduced new paradigm. Social networking service (SNS) is a service that maintains the connections among people within a virtual space through Internet even the they are physi- cally separated far away from others. SNS connects people through multiple types of links representing friendship, common interest, knowledge sharing, and so on. In recent years, SNS data has been used as an efficient tool for analyzing urban land use, urban city center [10, 28, 35] and urban floating population [9, 32]. The cor- responding analytical results could further provide references for planning urban land use and determining the commercial facilities.

By incorporating actual location information into SNS, location based social network (LBSN) services not only allow people in the social network share location information itself, but also allow them to share location-tagged media contents such as photo, video and text which may further affect the interdependence of people [20]. In addition to the people-people links as in SNS, LBSN services could further enable people-place and place-place links. In modern society, people share various information such as impressions and evaluations about places they visited through LBSN services, and the shared information is delivered to

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various people connected within LBSN. Based on the shared information, there even exists ap- plications recommending customized places for people which may further change human mobility patterns. Note that those change in human mobility patterns eventually affect the formation of URSCs. LBSN services have also induced a significant change in Internet search results. In these days, we can easily obtain the research results containing the information about the geographical proximity which is provided by the LBSN services [11]. Users of LBSN services can find each other in the physical space and interact with each other according to the relative distance [6]. Through introducing recommendation and estimation systems such as customized places, activities, friends, and routes, LBSN services show direct or indirect effects on human mobility patterns [3, 12, 15, 16, 21, 30, 33, 37–40].

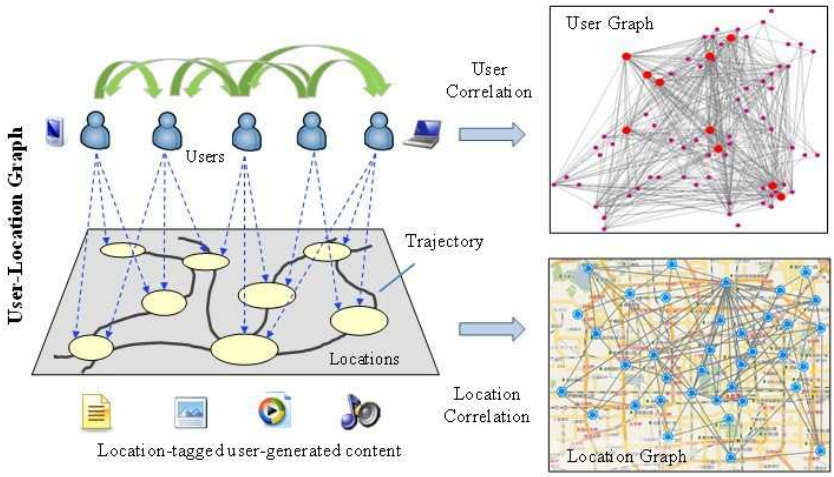

Fig. 1: Three major graphs extracted from LBSN.

In addition, because of the accumulated LBSN big data, which is easily accessible by people through internet, it enables research on social science based on spatial environment [20]. In particular, it is possible to analyze and predict the social ties and analyze the spatio-temporal human behavior. As case study, based on the spatial- temporal data of LBSN services, Cranshaw et al (2012) analyzed the human behavior, social dynamics, perception of urban region, and human mobility patterns.

The purpose of this study is to propose a methodology to detect URSCs using LBSN Big Data and analyze their activation levels. The structure of this paper is as follows. Section 2 introduces back- ground and related work. Section 3 describes the proposed method- ology. Section 4 presents the experiments and discusses the results. Finally, Section 5 summarizes the concluding remarks.

3 BACKGROUND AND RELATED WORK

3.1 Social Spatial Network

Wherever people live, there exists a social space which a place assigned with some value by people [36]. In general, those places defined in cities or architecture have the same context. Modern geography academically defines a physical space as the surface of the earth [8, 23] clarified the close relationship between the physical space and the social space by mentioning that a physical space becomes a social space when the physical space becomes to have cultural or local meanings. In other words, a social space (or place) is formed when socio-cultural meanings are attached to a physical space.

A social space is not an independent closed space and it can be interconnected with other social spaces through the social con- nections embedded in them. Note that those interconnections are possible even the social spaces are separated physically far apart. While the above mentioned long-distance interconnections were not possible in the past, nowadays they can be easily realized in the virtual space like Internet or social networks. Therefore, in addition to the interconnections among the social spaces physically close to each other, the virtual space provides more diverse communicating methods for the social spaces. At first, people share the discourse about some specific social spaces (or places) in a virtual space com- munity group. As the discourse sharing becomes more frequent, people turn out to visit the social spaces (or places) indeed. Through this example, we can observe the human movement between social spaces which can be defined as

a new kind of interconnection. By considering those interconnections representing human movement, we can form a social spatial network (SSN) as will be defined in Section 3.1.

Fig. 2: The SSN constructeud for Seoul.

3.2 Detection of URSCs

In order to detect URSCs, Guo et al (2017) proposed a method of applying a modularity optimization algorithm to the (physical) street network of a city where the street network is analyzed from the topological aspect of urban spatial structures [31]. Hillier and Hanson (1984) suggested the theory of Space Syntax to analyze the topological aspect of urban spatial structures [2]. In general, Space Syntax assumes the interactive relationship between the spatial structure and the social structure. From the success of Space Syntax in the research area of urban spatial analytics, it is confirmed that the regional social properties such as floating population and activation levels can be analyzed from the spatial structure. In this respect, the approach of Guo et al (2017) detecting the URSCs based on the modularity analysis of the urban street network is reasonable[31]. Alternatively, Emanuele et al(2018) also applied the concept of modularity [18] to the street network and detected the regional social community of a country in order to protect disease diffusion, while the street network is analyzed from the geometrical aspect which is an alternation to the topological aspect [27].

This study aims to propose a methodology to detect the URSCs

in a city in terms of the topological aspect of spatial structure. In modern cities, the human movement pattern is not only affected by physical space, but also is influenced by the social media in the virtual space. Now it is very common to search the Internet before setting a specific destination place. When human movement patterns are concentrated at a specific urban area because of its common social properties, this urban area become a URSC.

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A URSC is ultimately formed based on the social interactions among people. Therefore, it is important to find the patterns of human interconnections in urban areas when detecting URSCs. In this context, this paper proposes a methodology of detecting URSCs by considering the human movement as the interconnection patterns. In particular, we detect URSCs from an SSN where social spaces are connected based on the human movement.

3.3 Activation Levels of URSCs

Once a URSC is detected, it is important to check its activation level based on which we can set policies for solving urban prob- lems associated with the URSC such as urban regeneration. There have been several ways to measure the activation level of URSCs. Indices of Multiple Deprivation (IMD) in UK and Socio-Economic Indexes for Area in Australia (SEIFA) were introduced to quantita- tively evaluate the activation levels of URSCs with respective to the physical-, social-, and economic-environment. Through analyzing the diversity of visitors, Desislava et al (2016) confirmed the close relationship between the visitors' diversity and IMD [13].

In this context, we propose to evaluate the activation level of each detected URSC based on the diversity property of the social spaces in each URSC.

4 THE PROPOSED METHODOLOGY

The proposed methodology of detecting URSCs from LBSN Big Data mainly consists of two steps: 1) construction of an SSN from LBSN Big Data of a city; 2) the URSC detection by applying modularity optimization algorithms to the SSN.

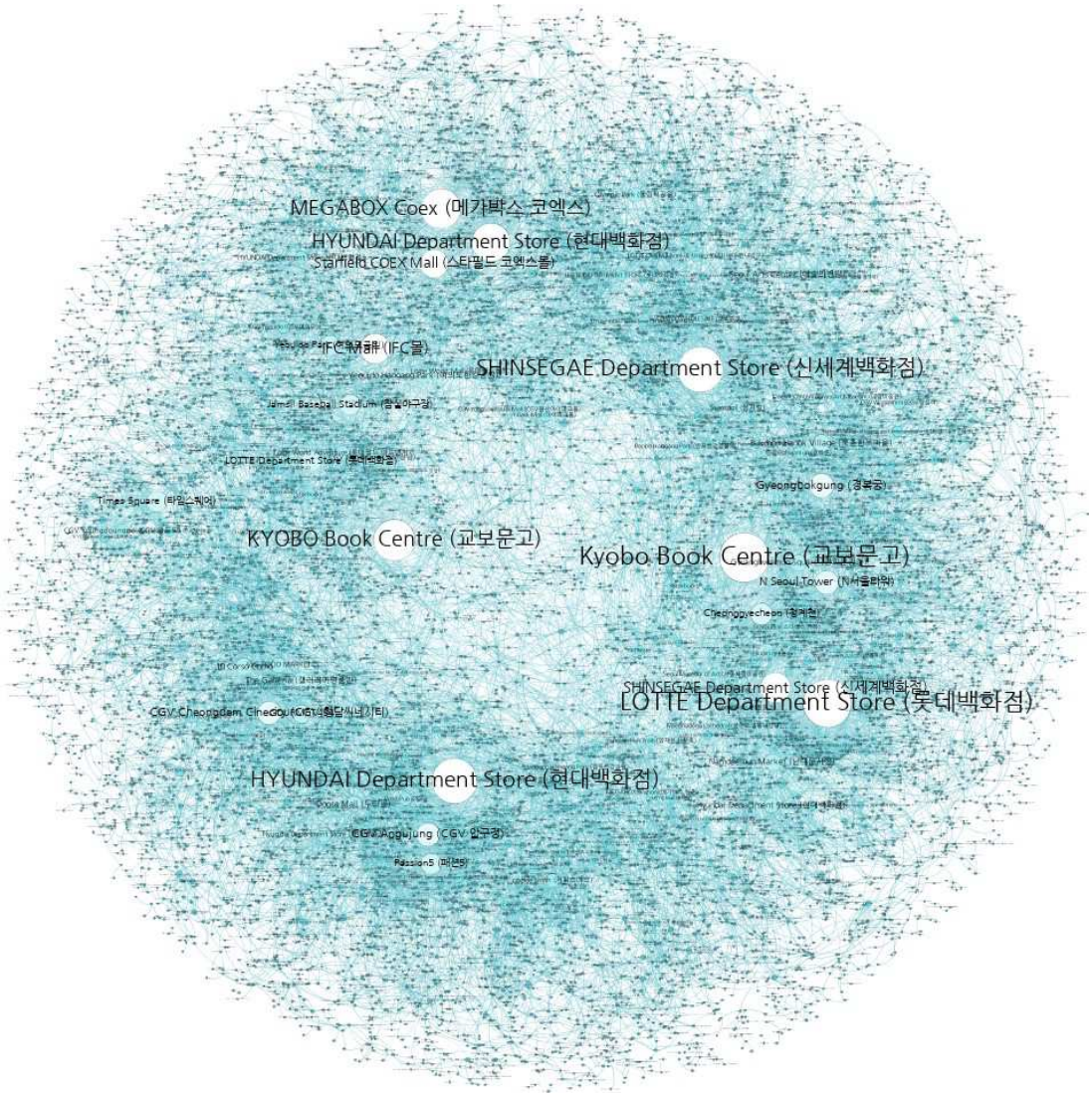

Fig. 3: Hubs in the SSN.

4.1 Construction fo the SSN

We construct an SSN by tracking human movements among the social spaces based on LBSN Big Data. We collect the LBSN Big Data from Foursquare, which is a representative LBSN service. Foursquare allows users to share geographical location information of a social space, number of visitors, tips, and so on. A venue in Foursquare represents a social space which has the categories of art & entertainment, college, events, food, entertainment, parks and recreation, professional, residence, shops & services, and transportation & travel. Within each category, there exists numerous types. Within each category, the social spaces are further distin- guished by a number of types. For example, there 56 types for the category art & entertainment. Through Foursquare Open API (Ap- plication Programming Interface) we have collected the LBSN Big Data accumulated from users. The following steps are introduced to build an SSN from the Foursquare LBSN Big Data:

- In the first step, we collect information about all the venues in the range of our interest and tag each venue as a node.
- In the second step, for each venue (or node), we assign di- rected edges up to 5 other venues (or nodes), each of which has the number of direct visits from the users, who are in the current venue, ranked top 5. The top 5 is chosen to ensure the reliable social connection between two venues. This in- formation could be extract by using the command of 'query NextVenue' in the Foursquare Open API.
- In the third stage, those nodes and edges collaboratively consist one SSN.

4.2 Activation Levels of URSCs

There are two main aspects of analyzing URSCs: 1) One is to investigate their spatial composition which can be analyzed by applying modularity to the SSN; 2) Another one is to assess the activation levels of the URSCs in a city which can be analyzed by applying the diversity index - Shannon entropy.

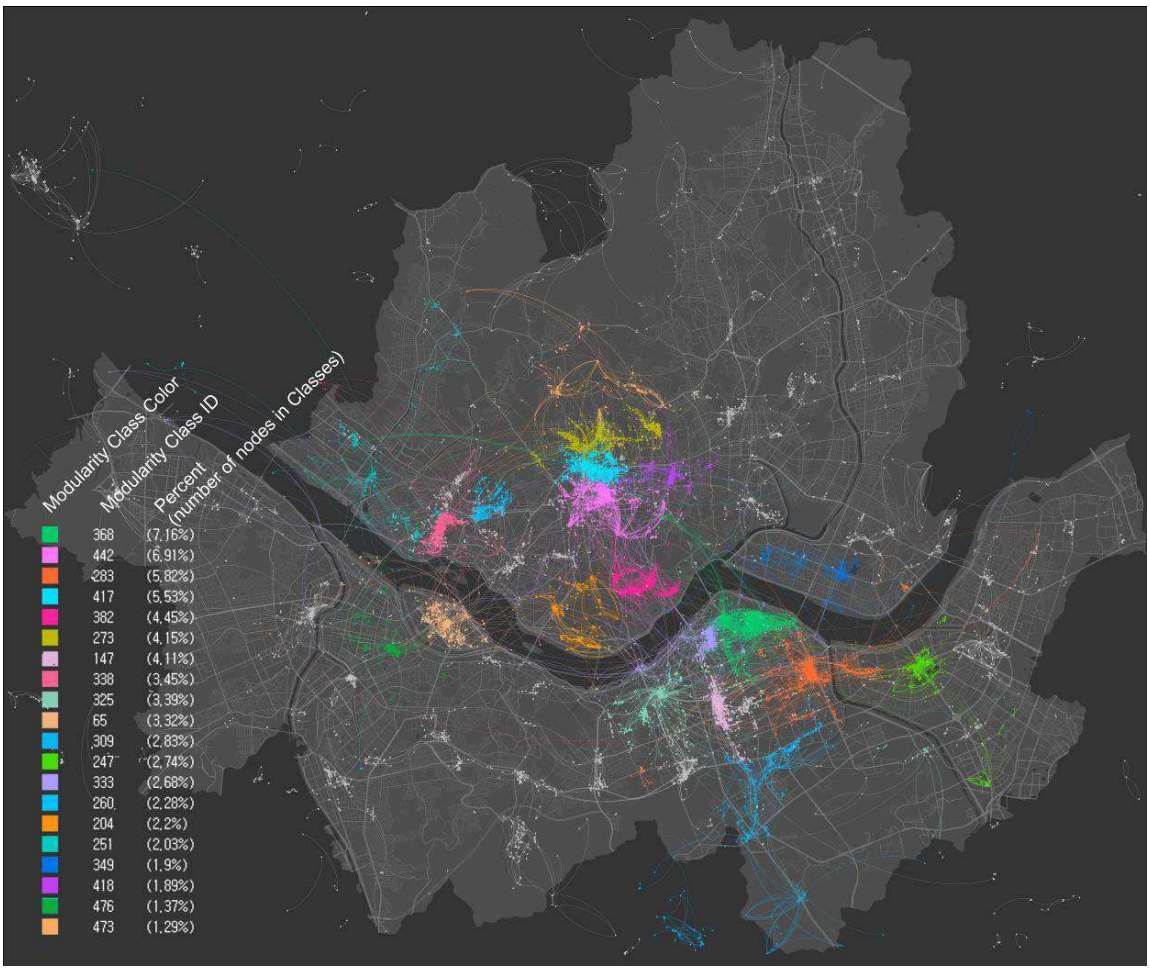

Fig. 4: The URSCs detected in Seoul.

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4.2.1 The Method of Modularity Optimization

Modularity optimization is frequently used for detecting community structure in general networks. In particular, modularity is one measure of the structure of community networks and is designed to measure the strength of division of a network into modules (or communities). Networks with high modularity have dense connections between the nodes within the modules but sparse connections between nodes in different modules. The modularity is a scalar value between âĹŠ1 and 1 that measures the density of links inside communities as compared to links between communities. In the case of the SSN where all the edges have the same weight as 1, the modularity of the SSN could be defined as

$$I_M = \frac{1}{2N}\sum_{i,j}\left[a_{i,j} - \frac{k_i k_j}{2N}\right]\delta(C_i, C_j) \quad (1)$$

Where ai, j is 1 if nodes I and j are connected, and 0 otherwise, $k_i = \sum_j a_i$, j , Ci is the community to which the node. i is assigned, δ(Ci ,Cj) is 1 if Ci = Cj and 0 otherwise, and $N = \frac{1}{2}\sum_{i,j} a_{i,j}$.

In this paper, we adopt the algorithm introduced by by Vincent et al (2008), which can heuristically realize the modularity optimiza- tion, and search for the URSCs from the SSN we have constructed where each social space is considered as a node while each edge between two nodes represents the connection between the two corresponding social spaces [3]. In particular, we used the open source called Gephi to implement the detection of URSCs [1].

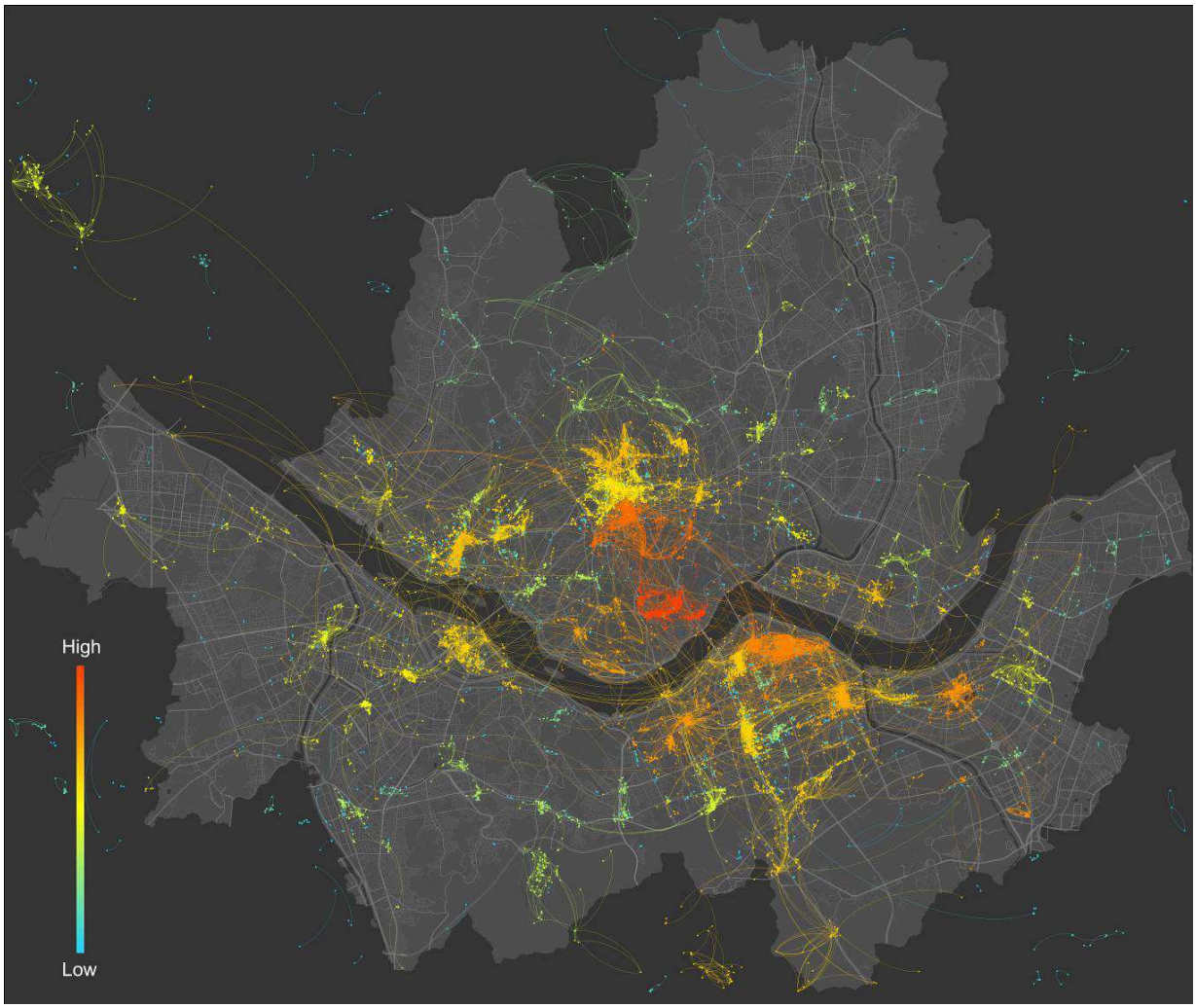

Fig. 5: The activation levels of the URSCs in Seoul.

4.2.2 Shannon Entropy for the Activation Level

While Shannon entropy [7] is well known as the measure for the information con- veyed by a dataset in Information Theory, it is also used frequently as a diversity index which quantitatively measure how many differ- ent types there are in a dataset (or a community) in Social Science. In this context, we use the Shannon entropy to represent the activa- tion level of a URSC. The Shannon entropy of each detected URSC can be calculated by

$$H = -\sum_{i=1}^{S} (p_i \ln p_i) \quad (2)$$

where

- S is the total number of types for the social spaces appeared in the URSC,
- i is the type index in the URSC,
- pi is the ratio of the number of social spaces tagged with type i over the total number of social spaces in the URSC.

5 EXPERIMENTS

5.1 Construction of the SSN for Seoul

We first collect the Foursquare Venues to construct the SSN for Seoul. The physical spatial range is taken as a square whose longi- tude and latitude coordinates of the southwest and northeast points are (126.7629, 37.4274) and (127.1829, 37.7074), respectively. We in- vestigate the temporal range from January 2010 to September 2017. As a result, there are total 11,076 nodes and 23,495 edges in the con- structed SSN which is shown in Figure 2. We can further observe that each node has the number of 2.121 edges on the average.

5.2 Experimental Results

Based on the constructed SSN for Seoul, we run Gephi and obtain the USRCs. The resulting network of USRCs has the modularity value of 0.921, which is quite close to 1, indicating a typical small- world network characteristic [14]. Through counting the number of edges between any two nodes, we find that the maximum length is 36 and the average length of the shortest path between any two nodes is 13.443.

Modularity Class ID URSCs size	URSC's	URSC's Ranking	URSC's Activation level Ranking
368	Cheongdam-dong - Apgujeong Rodeo Street	1	3
442	Myeongdong - City Hall - Sungnyemun Area	2	2
283	COEX - Complex area	3	7
417	Gwanghwamun - Insadong - Cheonggyecheon area	4	17
382	Itaewon - Gyeongryeon Dangil - Haebangchon - Hannam-dong area	5	1
273	Gwanghwamun - Bukchon - Wolchon	6	8
147	Gangnam Station Area	7	15
338	Hongdae area	8	10
325	Express Bus Terminal - Seorae Village Cafe Street - Banpo Sports Complex	9	5
65	Yeouido	10	14
309	Gap-dong - Yangjae-dong	11	13
247	Jamsil Lotte World	12	4
333	Sinsa-dong road - Banpo Hangang Park area	13	12
260	Shinchon Ida street area	14	16
204	Namsan - Yongsan Station - National Museum of Korea	15	6
251	World Cup Stadium	16	19
349	Ttukseom Station - Seongseu Station - Gunsan Metropolitan Area	17	9
418	Dongdaemun Plaza - Plaza Mayor - Cheonggyecheon	18	11
476	Yeongdeungpo Times Square	19	18
473	North side of Bukhansan	20	32

Table 1: Ranking of teh URSC's size and the activation level.

We further analyze the degree distribution of the whole SSN where the degree is defined as the number of edges connected to each node (or social space). Figure 6 shows the degree distribution analyzed from our constructed SSN where x label shows the number of edges and y-label shows the number of nodes having the same number of edges. We can observe that the degree distribution has the power law scaling which

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indicates that there are some nodes (or social spaces) that act as hubs in the SSN. As seen from Figure 3, there are a few nodes having many edges connected. We use white circles to represent those typical hubs in the SSN while a larger circle area indicates a larger number of edges. Therefore, we

can conclude that this urban SSN is a typical scale-free network defined by Barabasi (2002). This characteristic indicates that there are some concentrated social spaces which are visited by people from many other social spaces. Barabasi (2002) explained that there exists a trend of 'the poor get poorer, the rich get richer' in the scale- free networks when evolving. In other words, when a new node is created in a scale-free network, it is highly likely connected to the nodes playing the role of hubs. The scale-free nature of this urban SSN suggests that it is necessary to consider the connection to surrounding hub social spaces when practicing urban regeneration.

Figure 2.1 shows the detected URSCs where different color rep- resent different URSC. While we observed a total of a total of 479 URSCs in Seoul based on the constructed SSN, the top 20 USRCs hav- ing largest number of nodes are presented in Table 2.1. The largest URSC is appeared in near in Gwanghwamun - Bukchon – Sogwon - Cheonggyecheon area. Those top 20 USRCs are enumerated in Table 1.

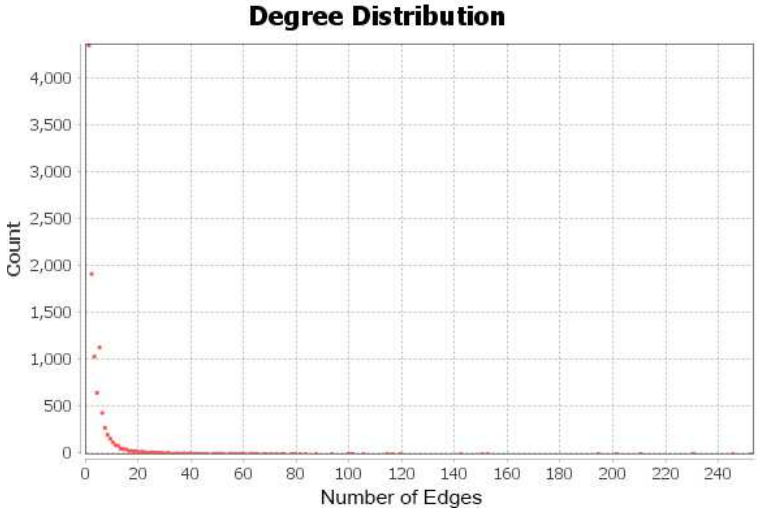

Fig 6: Degree distribution of the SSN.

Figure shows the activation levels of the USRCs detected in Seoul. In particular, top 20 USRCs showing highest activation levels are presented. We can observe that those USRCs almost overlap with the 20 USRCs presented in Figure 2.1. For comparison, we also show the activation levels in Table 1 where we can observe that among the top 20 USRCs having the largest number of social spaces, 19 are still ranked top 20 in terms of the activation levels. One expection is the region of 'North side of Bukhansan'. While North side of Bukhansan has a large number of social spaces (ranked top 20), as it is located far away from the center of Seoul, the corresponding activation level is relatively low.

5.3 Discussion

The methodology of detecting URSCs can be applied to urban re- generation which needs to simultaneously consider the problems related to the physical- and social-environment. Therefore, it is important to extract the boundaries of the URSCs in a city and evaluate the corresponding activation levels. The proposed method- ology is meaningful as we can investigate the social aspects which is confirmed from the experiment.

While we only applied Foursquare LBSN Big Data to check the proposed methodology, the accuracy would be improved if some other LBSN data like Twitter and Facebook is additionally consid- ered.

6 CONCLUSION AND FUTURE WORK

In this paper, we proposed a methodology of detecting URSCs by applying the LBSN Big Data. For this, we first constructed an SSN from the LBSN Big Data through representing social spaces and their connections by nodes and edges. Secondly, we adopted the method of modularity optimization, we detected the URSCs from the constructed SSN. Thirdly, we applied the diversity index, i.e., Shannon entropy to quantitatively

evaluate the activation level of each URSC. As a case study, we apply the proposed methodology to the Seoul city and investigated the social aspects of Seoul in terms of URSCs and the activation levels.

7 ACKNOWLEDGEMENTS

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Urban Structure Transformation between the Role of Urban Planning Methods and Real Estate Market Force – Case Study: the New Millennial Cities in Egypt

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1 ABSTRACT

Over the past forty years, many new cities have emerged in Egypt, including millennial cities. It noted that there are many urban changes in these cities since the beginning of their inception until now. Includes city area, patterns, characteristics, rates and percentages of land uses within the city, the decrease or increase of some elements ratios, disappearing of other uses, in addition to transfer of some uses from its usual place to another inside the city.

Many reasons have led to these changes as: the change of housing policies especially that deals with systems of subsidization, emerging of new housing patterns and models, and the strong participation of private sector in development of cities and residential areas.

The research aims to monitor the changes and urban transformations occurring within the major millennial cities within Greater Cairo region in Egypt since the beginning of its inception at late 1970th up to now, studying the different reasons that led to these changes, then deriving some indicators and set guide lines and put foundations and standards that Helps to develop urban planning of major new cities structure in Egypt.

Keywords: New Millennial Cities, Urban changes and transformations, urban planning, Housing policies and housing patterns.

2 INTRODUCTION

The city is always created to serve its inhabitants and to fulfill their requirements and their desires in a given society by using the available capabilities. The city influences society and the environment, and then city and its characteristics change. These changes are not limited to urban structure, environment and human behavior, but also change its economy, its components and its potentials.

Many studies indicate that cities have a strong ability to attract and establish a strong economy in many fields like production, service or administrative, and the real estate economy, which represents an important part of national economy for any country.

Many factors have a strong impact on the city planning and its urban structure, such as;

- environmental, and socio-economical characteristics that elaborate the basic requirements and desires of the population.
- Housing policies, construction elite responsible and political decision.
- Regulations, urban planning laws, planning methodologies within its specific steps [15].
- Real estate market and Finally,
- Technological development affects all aspects, and has an influential role in the physical changes of the city

In Egypt, housing policies have been changed, and due to that the city have been changed too. The individuals, associations, and private sector have been involved in development of various lands which allocated by government. The question now is [18];

- What is the most powerful player in making the new city structural changes? Is it real estate marketing or planning?
- Is there any impact of real estate marketing on urban transformations of cities?
- Is there a relationship between urban planning methodology and real estate marketing? Which Factor has the strongest impact on the other?

In response to this issues, two cases of the new Egyptian millennial cities were studded (as planned):

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(a) New Cairo City (East of Cairo)

(b) 6th of October City (west of Cairo)

The research will follow the changes that have taken place in both cities since the beginning of their inception in the 20th century, while studying the policies and The used planning methods for planning and implementation, as well as those responsible development during that period. As follows:

(2) Housing and the New Million Cities in Egypt

The idea of establishing new cities in Egypt started with ancient Egyptian civilization. They put the regulation of housing to all social sectors, as in Tall-ElAmarnah city. At mid-1970s Egyptians aimed to create new urban communities to make a comprehensive change in all aspects of life in Egypt (economic, social, environmental and urban). In 1979 the issuance of Law 59 to build integrated urban cities in the Egyptian desert and coasts, and was assigned to the New Urban Community Authority (NUCA) which manage new cities and communities in four generations.

- G1 Includes 10th of Ramadan, Sadat, 6th of October, Burg Al Arab and Damietta, ten new communities in Greater Cairo, most of which were later transformed into cities [23] [24].
- G2 Included the cities of Bard, Sheikh Zayed, Menia, Beni Suef and Thebes.
- G3 New Cairo which included (1-3-5) communities, Shorouq (Com. 2), New Assiut.
- G4 Included New city of Toshka and many cities that are twinned with the old cities in most of the country's governorates as; New Fayoum, Sohag and Beni Mazar.

These cities were established through ministerial decisions issued with the change of housing policies and the institutional framework, followed by the change of attitudes, Planning methodology, and housing elites.

New Millennial Cities, was began at 1992 after planning of the New Cairo city including communities (1-3-5) combined with the inter- areas east, while 6th October city turned into a millennial city at 2006, where planned population reach 1.5 million, followed by the New Administrative Capital at 2014 east of Cairo, of nearly 7 million people [2].

Figure 1: first New Millennial City (New Cairo)

(3) Institutional framework and changing the elite and officials:

The Ministry of Construction and New Urban Communities (NOAH) was established in 1978. It was headed by Eng. Hasaballah Al-Kafrawi, who adopted the policy of establishing new urban communities and started the establishment of 18 new cities. They aimed to provide low cost housing units for low-income peoples (ranging from 60 to 70%) [11] while the State shares with individuals and Real estate developer for provision of middle, upper middle and Upper class. [12]. At 1990th, Dr. Mohammed I. Suleiman enforced the vital role of private sector by spread of resorts and housing projects in the new cities. Ahmed El Maghraby take the responsibility in 2006 for his policy of managing new urban communities and decision-making in the manner of the businessman and the tendency to employ Egyptian and foreign expertise houses [17].

Figure 2: low income housing at 5th settlement (10000 units) and Alshorouk (10000 units)

This kind of development of new cities continued until 1992 when they decide that the state will only carry out the implementation of main basic facilities, and put the conditions for the land to speed up implementation in accordance with specific standards and requirements for quality. They give the private sector a greater role in development of various housing projects by giving them large and mid. land lots with relatively low prices. Many major projects had strong beginnings, including Al Rehab in New Cairo on about 3500 acres as total area, And Dream Land at 6th October city on 2000 acres, they use new thoughts and marketing ideas that has a strong role and influences on Community planning.

Egyptian state continues providing lands including small and med-sized lots areas ranging from 10 to 2000 acres for private communities such as Hyde Park, Mivida, new giza, and Helio Park in New Cairo and 6th October, on other hand they sell large areas for Egyptian and foreign real estate companies, as 8000 acres (Madinaty), and 11,500 acres for Mostaqbal city [4]. These companies make many large and med-sized communities included inside New Cairo and 6th of October .

State also provided many types of housing for low-income people by achieving Mubarak's presidential program, including Youth Housing Project in 1997, Future Housing Project in 1998. During period from 2005 to 2012, NUAH implemented national housing project in all provinces, (established 500000 housing units) [17]. They have partnered with some real estate associations and investors according to specific governmental housing models. And also adopted the Social Housing Program Family Housing Project which aims to create one million housing units within five years (between 2006 and 2011), as middle-income families within the Dar Masr project and Build your house project [18].

The state also provides lands ranging from 200 to 1200 m2 with complete infrastructure for individuals and small developers. At 2006, the state began to offer lands for real estate projects with auction system, they started with two lots of an area of 80 acres at New Cairo and 200 acres in 6th October, the price reach 4050, and 1200 EGP\m respectively, which is higher price about 6 times than the allocation by acquisition in city of 6th October, and 20 times in New Cairo. The new prices had a strong impact on the prices of units, where it rose from 2 to 3 times in only 1 year.

As a result of land price increase, developers and investors of real estate market has to find a new housing types and ideas to compete with other projects on land with less prices, these ideas were based on the achievement of environmental, recreational and social dimensions in addition to increase the quality of life especially in gated communities, similar to old romantic areas as Garden City and Heliopolis (at Cairo), they come back to dream cities, utopian city, the European countryside cities. Most of them depend on the centrality of the green, recreational and sports zones in central areas, and the main basic services and non-residential uses were placed on outer ring for privacy of the residents.

(4) Methodologies and planning process for the millennial cities.

Two types of planning Methodologies emerged for the new cities: The physical planning approach, which follow set of steps and studies to produce Master Plan which determine the landuse disribution for housing, services and economic uses for a certain population [1].

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The second Methodology is carried out by real estate developers, especially those who develop communities (50 to 500 thousand inh.), they compose development team including planners, analysts, administrators, economists and representatives, All team members has new genius ideas and applicable proposals, They also must be good representatives and depend on comprehensive concepts, and must care about sustainable development by achieving conservation of resources and capabilities for future generations. They use following planning tasks to develop the land, its stages and steps [18].

(a) Preparing a preliminary strategic real estate idea: where planners and visionaries propose visions and ideas to do a preliminary feasibility study include a forecast of costs, expected activities, and a determined plan of what can be done to achieve the vision of real estate of the company.

(b) Preparing detailed outline plan of real estate element: including units and land for all uses, then determines proposed financing and marketing plan and determine pricing for each.

(c) Preparation of project management documents: Which include advertising plans, financing, marketing and pricing, as well as planning documents and implementation management.

(d) Marketing activities (selling, sorting and spare, renting, leaving.)

(e) Securing and financing the project.

(f) Design and urban planning: includes legal and executive plans, implementation documents and all related to the aspects of urban in line with marketing plan.

(g) Construction and implementation stages

(h) Delivery and Accreditation

(i) The practice of selling or leaving or renting

(j) Insurance and efficiency during the warranty periods

Both two types begin with study and then analyze, followed by plans for mid. long periods, they care for people and users because their products remain for long years. They are responsible for covering all areas related to real estate development, implementing various projects for profit, contributing to Gross Domestic Production, generating jobs in various economic projects, and forming the physical and natural environment with its buildings and spaces [2].

(5) The role of the state, individuals, real estate investors in new cities planning in Egypt

Between 1996 and 2006, there were about 7.9 million Housing units built in Egypt, including urban housing units, 3.9 million was implemented by three groups, the state by related authorities and public bodies (about 10.5% of the total units), while private sector (investors, real estate developers and social associations), implement 24.3% of units, the remaining 65.2% of housing was built by individuals in an informal settlement [18].

- Real estate in Egypt is involved in the construction of about 948 thousand units, most of which are distributed to the Greater Cairo region and Alexandria [18].
- In new cities, the state participated in deveoping about 35.9% of the total units of 902 thousand units, while individuals built more than 41.5%, and about 12%by housing associations, and also 10.1% by investors (real eastate companies [18].

Figure 3: private communities by Real estate

- Here after the real estate major companies that had an active role in the planning and development of major projects and development were the following companies [26]:
    - Orascom Development Holding is a mid-level residential
    - Talaat Mustafa Group is a high level residential unit
    - Palm Hills Development of high level residential units
    - SODIC residential units of upper high level
    - Miemar Al Morshedy is a medium level residential unit
    - Emaar Egypt is a high level residential unit
    - DAMAC residential units of high standard
    - Qatari Dear high-level housing units

Most of private sector developers employ experts or contract with consulting firms including urban planners to accomplish development tasks and contractors to carry out the construction. Some of them have their own team work. They develop residential compounds, mostly implemented at five new cities around Greater Cairo, (New Cairo, 6th October, Sheikh Zayed, Obour and Shorouk). they focus on luxury homes, med. and upper med. housing such as (Talaat Mustafa Group and Eemaar Morshedy). On other hand individuals and small developers build housing for the less affluent people, which represent about 41.5% of Egypt's total urban housing production. and promote these projects through direct Media and/or marketing agencies [17].

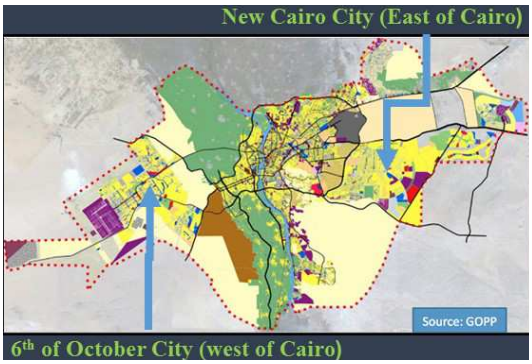

Figure 4: The case study millennial cities

3 CASE STUDY 1: (NEW CAIRO CITY):

At early 80th, three urban communities (1, 3 and 5) starts with an area ranging from 2000 to 3000 acres and a population of 200 to 250 thousand inh. per each one. At 1992 the first millennial city of areas about 27,600 acres including the three communities and areas in between [23], the city was surrounded by a green belt with an area of 2600 acres. The service center was planned in leaner form to represent an extension of Nasr City main service axis at east direction of Cairo, and to emphasize the fill the spaces between the three communities at 1992. during this period, the beginning of allocation of lands to real estate developers such as Al-Rehab Community, which represent large participation of real estate developer in cities.

At 2006 the city become one of major cities with an area 67000 acres to accommodate 3.7 million inhabitants [10]. It has allocated a number of medium and large lands for investors such as Madinaty, Heliopark, Future city, Hyde Park and other several gated communities. Then the city increased to reach about 78000 acres in 2014 to accommodate nearly 5,5 million. and including 4 other new communities (Sectors) to be developed by government and the private sector [18].

The city axial service center extending about 20 km from first ring road to east ended with services area in rectangular shape, its areas is about 19.5% of the total area, including 11% basic services and 8.5% green areas recreational services, these services are excluding special elements such as the fossilized forest on the south as well as the various services within the gated communities developed by private sector within the city [11]. These gated communities divided the city internally into fenced zones, the pace of construction has increased. Most of communities (1,3,5), and other gated community's zones have been totally completed. Here is some Communities at new cairo. The services areas ratio decrease by time specially the basic

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services but the green and recreational areas ratio are increasesd specially for communities developed by real estate as shown in table (1) [27].

City/community	total urban area Acres	Basic services	%	Green & Recreation	%	total area	%
5th community 1986	2175	380	16.46	235	10.8	615	27.26
New Cairo 2014	78000	8580	11	6630	8.5	15210	19.5
Al-Rehab City 1992*	3500	315	9	298	8.5	613	17.5
Madenaty 2004*	8000	640	8	960	12	1600	20
Abo Elhool 2004**	700	42	6	100	14	142	20
Mostaqbal city 2006*	11500	805	7	1550	13.5	2355	20.5
Heliopark 2006*	1695	120	7	170	10	290	17
beit Elwatan 2014**	3500	300	8.5	420	12	720	20.5

*- They are a part of New Caro city **- developed by state

Table 1: services ratio at New Cairo and its communities

(a) Al-Rehab City- New Cairo (Talaat Mustafa Development) 1992-1997 [22]:

Al Rehab is considered the first large integrated residential community established by private real estate developer. Its located in New Cairo city near the Cairo-Suez Desert Road, it was built on 3500 acres to accommodate 200,000 people. Its divided into ten neighborhoods each on an area of 250-300 acres, in addition to basic services (9%) which distributed on the outskirts of the city, recreational green areas is about (8.5%), including sports club and gardensin centeral area, while other smaller basic services are distributed as an intermediate ring within the city including some of green areas.

(b) Urban Community (Madinaty)- (Talgat Mustafa Development) 2004 [5]:

The city was built on 8000 acres to accommodates 600 thousand inh. The planning idea based on the Axial centralization of Green and recreational area, the basic services is about (8%) and 12% for green areas and recreational services. Many services that serve on a regional level, such as the media village, mega malls, smart village and Olympic sports village which have been settled on city outer ring.

(c) Abo Elhool Family house - New Cairo (State development) 2004 [14]:

It was about 700 acres, and is located near Cairo-Ain Sokhna road to the east of the fossilized forest. It was developed by the authority to accommodate and serve 100,000 inh. The residential community was divided into three district, in addition to a park, recreational areas, club, and mixed uses in the central area. Services represent 20% of the total area including 6% basic services and was distributed on its outer borders, and 14% for recreational, greens and a central park.

(d) The Mostaqbal City (The Arab Contractors) 2006 [6]:

The city was planned to accommodate more than 500 thousand people in about 11,500 acres. its located east of the Greater Cairo region and bordered by Cairo-Suez road at north, and by regional ring road from the east. The planning idea was based on locating large recreational area as central axis of the city surrounded by residential Zones, while services were distributed outer ring including basic services of about 7%, while recreational services and green areas reached 13.5%.

(e) Hyde Park Residential Complex - New Cairo (GCC real estate company) 2006.

The Community area is 1,120 acres and developed by gulf real estate company to accommodate between 25 and 30 thousand inhabitants, it contains a large green heart, were residential areas was settled around it. The total service is 25.5% of the total area including basic service which represent 9%, and distributed in organic forms on the outskirts of the residential zones, and there is 16.5% for green parks and recreational services. The community is located at south east of New Cairo.

(f) Helio Park - New Cairo (Development of New Egypt Real estate) 2006 [25]:

The city area is about 1695 acres, planned for 100 thousand people, its divided into 6 residential district located around a linear green center with total area 1060 acres which includes some commercial services too, each district has a central garden. There a regional civic center parallel to the Cairo / Suez road. The basic services area represent (9%), and is located on the outskirts of districts. Recreational areas and gardens

represents (7%) concentrated in the central axis. Other green areas are electricity lines and within each district, which represent about (10%) of the total area.

(g) Lake view- New Cairo (By Egyptian Oil Company subsidiary) 2006:

On 500 acres, residential Compound was located in the heart of the city axial central to accommodate about 10000 inh., where the state replaces a part of the central services with Luxury housing and sporting club, some Basic services distributed at north and south, and 5-star hotel too.

The idea of its plan was based on locating sports and recreation area in the center of the community surrounded by residential groups from the east, west and south. Basic services in the city is 8%, while green areas and recreational services represent 16.5%.

(h) Beit Al Watan Project (State Authority) 2014

Its located on Cairo-Suez Road, east of Greater, with an area about 3500 acres, Its planned to accommodate more than 200,000 people. its idea of planning was based on central leaner green axis extends from north to south surrounded by 8 residential districts, a concentration of huge services area at north and south. The basic services ratio is 8.5%, and the green and recreational service is 12.

Figure 5: The case study urban communities developed by state and private real estate

4 URBAN STRUCTURE CHANGES OF NEW CAIRO MILLENNIAL CITY

Through the study of New Cairo city, it noticed that many changes in city structure, as follows: -

- The state starts to change the city Urban Structure by gathering the three isolated communities (1-3-5) to form the first millennial city which follow the model of linear city with a long axial civic center surrounded by residential districts.
- The real estate developers have established communities surrounded by fences which called the Gated community, as Al Rahab, Lake View, Mivida, Hyde Park, that include mid size cities that emerged within the city and its borders as (Madinaty– HelioPolis and Future City).
- The communities which developed by real estate developers change the city internal composition including the planned uses and its urban patterns. There are landuse transformations of some sites, as the the chang of a part of the axial civic center to residential areas (as Lake View for example), and Abo Elhool area, which has transformed from secondary service centre to a residential community around a central park, also many basic service areas have been transformed into recreation areas such as to the Central Bank Club in the north.
- There are transformations from residential to regional service as (AUC) which has been transformed from residential uses into educational services.

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- The huge change in the city is the ratio of basic service and the green elements. Basic serviced decrease and the grean area increase in all communities that developed by real estate and the recent citeis that developed by the state.

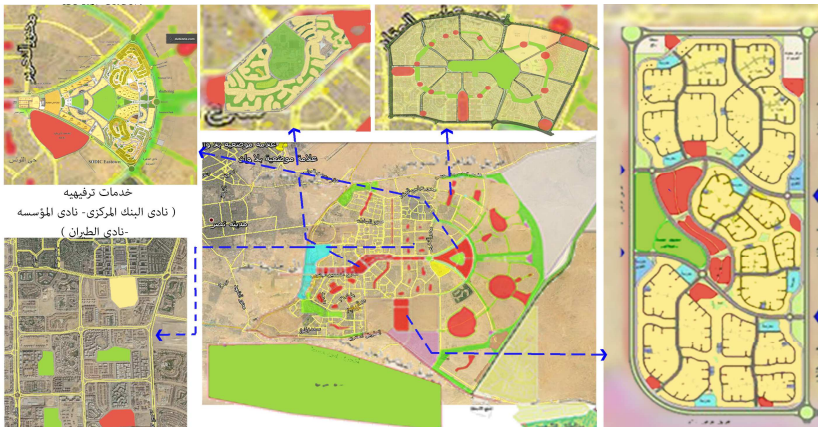

Figure 6: Urban changes of New Cairo

5 CASE STUDY 2: (6TH OF OCTOBER CITY):

6th of October is residential and industrial City located near Giza Pyramids area at west of Greater Cairo 38 km from the center. It connected by Cairo-Alexandria road, Wahat and Cairo-Fayoum road. It was planned in linear urban model. The service centers are representing the city artery. The whole city was surrounded by green belt, and also green Zone to separate industrial area at west from adjacent residential areas. The residential districts and neighborhoods contains its basic services. At the south there is different uses areas (tombs- housing of workers- residential areas- universities- clubs- recreational projects such as Dream Park).

The city Cardoon at (1978) is starts with 85680 acres to accommodate about 500000 people [23], the basic services area at that time represent about 8.1% and the recreation and green represent 7.3%. At 1992 the state allocated large and medium land to real estate developers such as Sodik, Dream Land, Mina Garden City for many private residential projects [8]. The planned population increased at year (2000) to 96390 acres for 1.5 million, and reached 2.5 million at 2012, and then reached more than 4 million in (2014-2015) plan, with an Urban area of about 80000 acres. The total service area ratio reached 19.4 %, including basic services 6%, while recreational and green areas represent 13,4 [16]. The services and green areas in 6 October city changes through time as shown in next schedule (2).

City/community	total urban area Acres	Basic services	%	Green & Recreation	%	total area	%
6 October City 1979	13700	1100	8.1	900	7.3	2000	15.4
6 October City 2006	75400	5500	7.3	4650	6.2	10150	13.5
6 October City 2014	98900	6430	6.5	12857	13	19287	19.5
dreamland 1992*	2000	130	6.5	310	15.5	440	22
Sheikh Zayed 1986*	10000	1500	15	1500	15	3000	30
Mena Garden City 1992*	210	7	3	38	18	45	21

*- They Developed by Real estate companies and are a part from October City**[27]**

Table 2: services ratio at 6 October and its communities

The city has many internal communities as:

(a) Mena Garden City Residential Complex (Mena Tourist Housing Company) 1992[3] [13]:

The city has adopted the distribution of the urban structure on a dedicated strip center for recreational services, sports clubs. There is one basic service center in the south, other one located on north west, it was established at the end of the twentieth century for Luxury villas and palaces on an area of 210 acres located in the tourist area in the city, and to accommodate about 8000 people. At the beginning of the 21st century was intensified housing with Townhouse and Twin House villas which increase the population to about 15 thousand people. The area of basic services represent only 3%, while recreational services, sports and green area of 18%, and the total area represent 21%.

(b) Dreamland Housing Group (Bahjat Group Companies Development) 1992[19]:

The project began at early 1990s and consider as the first major real estate projects in the City, its located on the Cairo -Wahat Road and ring road. It was planned on 2,000 acres to accommodate 40,000 homes (about 180 thousand people), 20% of its area is Residential buildings, and the rest is for roads, green spaces and services, services represent 22% of the total area, include 6.5% for basic services while 15.5% for gardens and recreational services [9].

Figure7: Two examples of Private sector development for urban communities

6 URBAN STRUCTURE AND ACTIVITIES CHANGES IN 6TH OCTOBER:

- The state planed the city using the linear model as a basic form, later on many changes to the activities and uses happened within the city, including transformation of some areas that were planned as service centers to housing projects due to increasing housing demand.
- Policies was made to apply of fair and homogeneous distribution of main and basic services and greens on many places of the city but later on the services distrbuted in un homogeneous order.
- The private real estate developer depends on concentrating green areas and recreational services such as social and sports clubs in the city center, (as Dreamland, Mena and others Gated communities), and distribute the domestic service on other decentralized places.
- Some changes come by changing services areas to housing projects such as (Build your home project) and some other gated communities.

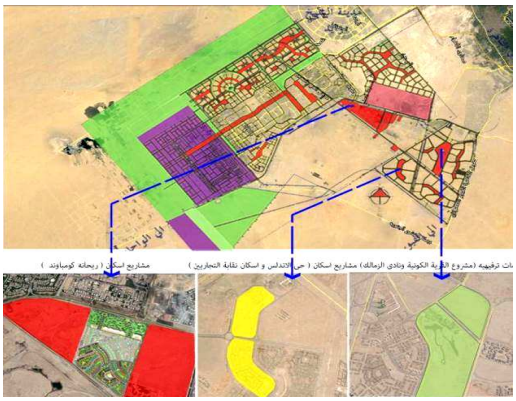

Figure 8: Urban changes of 6th October.

7 RESULTS

(a) The State plans to follow well-known planning models for city planning such as the central and linear model, and they plan to provide max. low income housing in those communities.

(b) Millennial city urban structure change coincides with the transformation of the state role through its institutions from main developer to legislator and observer only, and it's also coincides with the change of housing policies in the state and the change of elite and officials.

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(c) The city Changes include new Urban patterns and planning Models for units, as well as change of the whole city urban structure, there is also Changes in proportions of uses as basic services, recreational services and green, that

(d) The private sector and real estate developers actively participate and plan their land on an innovative model based on customer preferences. New models show their centers have no basic services, but have green areas and recreational uses.

(e) The state on late decade follow the experience of private developers in city planning. The same developers planning models was applied by state, such as green centers instead of basic service in city centers. The state investigates the requests of some investors to provide some activities within the city instead of the previously planned activities, where some services moved out of the civic center and replaced by residential areas or gardens and recreational.

(f) The internal change in the city has emerged through green centers and basic services on the outer ring. and at the whole city level through changes in some activities and uses, also the ratio of basic services decreases about 5% and the greens and recreations has increase twice times.

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Using Nature-Based Solutions to Create more Climate-Resilient, Green and Livable Mediterranean Cities: Experiences from Castellón and Cannes

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1 ABSTRACT

Cities around the world are undergoing significant transformations and are facing substantial challenges in the form of urban densification and extreme weather conditions due to climate change and ongoing urbanisation. Nature-based solutions (NBS) present an approach to address urban challenges through working with nature in order to achieve ecological and resilience objectives, whilstconcurrently creating opportunities for social and economic innovation. UNaLab is a project funded by the European Commission under the Horizon 2020 research and innovation programme, which aims to create a framework for implementation, demonstration and future upscaling of nature-based solutions in three demonstration cities (Tampere, Eindhoven and Genova), as well as for the replication of the solutions in seven replication cities: Basaksehir, Cannes, Castellón de la Plana, Prague, Stavanger, Buenos Aires, Hong Kong.

As part of this project, the cities of Cannes (France) and Castellón(Spain) have been working towards a NBS roadmap using different co-creation formats. In a weeklong on-site process, the current state of the urban systems regarding NBS in the city was examined and suitable intervention areas and project ideas were identified and co-developed together with various city stakeholders to enhance the cities' resilience and climate change adaptation potential. Amongst others, the interventions include the creation of green-themed corridors, the strengthening and revitalization of remaining urban agricultural land, the design and implementation of (circular) water retention systems or the renaturalization of existing rivercourses. Being Mediterranean cities, Cannes and Castellón face similar challenges and opportunities in terms of city greening and urban planning, which will be discussed in this paper. A presentation of the outcomes, impacts and experiences on how NBS are contributing to initiating a positive transformation process and the creation of livable, healthy and feel-good placeswill also be given.

Keywords: adaptation, resilience, mitigation, climate change, nature-based solutions

2 INTRODUCTION

2.1 Nature-based Solutions for increased climate resilience and livability in cities

According to the European Commission, NBS are "actions inspired by, supported by or copied from nature" which "aim to help societies address a variety of environmental, social and economic challenges in sustainable ways" (EC 2015). The concept has the potential to change conventional urban planning and more actively include climate resilience and sustainability topics in the socio-political debate on landscape planning and urban development by promoting a more ecological mindset.Resilience is thereby understood as "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks" (Walker et al. 2004), which in the context of climate change adaptation in cities is understood as the ability of urban systems to limit and deal with climate-related risks and disasters. Given this background, NBS are seen as promising opportunity for cities to future-proofing and preparing for the challenges that come with climate change and ongoing urbanization whilst improving the environmental performance of the system. Relevant ecosystem services and functions of NBS thereby include cooling services to mitigate urban heat islands, surface water regulation to reduce flooding and erosion, water and air purification, biodiversity, provisioning services, as well as climate regulation. Reduced disaster risk, improved outdoor comfort and human wellbeing, as well as inclusive green growth and improved social cohesion are some of the often-named resulting benefits (UNaLab 2019; EC 2015). In addition to that, NBS are useful to ensure that urban ecosystems and their biodiversity are correctly managed and protected (Nagabhatla et al. 2018), e.g. through supporting maintenance, enhancement and restoration processes(Wendling et al. 2018). Figure 1summarizessome of the different ecosystem services NBS can provide in urban contexts.

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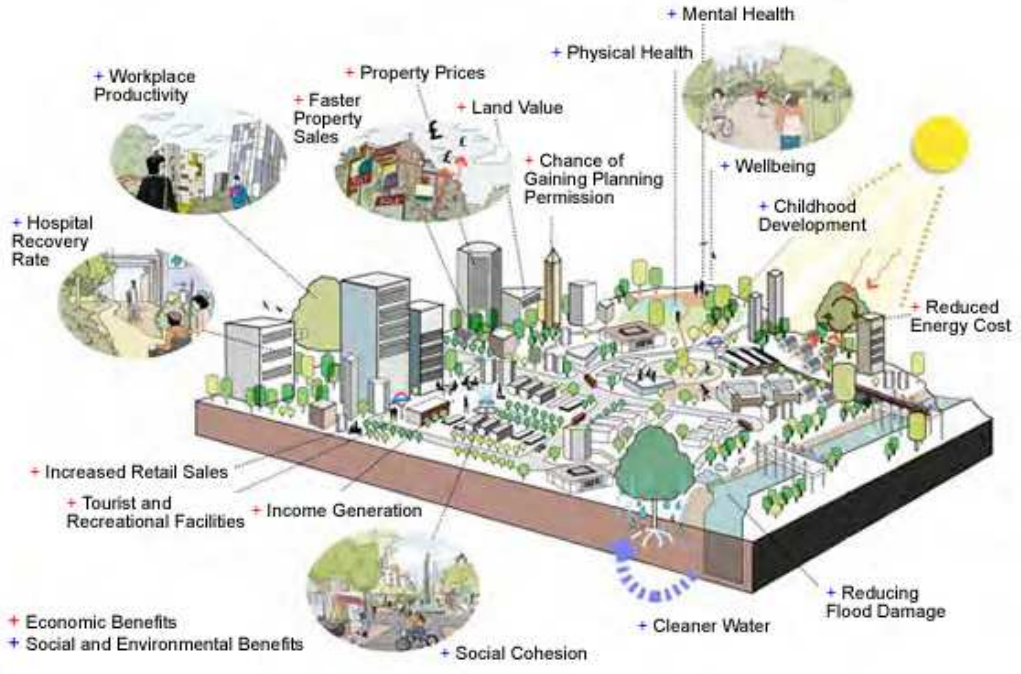

Fig. 1: Ecosystem services and benefits of NBS in cities (Arup 2014)

NBS and green and blue infrastructures are highly interdisciplinary and depend on many stakeholders in- and outside of the municipality due to their multiple benefits and cross-cuttingcharacter. As such, they demand good governance and cross-sectoral coordination for successful implementation(Hawxwell et al. 2019). Actions around environmental protection, greening of buildings, soilimpermeabilization and recovery, river renaturing and daylighting and the likealso depend on global policy support and political commitment. It is thus crucial to understand potential barriers and enablers to successful implementation and identify ways to overcome or fortify these. Within the UNaLab project, an urban systems assessment method was applied and further developed to identify important local impact factors to climate adaptation and green blue infrastructure and whilst involving relevant urban stakeholders in the development of future NBS projects.

2.2 The UNaLab Project

UNaLab is a project within the framework of the EU programme “Horizon 2020” with an international consortium of 28 partners and 10 cities in Europe and beyond.The project aims to demonstrate the effectiveness ofnature-based solutions (NBS), in tackling pressing urban challenges such as urbanisation, climate change and environmental protection in an innovative, efficient and sustainable way(UNaLab). Within the course of the 5 year project, the three frontrunner cities Eindhoven, Genova and Tampere areco-creating, implementing, and monitoring large-scale NBS interventions in an Urban Living Lab approach. The five European follower cities have actively learned from this process to develop their own roadmap towards water and climate resiliency in 2050. After the conclusion of this roadmapping process, the first results from the analysis have become evident, showing, for example, the similar and special characteristics and challenges with regards to NBS and climate change adaptation that arise in Mediterranean cities. In the case of UNaLab, Cannes and Castellón serve as model cities from this region.

Cannes is a Mediterranean city in southern France with about 75.000 inhabitants and a climate that is rather mild in the winter months and hot in the summer months. Due to its location, Cannes is exposed to natural forces such as floods, forest fires, landslides and others(Den Ouden et al. 2019).Castellón de la Plana is a likewise Mediterranean coastal city located in the Valencian Community in Spain. It has a population of 171.728 inhabitants who speak both Valencian and Spanish (Municipality of Castellón de la Plana 2019). With a characteristic soft and humid Mediterranean climate, lacking extreme temperatures but with marked seasonal rainfall and annual precipitations above 400 ml, it is this regards comparable to Cannes.

2.3 Characteristics and challenges of mediterranean cities

The Mediterranean region is located in a transitional area between the arid climate of North Africa and the temperate and rainy climate of Central Europe. This gives it particular characteristics as a result of the interactions between tropical and medium-latitude processes. The Mediterranean region is consequently vulnerable and sensitive to changes in climate, reflected in the non-linear (indeed, above-average) increase of temperature with respect to the world average. Climate models project droughts and a rise in temperatures, with a likely increase in heat waves and dry periods, which will stress the current water scarcity (Zachariadis 2016).AccordingtotheEuropean Environmental Agency(2018), the Mediterranean region is furthermore projected to experience:

- Larger air temperature raise than the world average;
- Decreasing precipitation, river flows, and water availability
- Increment in sea surface temperature and sea water acidification;
- Rise of sea level
- More heat waves intense and for larger periods of time
- Droughts more frequent and intense
- Increased risks of biodiversity loss;
- Adverse effects on forest fires, summer tourism, agricultural production and public health.(European Environmental Agency 2018)

It is projected by the IPCC that this region will suffer one of "the strongest warming of hot extremes" in a scenario of 1,5 °C temperature increment(Hoegh-Guldberg et al. 2018). Finally, reductions in food security are projected in a 2 °C increment scenario due to lower yields in crops (such as maize, rice and wheat), and to a negative impact on livestock(Hoegh-Guldberg et al. 2018). Coastal cities are likely the most affected, since the mean sea level rose 2,6 cm in the period 1992-2008 (Zachariadis 2016).

3 ONSITE ASSESSMENTS AND ROADMAPPING - METHODOLOGICALBACKGROUND AND PROCESS

As part of the UNaLab project, a comprehensive roadmapping process was conducted in all of the five European follower cities to design a development strategy to be followed until 2050 that integrates NBS in their urban planning. The methodology applied for this was co-developed and guided by the Technical University of Eindhoven, the University of Stuttgart and the Fraunhofer IAO and entailed different co-creation methods within the first two years of the project. It consisted of four distinctive steps which followed a general backcasting logic (Holmberg and Robert 2000). In the first two steps, the cities defined their general ambitions and visions with regards to climate resilience in the year 2050. After that, a comprehensive urban systems assessment was conducted in each citiesto define their status quo in climate adaptation and NBS. Finally, the results from these three steps were used as a basis to develop astrtaegic roadmap with specific solutions, projects, and milestones to move from the current state towards the desired future scenario(Den Ouden et al. 2019).

In this paper, specific attention is paid to the urban systems assessment process and its application in the two Mediterranean cities. It is an analitical tool based on the Morgenstadt City Lab methodologydesigned to understand cities in a systemic and holistic way and identify their current state in a particular field (Radecki 2019). Within the UNaLab context, it can be divided into two distinct phases: a) a remote data collection and literature review phase in which current strategies and strategic documents are evaluated and quantitative data collected in forms of indicators (where is the city today with regards to climate resilience?) and actionfields (how is the city already addressing resilience issues?); and b) a one week on-site assessment with expert interviews, site visits and workshops together with various local stakeholders. Seven main themes were chosen to structure and focus the work, all of these related to NBS and climate change adaptation: green and blue infrastructure, municipal strategy and planning, organization and structure, finance and procurement, regulations and incentives, ICT and data governance, and participation and citizen engagement. Furthermore, links to other sectors, such as energy, mobility or waste, were also evaluated (Den Ouden et al. 2019).

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In Castellón and Cannes, the on-site assessments took place between the 15.10. – 18.10.2018 and 05.11. – 09.11.2018 respectively. A team of three researchers visited each city and worked with a local mirror team from the city administration. In total, about 20 semi-structured interviews were conducted in each city with relevant stakeholders from the public, private and civil society sectors to identify local preconditions, barriers and opportunities, as well as to brainstorm current and future project ideas and intervention areas with regards to the aforementioned themes. The results were captured in standarized templates and on maps. At the end of the week, the results were presented, voted on and further elaborated in a larger co-creation workshops, which involved external actors as well. In total, 26 (Castellón) and 40 (Cannes) local stakeholders from diverse backgrounds participatedin theon-site assessment.

4 CASTELLÓN – A BLEND OF LANDSCAPES ON THE PATH TOWARDS SUSTAINABILITY

The local climate of Castellónis largely influenced by the geological interaction between the sea and "Els Ports" (Cordillera CosteroCatalana), which surrounds the Province of Castellón from the Northwest to the East. Its proximity to the shore minimizes the marine influx, making the climate variation mostly determined by North-South masses.Temperatures do not vary significantly throughout the year; the oscillations are mostly influenced by the distance from the shore (further inland, the temperatures are more variable) and altitude (areas close to the coast are warmer than inland, more elevated areas). Precipitation, on the other hand, varies significantly throughout the year.There is also a significant difference in precipitation between mountain and coastal areas, with more rain in the former and less in the latter, apart from large, end-of-summer storms (Municipality of Castellón 2017).

The economy of Castellón de la Plana is focused in services and traditional sectors, such as ceramics, agriculture (especially citrics) and building. However, the great maturity of these activities has generated some economic stagnation. This brings new opportunities to alternative emergent sectors, such as ecotourism, renewable energies, recycling, biotechnology, and more(Municipality of Castellón de la Plana).According to the Strategy for Urban, Sustainable and Integrated development of the urban Area of Castellón de la Plana (EDUSI), the sector <of services comprises most of the contracts with the 80,5% of the total 53.521 (Municipality of Castellón de la Plana).

Agriculture is a traditional sector whichcomprises 9.500 hectares where 86% of total production is of citrus fruits, especially oranges(Municipality of Castellón de la Plana). This sector is also important because it consumes 80 % of the total water uptake in the city(Municipality of Castellón de la Plana). The recent upgrade of the hydric infrastructure has reduced water consumption by 40%.(Municipality of Castellón de la Plana).8.500 ha are under irrigation and 1.000 ha are under rainfed technique. (Municipality of Castellón de la Plana).In addition, agricultural land surrounds the city, forming a "green urban belt", which has two main environmental functions: 1) to mitigate the emissions and pollution from the industry (e.g. ceramics production) and 2) to serve as a landscape, increasing citizens' quality of life(Municipality of Castellón de la Plana).Castellón is part of the Convenant of Mayors, an initiative of the European Commission (Headquarter of Energy) that indicates a commitment of the mayors of European cities to improve the energy efficiency in the urban environment. The Agreement of the Mayors aims to reduce cities' CO2 emissions by 20%.

The geographical location and the particularities of this Municipality described above make it especially vulnerable to the consequences of climate change. Wetlands,for instance, areat a very high risk not only due to their proximity to the coast but also due to the amount of concrete and impermeable surfaces in the urban center. Furthermore, large portions of agricultural land have been abandoned and are not productively used since the soil has been degraded due to the frequent and prolonged use of pesticides (Municipality of Castellón 2017). However, this situation has lead to a natural revegetation by various forest and herbs species (Municipality of Castellón 2017). Additionally, multiple irrigation canals have been closed or sealed and the water resources in general are not being managed in a sustainable way. For instance, less than 10% of the regenerated wastewater is currently being reused, although the existing treatment plant has the capacity to treat all the water collected there(Padilla 2018). Owing to these challenges, strategies are being developed for protecting the environment, increase the city greenery and improve the local ecosystem function such as the development of a green grid with protected zones around the urbanized areas, including wetlands and the coastal zone. However, even if there are multiple plans and documents addressing diverse subjects related to preserving the environment, the concept of nature-based solutions has still been historically absent (Marielisa Padilla 2018).

5 IDENTIFYING AND DESIGNING NBS INTERVENTIONS IN CASTELLÓN

Over the course of the week, 15 intervention zones in Castellón were identified as potential areas for the implementation of NBS. Some of the more relevant ones, including those which have started its successful implementation by January 2020, are presented below:

Creation of a green themed NBS corridor in Castellón:The main idea is to "extend" and re-design the planned implementation of bycicle lanes by using materials such as permable pavements and adding NBS elements such as shading trees and green walls. Further the lanesshould follow a specific 'theme' by connecting specific infrastructures such as sports facilities and museums. It was discussed that the intervention could be partly financed by the budget foreseen for the General Plan, although additional funding would need to be secured. Seven possible thematic corridors were identified: 1) Sports Corridor 2) Agricultural Park Corridor (ermitas) 3) Water Corridor 4) Maritime Corridor 5) Grau´s Civic Corridor 6) Cultural Corridor 6) Ceramic Corridor 7) The Chapel Corridor (ermitas).

Retention and management of rainwater: Building more natural water channels and floating gardens to store rainwater was identified as a key priority due to recurring flood risk. Since the city suffers from the phenomenon "the cold drop" or "la gotafria" in Spanish and also many houses and buildings around the wetlands were built below water level, representing a major risk of flooding for the inhabitants, better management of rainwater is a must when trying to increase the city's adaptability to climate change effects.

Promotion of the use of public and non-motorized transport while using NBS: Although the technologies related to this project are not NBS-specific, the overall concept of improving connectivity, increasing the green areas along roads and introducing non-polluting shared technologies and practices is coherent with NBS approaches in cities. Tree planting for creating shade and cooling the air but also transforming areas into more attractive and green ones was identified as a good way to promote non-motorized transport in Castellón. These initiatives can be also piloted in blocks designated as green islands in the city with pedestrian streets and good cycling infrastructure.

Apart from the above intervention areas, the following were co-created and identified for preparing the city to better face the challenges that come with a change of the climate:

- Reactivation, expansion and strengthening of the system of urban gardens
- Increased reuse of treated waste water for agricultural irrigation, irrigation of parks and street cleaning
- Creation of low emission zones in the urban area of Castellón

6 CANNES, THE INTERSECTION OF TECHNOLOGY, CULTURE AND CREATIVITY

Cannes is located at the Côte d'Azure in the Provence region. With about 75,000 inhabitants, it is a rather small city although the population more than triples during major summer events. Mostly known for the international film festival, the city has become an international hotspot for events, tourism and congresses, some of the largest economic drivers in the region. Further branches include the services, trade and aviation industry. Due to its high popularity and local vulnerability to natural hazards, the city has put huge efforts in risk prevention and management measures. Main risks include flooding caused by excessive rainfall, coastal submersion and flood wave andforest fires, as well as erosion and landslides. Especially, the severe flood event in October 2015 which caused several deaths and huge economic losses, lead to an increased awareness and interest in climate resilience and disaster management (Mairie de Cannes 2018).Cannes has also been very active in the fields of sustainable development and environment, introducing an Agenda 21 in 2008 with a concrete vision and action plan for becoming more sustainable and resilient. It thus uses the opportunity of the UNaLab project to harness the potential of NBS and further complement both, existing risk mitigation and sustainability schemes(Den Ouden et al. 2019; UNaLab).

7 IDENTIFYING AND DESIGNING NBS INTERVENTIONS IN CANNES

In the course of the on-site assessment in Cannes, 22 intervention areas and project ideas were developed, of which six were further elaborated and discussed in the final workshop. A selection of these is presented below:

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Development of a showcase district for NBS and green infrastructure:Currently, there is the plan of rehabilitating a former industrial area to become a mixed use urban district in which a new creative industry could settle and the first high-rise buildings of the city could be located. This was identified as a unique opportunity to pilot new ways of integrating more NBS in the planning process, making it a demonstration site for green infrastructure solutions. This could show the potential of directly incorporating NBS in urban planning and increase the attractiveness and diversity in Cannes by creating a blue-green park that runs through the district. It is hoped that the planned NBS interventionswill improve the local microclimate and contribute to the overall climate and water resilience of the city. Additional funding and political support were identified as the most important enablers for such an undertaking.

Protecting and enhancing closeby agricultural areas: La BasseVallée de la Siagne is the last remaining agricultural area close to the city. Located on a hill, it could serve as a retention area that protects the center from flooding during heavy rainfall events by capturing and absorbing rainwater runoff before it reaches the urbanized areas below. For this to function, adequate irrigation of crops and vegetation has to be ensured during the dry periods, which could be realized through the redirection and use of treated wastewater. Social cohesion, biodiversity, as well as preserving cultural identity and traditional agricultural practices were identified as possible co-benefits.

Redesigning public facilities to become green: Public facilities such as schoolyards, sporting fields, playgrounds, hospitals or parking areas could be redesigned to become small water retention areas in times of heavy rainfall. Greening and depaving these facilities could also result in a higher degree of outdoor comfort and create cooling spots during hot summer days, improving health and environmental awareness of the citizens. New design principles and criteria could enable the uptake of these ideas in upcoming renovations or new building projects.

Further ideas included:

- The piloting of new green roof concepts installed on industrial rooftops that are not traditionally tiled, which could survive the hot and dry summers and help to ensure a more widespread uptake in the future,
- Systematically introducing adapted and attractive green and blue components in renovation and rehabilitation projects in the city center and densely urbanized areas
- Or developing a pedagogical and user-friendly risk management software that could inform about NBS benefits and installations (Den Ouden et al. 2019).

8 RESULTS – NBS FOR INCREASING LIVABILITY AND RESULIENCE IN MEDITERRANEAN CITIES

The co-creative nature and method of the on-site assessments allowed for close stakeholder interactions on the topic of climate change adaptation and NBS in forms that had not being taken place in the two cities until then. As introduced above, the topic itself demanded the participation of representatives of the urban greening, water, energy, mobility, waste, building and many more departments with the local administrations, as well as the inclusion of private and civil society actors. This enabled the identification of synergies and the initiation of unprecedented collaborations and linkages, which enabled new projects and ideas.

Equally important was discoveringthe lack of this intersectoral cooperation (refer to table 1). This was exemplified during interviews when workers of the building department realized that elements such as green roofs, rainwater collection systems or the installation of solar panels were simply not considered in new construction or rehabilitation projects. This is regarded as a topic incumbent rather to the energy or water department. Therefore being able to connect all the different perspectives and having brainstorming sessions for the co-creation of multifaceted projects brought a whole new perspective in the way urban planning could be approached.

Given the climatic characteristics in both cities, a main focus in the on-site discussions was the efficient management and reuse of water. Whereas both cities usually experience a rather dry and hot weather which complicates urban greening (e.g. on rooftops and facades) and requires additional irrigation or the use of drought tolerant plants, large retention capacity is needed during the few days of the year where heavy

rainfalls occur. Locally adapted vegetation patterns, larger retention basins, as well as underground water storages and irrigation systems as supporting measures were thus issues of big interest. It was also stated that more technical know-how and training of technical and administrative staff could help improving successful project planning as well as implementation.

Both of thecity centers are perceived today as rather grey in the sense that most of the streets and public spaces have been paved using concrete; central squares and other important meeting points have been covered by artificial surfaces. This has been done in both cities, ignoring the effects on the water retention capacities of the soil, its permeability, temperature, biodiversity and the losses represented in terms of ecosystem services. This was not foreseen when these infrastructure projects were designed. Today, these Mediterranean cities are facing the consequences of the lack of green spaces, trees and permeable soils, among others. Thus it is seen as important that future refurbishments and building projects require the introduction of more green elements. In this sense it was discussed that the introduction of a locally adapted Technical Handbook on NBS could help build more knowledge around greening Mediterranean cities and reduce the threat of project failures.

	Cannes	**Castellón**
Green & Blue Infrastructure	-Dry valleys as special geological feature lead to high flood risk areas during heavy rainfalls -Focus and knowledge on native, pollinator-friendly and drought resistant species has to be strengthened -Protecting local habitats, especially the marine ecosystems, is very important	- Efforts to recover wetland areas -Low ecological connectivity between green areas -High availability of agricultural land to be restored -Closed irrigation ditches and canals Potential for better water management
Organisation & Structure	-Decision making power is rather centralized -Cross-departmental cooperation works well in existing sustainability or smart city related projects even if not formally institutionalized	-Openness to NBS in planned projects -Insufficient local administrative internal as well as external communication and exchange (with local utilities and service providers) -Limits of local government power
Municipal Strategy & Planning	-Long term vision and related action plan for a sustainable and resilient city and strategy on local flood risk management exist -Tools and criteria are missing to assess and influence building and construction projects	-Sustainability-oriented smart city strategy and priority projects -General structural plan with a strong sustainability perspective exists
Regulations & Incentives	-Building and zoning regulations pay special attention to flood risk and water retention capacity -Better regulation of public water use, soil quality and pollution could support NBS implementation and circular water structures -Centralised policy system makes it difficult for cities to issue incentives	-Lacking norms for NBS in the implementation of infrastructure projects -No incentives such as tax relief for green measures (e.g. roof greening and rainwater storage)
Finance & Procurement	-Additional funding for large scale projects and acquisition of strategically important land needed -National fund for risk mitigation activities exists which is sustained by insurance fees -Holistic cost-benefit analysis and new stakeholder engagement forms should be developed	-NBS projects and concepts can be included in infrastructure projects from the General Plan and EDUSI with allocated budget -The procurement processes allow the inclusion of "green" requirements and take sustainability criteria into account
Participation & Stakeholder Engagement	-Many sustainability and NBS related events exist -Active use of social media and other means of communication that could feature NBS and raise awareness on ecosystem services -Citizen involvement is seen as crucial means to gain political support	-Urban planning supported by a local group from the social and economic sectors. -Cooperation between the municipality and the private sector can be improved
ICT & Data Governance	-Open data strategy in place private companies are often hesitant to share relevant data due to privacy issues -Mapping of flooding zones and priority areas, as well as TIGRE risk management platform could be used to better plan NBS	-Developments with a focus on environmental quality, energy efficiency and waste management -A governance system is to be set up to monitor sustainability strategies
Inclusive Urban regeneration	-Redevelopment projects and provision of family gardens help to even out social disparity -Successful NBS implementation has led to rise in property prices	-Strategic objective of "social integration and poverty reduction" with a line of action to rehabilitate degraded urban areas. -Identification in EDUSI of 11 degraded areas suitable for strategic, green projects
Links to other sectors	-Biowaste composting is being enhanced and systematised in the coming years -Green cycling and walking infrastructure is being enhanced -Solar panels seen as opportunity to protect green roofs from intensive sunshine	-Potential conversion of the traditional transport infrastructure in the city center to green areas -Aim of improving public transport infrastructure and non-motorised mobility, e.g. via green spaces

Table 1: Local impact factors for Nature-based Solutions in the cities of Cannes and Castellón.

Due to their climate characteristics and geographical locations, both cities present ideal conditions for agriculture. However the growth of real estate, harmful agricultural practices, lack of appropriate policies,

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lack of enforcement, lack of financial incentives and challenges related to soil degradation and water shortageshave put some of these agricultural areas under threat or lead to their loss or abandonment. The result is a continuous decrease in green cover.Therefore efforts and thoughts have been put into revitalization and promotion of local agriculture, so that it can continue providing essential cultural, provisioning and regulating services in these cities, including soil recovery, economic competitiveness restoration, local food supply enhancement and water retention capacity (see table 1). In Castellón ideas were formed around reactivating the abandoned urban and peri urban agricultural areas “el Mestrets” whereas in Cannes supporting measures were discussed to protect and further develop the “BasseVallée de la Siagne.”

Viewed from the perspective of NBS and their intrinsic crosscutting character, the co-creation sessions focused in making clear the existing connections between the sectors and more importantly identifying the synergies that could be created. Since its beginning, the UNaLab project has been creating awareness around this topic; the onsite assessments in each of the cities were the optimal platform for the design of projects that help to fight climate change, revert some of the negative effects of urbanization and most importantly apply collaborative approaches.

The table presents further outcomes of the research work carried out regarding local key impact factors for the implementation of NBS in these two cities.

9 CONCLUSIONS AND OUTLOOK

The contrast between a usually hot and dry climate, and very concentrated, intense rainfall during a few days each year is a typical characteristic of and challenge to cities in the Mediterranean region. Forecasts predict these extremes to become even more distinct and cities to become even more vulnerable with ongoing climate change. This highlights the need for better adaptation strategies, especially in the areas of combating urban heat islands, water shortage and flood risks. Recently on the research and demonstration agenda, the concept of NBS presents a promising opportunity to use natural elements and processes to improve water and climate-related resilience, as well as to improve livability and socio-economic development in cities. Under the described climate conditions, similar technical challenges arise. A good management of local water resources, as well as the use of locally adapted plants, is key for successful implementation and final impact of such solutions.

Doubtlessly, NBS can be valuable tools in tackling climate change as they translate into a wide spectrum of interventions for renaturating and protecting ecosystems as well as generally increasing blue and green infrastructure in cities. However, for the standardization of NBS implemention, processes must be institutionalized, for example in requiring an NBS element in every refurbishment or new development project. Changes at the governance level are crucial, and modification of the right policies at different levels can help to guarantee the long term impact of the process that these administrations are enthusiastically participating in within Unalab.

Likewise, efforts around awareness-raising are key to spread the use of NBS. The more people understand the ecosystem services provided by these interventions, the more acceptance and initiatives can be born around this topic. Here, the need for marrying ecology and economy needs to be highlighted. For example, a project for planting trees or increasing green areas can have greater impact when combined with an economic benefit. For instance in the agricultural areas to be restored, increasing shade brings economic benefits in the form of increasing soil fertility, soil water retention ability, plant growth and erosion prevention, among others.

Furthermore, NBS are largely cross-cutting and interdisciplinary concepts which require good coordination and close collaboration between different municipal departments as well as external stakeholders. The on-site assessments in Cannes and Castellón have shown that by directly involving and bringing together relevant actors, local impact factors can be more easily identified, project synergies be discovered and resource efficiency increased. As a result, a colourful variety of projects were co-created, from the renaturation of abandoned agricultural areas to green roofs and urban gardens, thematic green corridors and water retention ponds which will transform the cities into more resilient and livable places for their citizens.

More research and the collection and exchange of different best-practice examples from this region will help to spread knowledge and accelerate the uptake and use of NBS as means to make future cities more resilient and livable. The UNaLab project aims to contribute to these developments by further conducting NBS

impact monitoring and assessing important preconditions and implementation principles. In addition, the project has the goal of developing and testing viable business models, supportive governance actions and co-creation tools, and feeding these into a joint replication framework that can be used by cities and practitioners alike.

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🏆 *reviewed paper*

Vibrant or Dull Urban Spaces: Are City of Tshwane "A Re Yeng" and "Gautrain" Connector Points Places of Social and Economic Interaction?

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1 ABSTRACT

Public transport infrastructure investments have been widely advocated for as catalysts for economic growth and development. They have also been regarded as pivots of functionality of economic nodes and communities. Thus, considerations of innovative strategies in investing in public transport infrastructure as contributors of socio-economic transformation through facilitating growth of business operations and creation of small-scale entrepreneurship has gained momentum. The common envisaged outcome of such innovative approaches is creation of vibrant urban centers and economic spaces characterized by a variety of social and economic activities. This paper investigated the impact of implementation of innovative urban public transport systems on business operations and formation of new small-scale businesses within the City of Tshwane. The study adopted mixed research approaches where qualitative and quantitative data were gathered concurrently. Field observations, key informant interviews, questionnaire administration were used for data collection. Subsequently, content data analysis was applied through the exploration of findings under various relevant themes of public transport infrastructure and business operations. Findings reveal limited improvement on business operations or formations, especially integration of previously disadvantaged communities and informal traders to the local economy. Even for few opportunities created, limited entrepreneurial skills, knowledge and expertise amongst people previously systematically excluded restrained them from taking advantage of such opportunities. Skewed focus on public transport infrastructure roll-out coupled with limited practical focus on socio-economic benefits as trickle-down effects was observed as another obstacle hindering creation of vibrant socio-economic spaces through public transport infrastructure investments. This work recommends the creation of activity nodes for social and economic interactions at connector points to the benefit of local economy and residents. To complement such, human capacity development and entrepreneurial skills development amongst the previously disadvantaged group is advocated for in to attain socio-economic transformation.

Keywords: Place Making, Public Transport Infrastructure, Activity Nodes, Business Operations, Vibrant Communities

2 INTRODUCTION

Sustainable public transport infrastructure investments are characterised by applied analytical methods to optimize an efficient transport network with improved consumer experience and accelerated economic growth and development (Divall & Hine, 2017). Undoubtable, Integration forms the core of public transport infrastructure investments as it constitutes an organizational process through which the planning and delivery of elements of the transport system are brought together, across modes, sectors, operators and institutions, with the aim of increasing net social benefits (Preston, 2012). In the same vein, Boschetti, Maurizi, and Cré (2014) also notes that through innovative urban public transport systems with strong focus on integration, cities will become hotbeds for innovation, where trade, tourism, commerce, services and education will be improved and prosper. Notably, cities with well-coordinated integrated transport systems are most likely to have an improved Gross Domestic Product (GDP) accompanied by higher levels of productivity (Graham & Niekerk, 2014). In contrast, the apartheid/colonial inherited, fragmented spatial form in developing countries is such that infrastructure investments should redress past spatial imbalances while creating vibrant socio-economic space(s) for social and economic interaction. Cervero (2001) observes that land use patterns of a city or town also influence the travel pattern transport network for socio-economic activities of people and overall economic functionality of cities. Thus, public transport infrastructure investments should find the right balances of all segments of the physical infrastructure, and socio-economic transformation.

Since the dawn of democracy in 1994, South Africa has prioritized socio-economic transformation through numerous policy pronunciations and public transport infrastructure investments which have been centred on

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reducing unemployment, poverty alleviation and bridging the inequality gap (Gumede, 2013). Nonetheless, Cilliers and Camp (2013) observe that South African government continues to produce policy instruments that are good on paper but does not positively impact on people's lives hence continued challenges inequality, unemployment and poverty.

Lessons from the City of Linz in Austria suggest that an integrated approach to public transport systems and socio-economic transformation creates hotbeds for innovations, where stations or connector points can be designed as places of social and economic interaction (Klementschitz & Stark, 2009). Thus, mechanisms must be developed to ensure that public transport infrastructure investments factor in the value of social, economic and environmental aspects of development focusing on realistic solutions to community problems. The paper starts by briefly discussing literature review, followed by research objective(s) and the methodology followed. The paper then discusses study findings and conclude by providing discussion, concluding remarks and recommendations.

2.1 Scope of the paper

This paper investigates prospects of designing stations/connector points as activity nodes for socio-economic transformation as part of public transport infrastructure investments. Pretoria Central (Bosman) and Hatfield Innovative urban public transport systems (Gautrain and A Re Yeng) main connector points within the City of Tshwane were used as focus areas. It deliberates on the significance of public transport infrastructure investments in strengthen local economies and enhancing socio-economic transformation. The role of Transit-Orientated Development (TOD) in place-making and socio-economic transformation is the golden thread and focal point of discussion throughout the paper. The extent to which the previously disadvantaged and urban poor benefited economically from public transport infrastructure investments becamme essential in determining the effectiveness of such investments. The paper advocates for designing stations/connector points as activity nodes for social and economic prosperity.

3 LITERATURE REVIEW

Transit-Orientated Development (TOD) as a core component of infrastructure development for smart growth and compact cities plays an integral role in shaping urban form (Todes, 2012). In the same vein, Situma, (2002) observes that TOD contributes in shaping better spatial forms to create vibrant economic spaces through creation of activity nodes along public transport corridors and main intersections making public transport investments responsive to socio-economic disparities facing developing countries. Furthermore, Litman (2017) argues that Public Transport Infrastructure investments should look beyond the dynamics of a well-coordinated transport system. Effectively, connector points or stations can be used as pivots for socio-economic innovation and prosperity through designing them as hubs, where small-scale entrepreneurs and informal traders can prosper and contribute to the local economy. According to Pojani and Stead (2015), well-coordinated and comprehensive public transport systems can still be disintegrated if it neglects social, economic and environmental considerations. Thus, innovative approaches must be sought to improve the state of public transport infrastructure for spatial integration and socio-economic transformation. In South Africa, such initiatives have been commissioned through national government led Integrated Rapid Public Transport Networks initiative which saw the introduction of the Gautrain and Bus Rapid Transit (Van Ryneveld, 2008). However, Mashiri, Mokonyama, Mpondo, Jakhwizara and Mdunge (2014) observe that despite massive investments, poor planning has meant insignificant changes in traffic congestion, conflicting vehicle-pedestrian movements, uncoordinated small-scale freight vehicles and parking shortages.

3.1 Spatial form effects on socio-economic vibrancy

Spatial structures and forms inherited from the apartheid planning system have hindered and frustrated social-economic transformation in most parts of South Africa (Turok, 2013). The defining feature has been the notion that issues of economic disparities and labour market polarization persist and coexist, with the previously disadvantaged being continuously marginalized. Many discussions are taking place around spatial restructuring of public transport to support the economy (Cervero, 2013). More so since fragmented spatial form is central to prevailing socio-economic challenges. Hence the renewed call for redressing the past spatial imbalances through Transit Orientated Development (Chakwizira & Mashiri, 2009). Low income earners who reside in isolated townships are the most affected by the fragmented spatial form, hence some

become discouraged job seekers or give up their jobs due to spending most of their income on transport before they can take care of other basic household needs. Travel costs and a lack of access to economic opportunities have been the predominant challenges where the urban poor spend more than a third of their income on transport (Roux, Mfinanga, & Del Mistro, 2012). They use more than one mode of transport (pay multiple fares) for one trip which perpetuates poverty and inequality due to lack of modal integration with single travel fare per trip instead of paying at each interchange (Franklin (2014). Integrating residential areas and economic nodes through a single multi-modal public transport network can ensure affordability, thus enabling people to effecively participate in the economy thereby making spatial integration a focal part of socio-economic transformation.

3.2 Spatial injustices and socio-economic disparities

Social and economic transformation has undoubtedly been the core of South Africa's post-apartheid economic growth and development agenda (Patel, Freeman & Mitchell, 2001). Pre-1994, the South African economy used to be that of a polarised labour market, where benefits of most skilled jobs were accessible mainly by the minority or whites, and the native people occupied the low-income jobs in the unskilled or semi-skilled labour market (Triegaardt, 2006). Income disparities reflect historical imbalances with a racial and geographic footprint, hence post-1994 policy interventions being aimed at spatial and socio-economic transformation. Skills shortages, limited training and experience has been observed as central to urban poor's inability of to be absorbed to the middle and high-income jobs (Adelzadeh, Alvillar & Mather, 2001). Questions have been raised as to whether the state has created a dependency culture, where people are solely dependent on government to provide for their needs. Evidently, there has been minimal impact of the transformation strategies on spatial integration, socio-economic transformation and land reform, despite having proliferation of micro-financing and institutional transformation (Musakwa & Gumbo, 2017). In public dialogues and service delivery protests, socio-economic disparities have been the focal point of the discussion where inclusiveness of government policy initiatives have been questioned. The defining feature agreed upon in all these dialogues has been the notion that socio-economic disparities and labour market polarization persist and coexist leading to informal trading becoming the most viable source of income for the urban poor and previously disadvantaged (Srinivas, 2016). Mechanisms must be developed to accommodate informal traders to trade legally on properly designed station precincts in keeping with the aesthetic and spatial form of urban nodes where the stations are located.

4 OBJECTIVES /RESEARCH QUESTIONS

Since the dawn of democracy, South African metropolitan cities like Tshwane, Cape Town and Johannesburg have witnessed massive public transport infrastructure investments, (Tsikai, 2016). While public transport infrastructure is advocated for as the backbone of economic development (Cromhout, 2016), public transport infrastructure investments witnessed in the City of Tshwane ability contribute to creation of vibrant urban spaces for social and economic interaction leaves much to be desired. The main objective was to determine whether main stations are designed as innovative hubs for socio-economic vibrancy when implementing innovative urban public transport systems. The main reference point was whether or not an enabling environment is created for small-scale entrepreneurs to thrive while enhancing social upligtment. This paper investigated the core components that influence business growth that can be incorporated into design guidelines for designing stations precints/connector points as activity nodes for a variety of social and economic activities.

5 APPROACH AND METHODOLOGY

The study followed mixed approach by combining components of qualitative and quantitative approaches in data collection, analysis and interpretation. Field observations (including informal discussions with the people who are directly or indirectly involved in activities within main nodes or stations), key informant interviews (20 semi-structured interviews), questionnaire administration (100 questionnaires) were used instruments for data collection. Subsequently, an inductive approach to data analysis was followed through exploring findings under various relevant themes of public transport infrastructure and business operations. The questionnaires were structured according to themes that were aimed at determining factors that influence socio-economic interaction and business growth for small-scale entrepreneurs in urban or public transport nodes. The field observations and key informant interviews with officials working directly with public

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transport infrastructure investments were used to broaden the researcher's perspective on the main subject and ensure appropriateness analysis, interpenetrations, conclusions and recommendations. From this premise, the researcher could assess and determine socio-economic vibrancy of station precincts. The SPSS statistical software was then used to capture data collected through administering of questionnaires to small-scale entrepreneurs and local residents with the aim of identifying core components that influence business growth using the Chi-Square test by way of assessing significance levels of various factors.

6 RESEARCH ANALYSIS & FINDINGS / RESULTS

It is evident that the apartheid inherited fragmented spatial form can no longer be reversed. Rather, mechanisms should be put in place to mitigate the situation, especially for the urban poor who find themselves located far from socio-economic opportunities and without adequate sources of income to sustain their livelihoods. Densification along public transport corridors as already envisaged by the City of Tshwane is essential in ensuring that congested townships are freed from overcrowding with more housing opportunities available closer to economic opportunities. This will also help mitigate heavy traffic congestion between townships and economic opportunities. Nonetheless, accommodating the urban poor in housing options that may be created is a challenge, with property developers concerned about their investment returns if they support the municipal corridor densification strategy. Findings suggest limited improvement in business growth, especially in the integration of previously disadvantaged communities and informal traders to the local economy. Skewed focus on the public transport infrastructure rollout coupled with limited practical focus on socio-economic benefits as trickle down effects was observed as another obstacle hindering the creation of vibrant socio-economic spaces through public transport infrastructure investments. Missed opportunities were observed, especially when it comes to accommodating the informal economy and small-scale entrepreneurs. The need to design main stations as activity nodes that encourage a variety of economic and social activities was identified as an area of improvement. Though limited in quantity, economic activities around the Pretoria Central precinct confirmed that this is indeed an area that needs to be explored further, while missed opportunities were note in the Hatfield economic node.

6.1 Socio-Economic Transformation through Business Growth and Operations Improvements

The state of business operations is essential to socio-economic transformation, as it provides a platform for small-scale entrepreneurs to thrive and for employment creation. The informal economy is often-in the policy formulation, yet it supports most families of the urban poor or previously disadvantaged communities (Brown & McGranahan, 2016). Evidently, too little if anything has been done at planning and strategy formulation phase to ensure that implementation of innovative urban public transport systems goes beyond improving urban mobility to create an enabling environment for small-scale businesses to grow to boost the local economy. The Municipal regional spatial development frameworks focus mainly on densification, with no emphasis on creation of activity nodes on major intersections along densification corridors which will enable small-scale entrepreneurship growth and employment creation. Where there is minimal improvement in business operations and lack of opportunities for upcoming entrepreneurs, poverty, unemployment and inequality will continue to rise with more people trapped in poor living conditions. The study findings suggest that there are limited improvements on business operations which can be attributed to public transport infrastructure investments. The informal economy is evidently neglected, as it is one of the segments which has hardly benefited from the implementation of innovative urban public transport systems.

6.1.1 The state of business operations around the Pretoria (Bosman) Central Stations

The observations made during primary data collection suggest that there is a potential to accomodate small-scale businesses with station precincts. Figure 1 below provides an overview of the business operations in Pretoria central for both the A Re Yeng and Gautrain stations. The significant aspect in the Gautrain station is the presence of established businesses and small-scale entrepreneurs (though very limited). The top-left corner shows the small-scale entrepreneur kiosk or mini-shop providing perishable goods typical of those provided by informal traders. The structure and physical appearance of this container is in keeping with the aesthetic value around the Bosman Station and not in conflict with an established coffee shop as seen in the top-right corner. Such can be explored further to create vibrant socio-economic space(s) through designing station precincts as activity (mixed-use) nodes characterised by a variety of social-economic activities similary to light railway stations in the City of Linz, Austria.

Figure 1: Spatial form around Gautrain and A Re Yeng stations in Pretoria central (Source: Author's illustration based on field observations during primary data collection)

The opportunity presented by the high concentration of various public transport related activities in one node cannot be over-emphasized. A variety of public transport modes concentrated in one location presents an opportunity for the creation of a mixed-zone activity node which accommodates small-scale entrepreneurs and established businesses, given different services they provide to commuters and people working or living in the area. The city should consider such initiatives in the form of a precinct plan linking Bosman station with the City Centre, where there is also the Church Square main station for the Tshwane Bus Service also near the A Re Yeng Station. Activities of small-scale entrepreneurs are evident, but with proper planning this can be transformed to a vibrant activity node for small businesses and social upliftment. The amount of space evidently available as seen in the bottom left corner picture, there is a potential to create more opportunities to accommodate small-scale entrepreneurs (including informal traders) without negatively affecting the aesthetic value of the station precinct. Furthemore, a need for skills development to enable previously disadvantaged people to take full advantage of opportunities created was identified.

6.1.2 Missed opportunities in the Hatfield stations nodes

Unlike the Bosman station in Pretoria Central, there is not even a single shop in the precinct of the A Re Yeng and Gautrain stations in Hatfield, as ample vacant space is vissible on figure 2 below. This presents an opportunity to create an activity node. The picture on the top-left corner depicts the A Re Yeng Station, with the Gautrain bus stations nearby. The picture on the bottom right corner depicts Gautrain station taken from the same location as the one on the top left corner which clearly illustrates the proximity of the Gautrain and A Re Yeng Stations. Considering prospects observed in the Pretoria Central Stations in the context of socio-economic hubs created in the City of Linz light rail stations, the ample space available within the Hatfield station precinct represents a missed opportunity for a vibrant socio-economic node where small-scale entrepreneurs can trade and provide services to commuters and people living or working in the area. Structures of aesthetic value like the one in Bosman/Pretoria Station on figure1 above could be ideal to accommodate informal traders in the Hatfield The A Re Yeng and Gautrain stations are closer to each other in Hatfield than it is the case in Bosman (Pretoria Central). Though aspects of informal trading are not fully evident in the Bosman Gautrain station, at least glimpse of it is visible with a precedent for a potential future expansion. This is hardly the case at the Hatfield station as there is ample space which is underutilized and could be used for a mixed-use zone or platform to create a vinbrant, innovative socio-economic hub for small scale business opportunities. Such considerations can be made when implementating innovative urban

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public transport systems. This will translate into integrated efforts for socio-economic transformation and innovative urban public transport planning systems implementation.

node.

Figure 2: Spatial form around Gautrain and A Re Yeng stations in Hatfield (Source: Author’s illustration based on field observations)

6.2 Components Promoting Business Growth

The study findings reveal that there is minimal improvement in business operations and limited opportunities for upcoming entrepreneurs through the introduction of innovative urban public transport systems. This emphasises the need to strengthen the local economy through designing station precincts as activity nodes or vibrant socio-economic urban spaces and social upliftment. The case of the City of Linz in Austria, suggest that stations for innovative urban public transport systems can be designed as activity nodes for economic and social activities (Vougioukas, Sammer, Monzon, Evans, Ambrosino, 2008). While conducting key informant interviews, it became evident that there is a limited effort to design stations as activity nodes to act as hotbeds for socio-economic transformation. Rather more focus is given to densification along the A Re Yeng (BRT) corridors. This can be considered as an area of improvement to ensure that public transport infrastructure investments go beyond improving mobility and connectivity and becomes a catalyst for socio-economic transformation. To attain socio-economic transformation, an enabling environment for growth of small-scale entrepreneurship and employment creation should be created as part of public transport infrastructure investments. Place-making through designing stations as vibrant socio-economic hubs is essential to create an enabling environment for small-scale entrepreneurs is essential. This will help counter the challenges of poverty, unemployment and inequality while also promoting social cohesion with such vibrant socio-economic spaces.

Despite no signs of small-scale economic activities at the Hatfield economic node stations, there were economic activities noted at Pretoria Central economic node station, though limited. Consistent with lessons drawn from the City of Linz it was essential to identify Principal Factors as areas of consideration when designing activity nodes in and around public transport precincts and take advantage of missed opportunities in the evidently dull urban spaces. Such Principal Factors were identified by way of examining similarities and patterns through Chi square test for relational analysis between public transport infrastructure and business growth (small-scale entrepreneurship and informal economy) towards vibrant economic spaces and social upliftment. The following Principal Factors were identified using SPSS statistical software:

- Proximity to Public Transport nodes or Intersections
- Business Location

- Easy Access

Figure 3 below illustrates the interdependent nature of the identified Principal Factors, which suggest that to design station precincts as vibrant spaces for social and economic interaction, proximity public transport nodes, business location and accessibility of small businesses within the station precincts are should collectively form the core of design guidelines given their prominent significance.

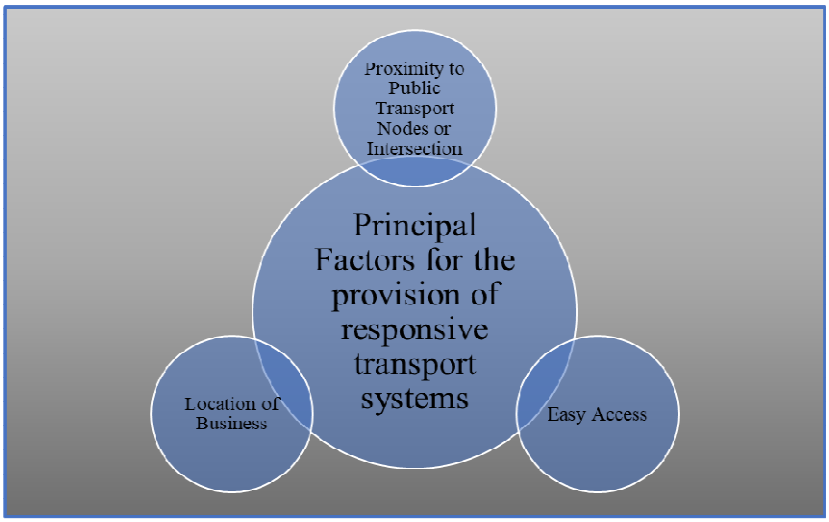

Figure 3: Principal Components for transformative public transport systems (Sources: Author's illustration)

As illustrated in figure 3 above, proximity to public transport nodes is directly linked to creating an enabling environment where small scale entrepreneurs are strategically positioned at the convenience of commuters who might be travelling for different reasons but need products or services provided by small-scale entrepreneurs within public transport station precincts. Proximity is directly linked location and easy access as public transport nodes are a strategic business location where customers can have easy access to economic opportunities, thereby reducing number of trips travelled by commuters to obtain essential household needs and services. Undoubtable, proximity to public transport nodes and intersection, strategic business location and easy access are collectively essential for innovations within public transport infrastructure investments.

6.2.1 Proximity

To determine the significance of business proximity to public transport nodes or intersection, the P-value of 0.05 was used as the significance level. The null hypothesis was that there is no relationship between business growth and proximity to public transport nodes or corridors and the alternative hypothesis being that there is a relationship between proximity to public transport corridors and business growth. For a significance level, less than or equals to 0.05, the null hypothesis was rejected in favour of the alternative hypothesis (Table 1).

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	12.403[a]	1	.000		
Continuity Correction	10.601	1	.001		
Likelihood Ratio	11.504	1	.001		
Fisher's Exact Test				.001	.001
Linear-by-Linear Association	12.279	1	.000		
N of Valid Cases	100				
a. 0 cells (0%) have expected count less than 5. The minimum expected count is 6, 38.					
b. Computed only for a 2x2 table					

Table 1: Significance level of Proximity to Public Transport nodes or Intersection; Source: Author's SPSS analysis using Hypothesis Testing (P-value approach)

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As depicted in table 1 above, the P-value highlighted in green is less than 0.05 which suggest that there is a strong relationship between business growth and proximity to public transport infrastructure nodes. Thus, designing public transport nodes as hotbeds for socio-economic transformation through an integrated approach to public transport infrastructure investments and local economic development is essential to promote small-scale entrepreneurship and social upliftment. Innovations should incorporate proximity to public transport nodes as a core principle for designing vibrant socio-economic spaces.

6.2.2 Location

As already alluded that business location is directly linked to proximity to public transport nodes, to determine the significance of business location in relation to the proximity to high concentration of business activities and clients, the P-value of 0.05 was also used as the significance level. The null hypothesis was that there is no relationship between preferred business location and proximity to the market or clients and the alternative hypothesis being that there is a relationship between preferred business location and proximity to clients or market. For the significance level less than or equals to 0.05, the null hypothesis was rejected in favour of the alternative hypothesis (Table 2).

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8.101[a]	1	.004		
Continuity Correction	6.915	1	.009		
Likelihood Ratio	8.389	1	.004		
Fisher's Exact Test				.005	.004
Linear-by-Linear Association	8.020	1	.005		
N of Valid Cases	100				
a. 0 cells (0%) have expected count less than 5. The minimum expected count is 14, 57.					
b. Computed only for a 2x2 table					

Table 2: Significance level of Business Location; Source: Author's SPSS analysis using Hypothesis Testing (P-value approach)

Table 2 above depicts that the significance level is exactly 0.005 which affirms that the null hypothesis must be rejected in favour of the alternative hypothesis that proximity to clients or market is significant in identifying business location. This suggest that all business that have potential to thrive within public transport infrastructure precincts should be accommodated through a public transport station precinct plan.

6.2.3 Access

The significance of easy access to a business establishment in relation to the concentration of businesses within public transport nodes, where people can have easy access to business establishment through public transport was determined using P-value of significance level of 0.05. The null hypothesis was that there is no relationship between business accessibility and public transport station precincts, while the alternative hypothesis was that there is a relationship between business accessibility and public transport infrastructure ability to provide access. For the significance level, less than or equals to 0.05, the null hypothesis was rejected in favour of the alternative hypothesis.

Table 3 depicts that the significance level is exactly 0.007 which clearly depicts that businesses, especially small business will grow and have more clientele if they are easily accessible through public transport. The overall indication is that there is a close relationship between access through public transport and business growth to the benefit of the local community within a city or town. Accordingly, small business establishments should be easily accessible through public transport to enhance trade and socio-economic vibrancy.

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.700[a]	1	.006		
Continuity Correction	6.500	1	.011		
Likelihood Ratio	8.349	1	.004		
Fisher's Exact Test				.007	.004
Linear-by-Linear Association	7.623	1	.006		
N of Valid Cases	100				

a. 0 cells (0%) have expected count less than 5. The minimum expected count is 11, 16.

b. Computed only for a 2x2 table

Table 3: Significance level of Easy Access; Source: Author's SPSS analysis using Hypothesis Testing (P-value approach)

7 RESEARCH CONTRIBUTION

The paper advocates for inclusive Place Making and Socio-Economic Sustainability as one of the core principles of public transport infrastructure investments where connector points within a multi-modal public transport network are used as innovation hubs for business growth and socio-economic transformation. The paper calls for collective strategy formulation in Transit Orientated Development by moving beyond evidently, skewed focus on public transport infrastructure rollout. Place making through designing connector points as vibrant socio-economic spaces complemented by human capacity development (necessary entrepreneurial skills, knowledge and expertise) for previously disadvantaged communities were identified as interdepended components to enhance socio-economic transformation as trickle-down effects of public transport infrastructure investments.

8 RESEARCH LIMITATIONS

The study focused mainly on innovative public transport systems in form of Gautrain and A Re Yeng BRT systems which are receiving most of the government funding for public transport infrastructure under the IRTPN initiative within the City of Tshwane area of jursidiction. As such, other mode of public transport like mini-bus taxis, Metrorail trains and various bus services were not investigated as part of the primary data collection to get a holistic picture of public transport network in the City of Tshwane. Nonetheless, to a large extent, this study tried to obtain respondents views on other modes of public transport in comparisons to innovative urban public. The need for a holistic integrated public transport systems where all public transport service providers work together towards a common goal was then identified in the process.

9 DISCUSSIONS AND CONCLUDING REMARKS

There are limited innovations for socio-economic prosperity in the design of stations and main intersections, hence dull urban spaces due to skewed focus on public transport infrastructure rollout, coupled with limited practical focus on socio-economic benefits as trickle down effects. This was observed as the main obstacle hindering creation of vibrant socio-economic spaces as part of public transport infrastructure investments. The often overlooked component of designing stations (connecter points) as vibrant socio-economic spaces for the benefit of small-scale entrepreneurs was apparent. Findings reveal limited improvement on business operations or formations, especially integration of small-scale entrepreneurs from previously disadvantaged communities and informal traders. Even for the few opportunities created, limited entrepreneurial skills, knowledge and expertise amongst people previously disadvantaged lead to them being systematically excluded from taking advantage of opportunities created.

Most people who continue to be marginalised and are subjected to poverty and poor living conditions are also characterized by low literacy skills and limited tertiary education. Negative self-esteem remains a major obstacle that needs to be overcomed to enable people to take full advantage of opportunities being created. The youth form township families also lack the zeal for education and skills development. Notably, self-determination is lacking amongst previously disadvantaged communities and rather a dependency culture and lack of skills development deepens socio-economic disparities. The need for human rehabilitation to

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enable people to become small-scale entrepreneurs concurrent with creation of opportunities as part of public transport infrastructure investments is evident. Thus, investment in human capacity development and skills development should form an integral part of socio-economic transformation policy interventions. In line with other democratic dispensation policy documents, the National Development Plan, Vision 2030, skills development is an essential area of intervention for socio-economic transformation and redressing past imbalances manifesting in the polarised business sector and labour market. Evidently, there is a need to create an enabling environment for small-scale entrepreneurs to thrive. The previously disadvantaged can be trained for possible Small, Medium and Micro-sized Enterprises (SMMEs) opportunities (trickle-down effects) from public transport infrastructure investments.

9.1 Designing connector points as activity nodes for social and economic vibrancy

This work recommends the creation of activity nodes through designing of connector points as vibrant urban spaces for social and economic interactions to the benefit of the local economy and residents. To complement such, human capacity development and entrepreneurial skills development amongst the previously disadvantaged group should be factored in to enable people to take full advantage of opportunities created. Other than government tender business opportunities, small-scale formal and informal businesses can be encouraged by creation of activity nodes for economic and social activities as part of public transport infrastructure investments. If stations do not incorporate small scale business opportunities, they become dull places with missed opportunities that could have strengthened the local economy.

Government, in collaboration with other stakeholders, should invest in human capacity development to ensure that people take advantage of opportunities created. Government must also see to it that already established businesses mentor small businesses through mandatory skills transfer programmes on government tender projects. There can be a service level agreement that each beneficiary of the government tender incorporates a skills transfer component to mentor and actively involve one or two upcoming entrepreneurs from previously disadvantaged communities. This will ensure that upcoming entrepreneurs acquire credible experience, making them eligible to properly tender for future projects.

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🏆 *reviewed paper*

Vom Konzept zur Tat – die Weiterentwicklung des Smart-City-Wheels zur Smart-City-Onion

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1 ABSTRACT

Die Digitalisierung ist in Städten und Regionen immer wahrnehmbarer, so dass sie für eine nachhaltige Stadt- und Regionalentwicklung eingesetzt werden kann (Engelke et. al. 2019). Das „Smart City Wheel“ und das „Happy Cities Hexagon“ des Klima- und Stadtstrategen Boyd Cohen zeigen dabei Herangehensweisen, wie Regionen zukunftsgerichtet und smart werden können und welche Themenbereiche dafür essentiell sind (Cohen). Das Sechseck fokussiert sich auf die Bewohnerinnen und Bewohner der Region und illustriert, was Bürgerinnen und Bürger einer Stadt glücklich und zufrieden macht. Das Wheel hingegen symbolisiert einen gesamthaften Zugang mit allen Hauptkomponenten und Sektoren. Mithilfe des Smart City Wheels können Gemeinden und deren Verwaltungen systematisch und transparent erörtern, welche Möglichkeiten vorhanden sind, um die Gemeinde smarter, intelligenter und damit zukunftsfähiger zu machen. Gleichzeitig bietet das Wheel als Prüfinstrument die Möglichkeit, die „Smartheit“ der Stadt zu beleuchten und mit anderen Städten zu vergleichen, wie dies beispielsweise der jährlich erscheinende Smart City Index zeigt.

Die Umsetzung von Smart City Strategien in der Realität anhand des Smart City Wheels findet mehrheitlich in einer breiten Akteurskonstellation und prozessorientiert statt. Ziele, Produkte und Ressourcen werden nicht zu Beginn starr definiert, sondern im Laufe des Planungs- und Umsetzungsprozesses agil eingesetzt. Diese Vorgehensweise widerspricht allerdings vielfach der Herangehensweise von Gemeinden, die vorab eine plan- und budgetierbare Herangehensweise wählen. Dies wiederum schränkt die bei der Entwicklung von Smart Cities notwendige Agilität und Anpassungsfähigkeit der Gemeinden ein.

Diese Lücke vom Konzept zur Tat soll mit der Smart City Onion geschlossen werden. Das Vorgehensmodell der Smart City Onion soll die beiden Ansätze, agil projektbezogenes und planbar konzeptionelles Vorgehen mit ganzheitlichem Anspruch, verbinden. Vom pragmatischen Einstieg über einzelne Projekte bis hin zur Anpassung bestehender Steuerungsmechanismen führt das Modell durch die wachsende Komplexität.

Die Erarbeitung der Smart City Onion stützt sich auf den Forschungsschwerpunkt „Digitalisierung und Raum“ an der HSR Hochschule für Technik Rapperswil. Insbesondere stützt sie sich auf eine breit angelegte Delphi-Studie der Schweizer Raum-, Verkehrs- und Landschaftsplanung (Engelke et. al. 2019) im Rahmen des Forschungsprojekts NUDIG – Nutzung der Digitalisierung für eine nachhaltige Landschafts- und Raumentwicklung“ sowie die IBH-Plattform „Gewerbegebiete 4.0“ (Conrad, Engelke, Schlatter, Zwicker-Schwarm 2019).

Dieser Beitrag zielt darauf ab, die Entwicklung und die Komponenten der Smart City Onion zu beschreiben und einen Ausblick auf die Anwendbarkeit in den Reallaboren zu werfen.

Keywords: Vorgehensmodell, Smart City, Digitalisierung, Smart City Wheel, Smart City Onion

2 DIGITALISIERUNG UND GEMEINDEENTWICKLUNG

2.1 Digitalisierung und Auswirkungen auf den Raum

Digitalisierung und Vernetzung beeinflussen unsere Städte und Regionen immer mehr, wodurch Methoden und Prozesse nötig sind um auf diesen Trend zu reagieren. Die Auswirkungen der Digitalisierung auf den Raum sind unübersehbar. Sie sind in Kombination mit anderen Megatrends wie Globalisierung, Individualisierung und Demografie zu betrachten und betreffen fast alle gesellschaftlichen und wirtschaftlichen Bereiche (Rat für Raumordnung 2019).

Kaum eine Gemeinde beschäftigt sich nicht mit Smart City Themen oder Digitalisierung. Die strategische und integrierte Auseinandersetzung mit digitalen Transformationsprozessen ist allerdings eher noch die Ausnahme als die Regel. Chancen und Risiken, die durch den digitalen Wandel entstehen, lösen vor allem in kleinen und mittleren Gemeinden und Planungsorganen Unsicherheiten aus (Roland Berger 2019). Insbesondere die Auswirkungen auf städtische Infrastrukturen, bauliche Elemente und öffentliche Räume

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sind bislang kaum erforscht und schwer einschätzbar. Wenige Ausnahmen, die sich bereits mit der veränderten Stadtstruktur durch Digitalisierung beschäftigt haben, gehen beispielsweise von der Entwicklung sogenannter Mobilitätshubs aus. So resümiert Heinrichs etwa: „Als sichtbare Veränderung der Stadtstruktur durch ein Verkehrssystem mit Elementen des automatisierten Fahrens wird in verschiedenen Szenarien die Entstehung sogenannter Mobilitätshubs oder -knoten beschrieben […], wo eine Bündelung unterschiedlicher Mobilitätsangebote auch von einer Änderung sonstiger Nutzungen ausgeht." (Heinrichs 2015). Mit welchen anderen Auswirkungen der Raum konfrontiert wird, ist Gegenstand aktueller Forschungen.

Die Diskussion in Forschung und Praxis zeigt, dass sich Städte und Regionen durch die neuen Technologien verändern werden. Die Antworten, wie und wann Gemeinden und Verwaltungen darauf reagieren, werden unter dem Schlagwort „Smart City" subsumiert.

Im Zuge der Bearbeitung des Forschungsprojekts „NUDIG – Nutzen der Digitalisierung für eine nachhaltige Landschafts- und Raumentwicklung" an der HSR Hochschule für Technik Rapperswil ist die Planungslücke identifiziert worden, die mithilfe eines neuartigen Smart City Modells geschlossen werden soll.

2.2 Resultate aus Forschungsprojekt NUDIG

Das Forschungsprojekt „NUDIG – Nutzen der Digitalisierung für eine nachhaltige Landschafts- und Raumentwicklung" an der HSR Hochschule für Technik Rapperswil (CH) erforscht den Nutzen der Digitalisierung für eine nachhaltige Landschafts- und Raumentwicklung. Ziel ist es, folgende Frage zu beantworten: Wie kann es die Digitalisierung ermöglichen, dass sich Siedlungsgebiete, Verkehr und Landschaft nachhaltiger entwickeln und zielgerichteter aufeinander abgestimmt werden?

Diese und wichtige andere Fragestellungen in Bezug auf Digitalisierung in den Schwerpunkten Raumentwicklung, Mobilität und Verkehr sowie Landschaft und Freiraum wurden ausgewählten Expertinnen und Experten aus diesen drei Fachdisziplinen gestellt.

Das zentrale Ergebnis der Umfrage ist, dass sich die Fachdisziplinen der Digitalisierung nicht verweigern können und die Raumnutzungen und die Wahrnehmung von Raum beeinflusst und verändert werden. Die Digitalisierung eröffnet für alle Raumkategorien Potenziale für eine nachhaltige Entwicklung. Sie wird sich aber nicht in allen gleich auswirken. Vor allem für die ländlichen Räume sind die Auswirkungen am wenigsten deutlich absehbar. Für die Agglomerationen lassen sich die Chancen bereits klarer benennen. Zu nennen sind beispielsweise in der Mobilität die Steigerung der Verkehrssicherheit, die Reduzierung der Umweltbelastung und eine effizientere Abwicklung des Verkehrs. Im Bereich der Landnutzung wird eine nachhaltigere Landwirtschaft, gezielte Lenkung und Information von Naherholenden sowie eine flächeneffiziente Raumnutzung oder die Umgestaltung der öffentlichen Räume ermöglicht.

Aus den Ergebnissen der breit angelegten Delphi-Umfrage konnten anschliessend konkrete Handlungsansätze und Stossrichtung abgeleitet werden:

2.2.1 Potenziale erschliessen

Potenziale der Digitalisierung lassen sich durch die Durchführung kleiner, kurzfristig zu realisierender Projekte erschliessen. Reallabore bieten hier den Rahmen, um solche Projekte zu verwirklichen.

2.2.2 Steuerungsbedarf ausschöpfen

Durch die neuen Technologien werden sich die Räume selbst und deren Steuerung an neue Anforderungen anpassen müssen. Eine Flexibilisierung der bestehenden, flächenbezogenen Planungsinstrumente oder auch eine Ergänzung um eine auswirkungsbezogene Steuerung ist die Folge.

2.2.3 Daten nutzen

Daten spielen in der räumlichen Planung eine immer grössere Rolle. Um mittelfristig nicht die Handlungsfähigkeit zu verlieren, ist eine räumliche Datenpolitik aufzubauen, um das Wissen über den Raum zu behalten.

2.3 Entwicklung der Smart City Onion

Smart City ist ein Begriff, der je nach Problem, Anwendung oder Akteuren unterschiedlich definiert werden kann. Giffinger (2007) versteht unter einer Smart City „A city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of

endowments and activities of self-decisive, independent and aware citizens.“ (in Albino et al. 2015). Eine weitere Definition ist „Smart cities have high productivity as they have a relatively high share of highly educated people, knowledge-intensive jobs, output-oriented planning systems, creative activities and sustainability-oriented initiatives“ (Kourtit et al. 2012 in Albino et al. 2015). Smart City war zunächst vor allem eine Top-down-Vision von Großkonzernen, die den Fokus auf milliardenschwere Infrastruktureinrichtungen der Städte legte. Smart City kann aber auch anders gestaltet werden. Sie entsteht auch in einer Rückkopplungsschleife als Bottom-Up-Realität. Digitales Leben und analoge Stadt – analoges Leben und digitale Stadt: Beide sind untrennbar miteinander verbunden (Förster, Schüller 2017).

Unklar ist derzeit, inwieweit bei der Smart City von einem neuen stadtentwicklungspolitischen Leitbild ausgegangen werden kann. In Deutschland wird Smart City kritisch diskutiert und hat vor allem wirtschaftsfördernden Charakter. In Österreich fungiert das Thema quasi als „Trojanisches Pferd“, um Konzepte der integrierten Stadt- und Regionalentwicklung voran zu bringen (Libbe 2014).

Smart City Strategien sind oft Teil eines räumlichen Leitbildes für Städte oder Stadtregionen. Sie gehören zur Planungsphase und beinhalten heute meistens Pilotprojekte und konkrete Massnahmen, ohne auf einer ganzheitlichen Smart City Strategie zu basieren. Diese Strategien sind oft problem- und zielorientiert aber oft nicht gesamthaft und lösungsorientiert. Gleichzeitig sind Strategien oft zu steif und unagil, um mit dem Tempo der Digitalisierung Schritt zu halten.

Die breitangelegte Delphi-Umfrage des NUDIG-Projekts an der Hochschule für Technik Rapperswil bestätigte dieses Problem. Diese Planungspolarität soll mit der Smart City Onion geschlossen werden.

Bereits heute gibt es einige bekannte Smart City Modelle, wie beispielsweise das „Smart City Wheel“ und das „Happy Cities Hexagon“ des Klima- und Stadtstrategen Boyd Cohen. Während das Happy Cities Hexagon den Fokus auf die Bevölkerung von Städten legt und beurteilt, wie hoch die Zufriedenheit der Bewohnerinnen und Bewohner in der Stadt ist, zeigt das Smart City Wheel eine Herangehensweise bzw. konkrete Themenbereiche, die Verwaltungen und Städte beachten sollten, um eine ganzheitliche Smart City Strategie zu entwickeln. Das Wheel von Cohen zeigt Indikatoren für die Beurteilung von Smart Cities und zusätzlich Aspekte zu den Schlüsselkomponenten: Menschen, Wirtschaft, Umwelt, Energie, Governance, Lebensumfeld und Mobilität. Gleichzeitig bietet das Wheel als Prüfinstrument die Möglichkeit, die „Smartheit“ der Stadt zu beleuchten und mit anderen Städten zu vergleichen, wie dies beispielsweise der jährlich erscheinende Smart City Index zeigt, der auf Cohens Wheel beruht.

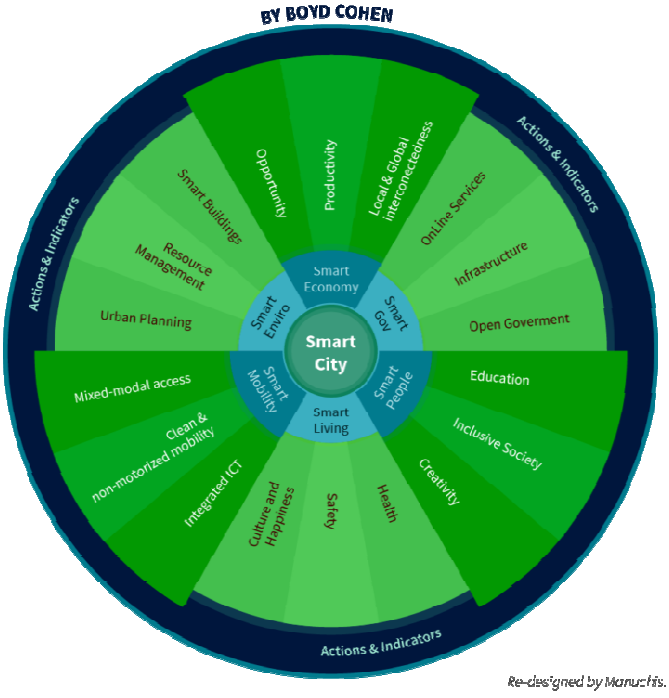

Abbildung 1: Smart City Wheel

Oftmals fehlt es für Planungsträger an konkreten Konzepten und Vorgehensweisen. Insbesondere in mittelgrossen Städten mangelt es häufig, aufgrund von finanziellen und personellen Einschränkungen, an

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Strategien und umsetzbaren Herangehensweisen. Eine aktuelle Studie vom Beratungsunternehmen Roland Berger, in der 50 Expertinnen und Experten aus 50 mittelgrossen europäischen Städten befragt wurden, bekräftigt dieses Problem:

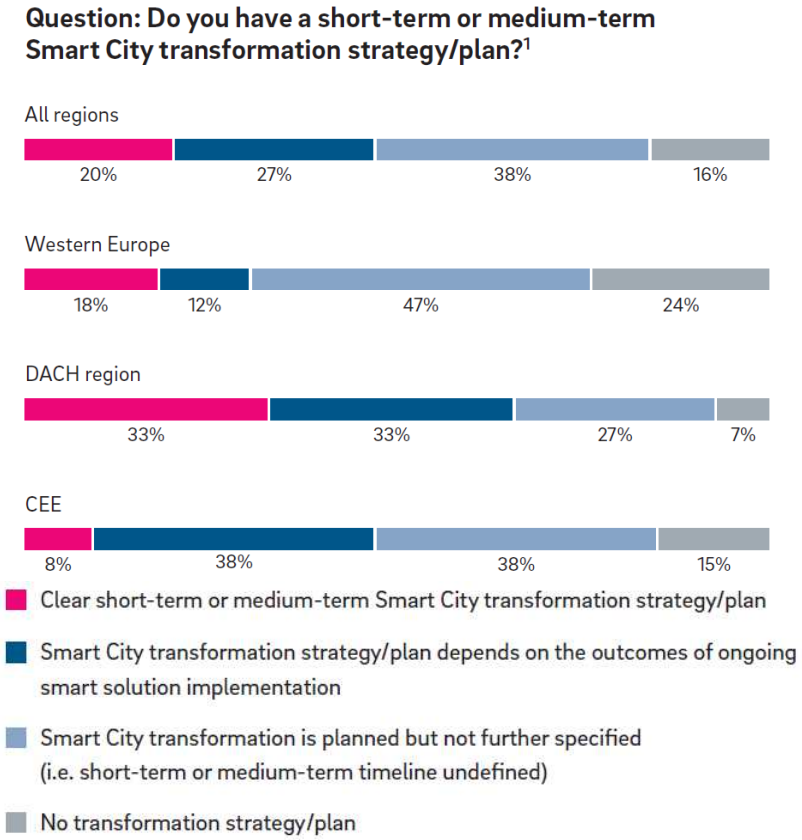

Abbildung 2: Haben Sie eine kurz- oder mittelfristige Smart City Anpassungsstrategie bzw. ein Smart City Konzept? (Roland Berger 2019)

Aber gerade diese Städte haben die Aufgabe zwischen dem ländlichen Bereich und den angrenzenden Verflechtungsräumen gute und smarte Verbindungen zu schaffen, wodurch Synergien zwischen einzelnen (Pilot)projekten entstehen können. Einzelne Pilotprojekte eignen sich, um eine Idee zu bekommen, was innerhalb des Themas Smart City möglich ist, und eine erste Resonanz von der Bevölkerung zu erhalten. Die dauerhafte Fokussierung auf einzelne Projekte kann allerdings zu einem Ansatz führen, bei welchen Wechselwirkungen zwischen den einzelnen Projekten oft übersehen werden. Viele Möglichkeiten, die Smart City Strategien realisiert werden könnten, werden daher schlicht verabsäumt. Daher sollte ein gesamtheitliches und trotzdem agiles und dynamisches Vorgehensmodell für Smart City Strategien gewählt werden, da sich in Zeiten der Digitalisierung Modelle und Techniken ändern können, wodurch sich auch die Strategie anpassungsfähig zeigen muss (Jaekel 2015).

Eine Möglichkeit, Digitalisierung und Smart City anzugehen, ist die Smart City Onion, die im nachfolgenden Kapitel beschrieben wird.

3 DIGITALSIERUNG ANGEHEN – DIE SMART CITY ONION

3.1 Agiles Vorgehen und konzeptionelles Vorgehensmodell

Es gibt genügend unterschiedliche Smart City Ansätze. Das Smart City Wheel stellt beispielsweise eine Themenübersicht über die wichtigsten Smart City Aspekte dar, eignet sich aber nicht als konkrete Herangehensweise und widerspricht vielfach der Planungspraxis in Gemeinden, die vor allem durchgeplante und konzeptionelle Vorgehensweisen bevorzugen. Die notwendige Agilität und Anpassungsfähigkeit, die es bei Smart City Themen aber braucht, wird in diesem Ansatz nicht thematisiert.

Ergebnisse im Forschungsschwerpunkt „Digitalisierung und Raum“ zeigen, dass Agilität nötig ist, um Digitalisierung im Rahmen von Raumentwicklungsagenden zu implementieren. Die Festlegung auf einen

kongruenten Zielrahmen ist mit Unsicherheiten behaftet, daher sollte die Herangehensweise anpassungsfähig und flexibel sein, damit im Prozess der Umgang mit Digitalisierung erlernbar und veränderbar bleibt.

Ausgangspunkte des agilen Prozesses bilden Projekte, die kurzfristig zu realisieren und gegebenenfalls zu revidieren sind. Erfahrungen sollten zu Beginn gesammelt werden und als Best-Practice-Beispiele vorausgehen, um dann konzeptionell übertragen werden zu können. Die Ergebnisse dieser Projekte können dann in Zukunftsbilder einfliessen.

Das Vorgehensmodell der Smart City Onion verbindet die beiden Ansätze, vorab planbares konzeptionelles Vorgehen und ganzheitlicher Anspruch. Vom pragmatischen Einstieg über einzelne Projekte bis zur Anpassung bestehender Steuerungsmechanismen zeigt das Modell die wachsende Komplexität bei Smart City Strategien auf.

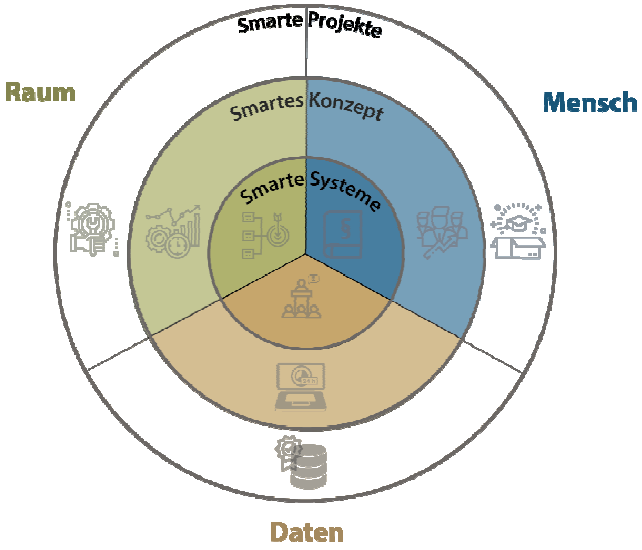

Abbildung 3: Smart City Onion

Die Smart City Onion zeigt die Verbindung der thematischen und der prozessbezogenen Dimensionen einer Smart City auf. Die thematischen Dimensionen „Raum“, „Mensch“ und „Daten“ beschreiben dabei die räumlichen bzw. raumplanerischen Aspekte einer Smart City. Die prozessbezogenen Dimensionen hingegen, die in drei Schichten wie „Zwiebelringe“ gegen innen in der Komplexität zunehmen, sind „smarte Projekte“, „smartes Konzept“ und „Smarte Systeme“.

Im Folgenden werden die thematischen Dimensionen beschrieben und um die prozessbezogenen Dimensionen ergänzt.

3.1.1 Thematische Dimension „Raum“

Die vorwiegend physische Gestalt gliedert sich in die drei Schichten der Onion, die mit wachsender Intensität zur Smart City im Sinn einer nachhaltigen Entwicklung führen.

Raumwirksame Auswirkungen koordinieren

Die Auswirkungen der Digitalisierung auf Raum und Landschaft sind letztendlich physisch, daher sind die bestehenden Instrumente der räumlichen Planung grundsätzlich tauglich, um diese zu steuern.

Thematiken der Digitalisierung können auf der strategischen Ebene über Sachpläne sowie über kantonale und kommunale Richtpläne gesteuert werden. Ergänzend kann auch eine Steuerung der Raumnutzung über eine Finanzierung in den Agglomerationsprogrammen erreicht werden. Auf der allgemeinverbindlichen Ebene scheint eine Flexibilisierung (der Anwendung) der Instrumente angebracht. Auch ist eine andere Aufgabenteilung zwischen dem Steuerungsauftrag durch die öffentliche Hand und einer Ausführung durch Private denkbar. Hierbei ist aber sicherzustellen, dass die Kompetenz vertikal über alle Planungsebenen verbunden bleibt.

Mittelfristig ist zu überlegen, ob die flächenzentrierte Steuerung, auf welcher die bestehenden Instrumente der räumlichen Planung basieren, nicht um eine auswirkungsorientierte Steuerung der Raum-nutzung ergänzt

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werden müsste. Also die Flächennutzung nach den Auswirkungen der Nutzung des Raums zu regeln und nicht (allein) über die Ausscheidung von Zonen für Wohnen, Gewerbe oder Industrie.

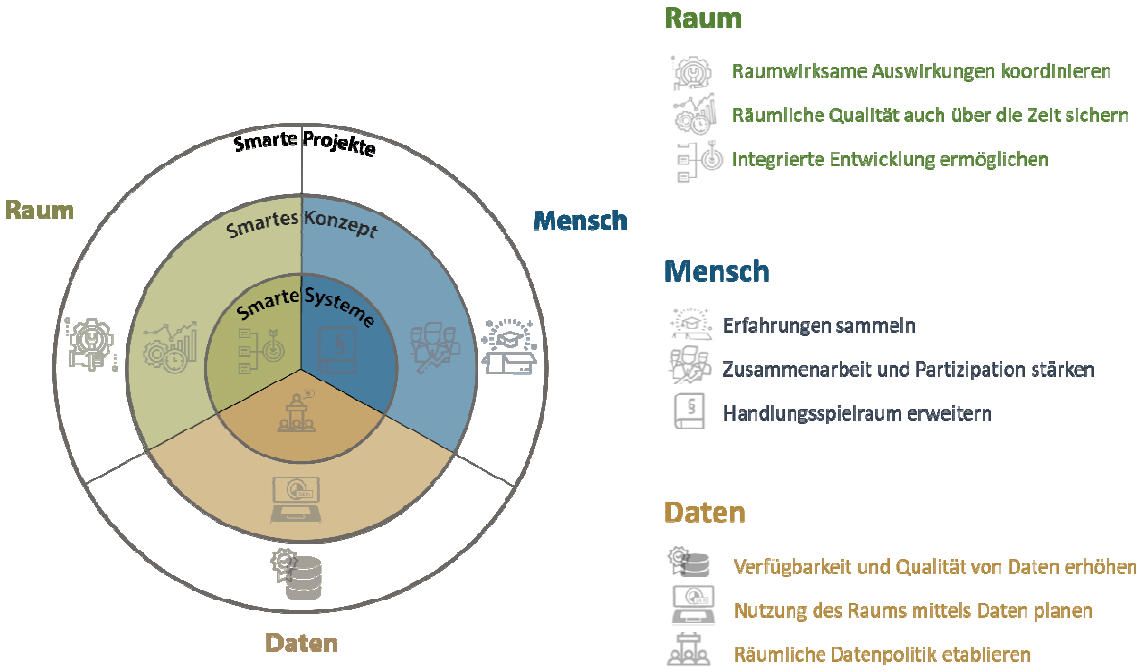

Abbildung 4: Thematische Dimensionen der Smart City Onion

Räumliche Qualität auch über die Zeit sichern

Wie aufgezeigt hat die Digitalisierung Auswirkungen auf den Raum. Diese treten kleinmassstäblich beispielsweise bei neuen verkehrlichen und infrastrukturellen Ansprüchen im öffentlichen Raum auf, in einem mittleren Massstab bei geänderten Ansprüchen an die Naherholung oder grossmassstäblich bei neuen Angeboten in den Verkehrssystemen oder in der Grundversorgung. Zuerst ändern sich die Ansprüche und Nutzungen an den Raum, gefolgt von Anpassungen an die physische Gestalt des Raums bis zu einer auf Langfristigkeit ausgelegten Anpassung der Systeme.

In allen Zuständen ist die Qualität der Nutzbarkeit sowie der räumlichen Gestalt sicherzustellen. Gerade auch bei Übergangslösungen, die nicht nur in einem fachlichen System (wie bspw. der Verkehrsplanung) gute Lösungen hervorbringen, sondern auch transdisziplinär qualitativ gute Zwischenzustände ergeben, braucht es diese Sicherstellung.

Integrierte Entwicklung ermöglichen

Die Steuerung der räumlichen Entwicklung benötigt Ziele. Übergeordnete Ziele werden auf politischer Ebene aufgestellt und politisch verantwortet und durch die entsprechenden Ämter des Bundes ausformuliert. Die Konkretisierung erfolgt auf Ebene der Gemeinden. Auf welcher dieser beiden Ebenen ein kongruentes Zielsystem der Digitalisierung verankert werden sollte und ob es überhaupt möglich ist, ein kongruentes Zielsystem der Digitalisierung aufzustellen, ist Gegenstand der Diskussion. Es ist daher ungewiss, wann und ob Zielsysteme betreffend Digitalisierung vorliegen.

Daher ist der Nutzen von Zielsystemen mit Fokus auf die Digitalisierung erkennbar zu machen und für die Akteure verständlich aufzuzeigen. Dafür braucht es (erste) gute Beispiele und Pilot- oder Modellregionen. Diese können dann auch genutzt werden, um sich induktiv einem Zielkonzept zu nähern. Szenarien und Simulation helfen hier, die Auswirkungen der induktiv gewonnenen Aussagen darzustellen und ein Zielgerüst aufzustellen, die zu einem Zielsystem führen. (vgl. Sinning 2003)

3.1.2 Thematische Dimension „Mensch“

Erfahrungen sammeln

Erfahrungen sammeln bedeutet, durch konkrete Projekte den Nutzen erkennbar zu machen, bevor sie in einem grossen Massstab implementiert werden. Durch einen solchen agilen Ansatz können die Akteure in Gemeinden und Agglomerationen sensibilisiert werden und sich mit dem Thema Digitalisierung und deren

Auswirkungen vertraut machen. Wichtig bei diesem Vorgehen ist ein Austausch zwischen den Projekten und ein Lernen aus den Erfahrungen bereits laufender bzw. abgeschlossener Projekte. Dazu ist eine Koordination der Projekte geboten, so dass sich thematische Cluster für neue Technologien und Angebote bilden könnten. Auch ist das Bündeln bestimmter Themen in Pilotregionen oder „Reallaboren" ein, beispielsweise in Deutschland verbreiteter, geeigneter Ansatz. Grundsätzlich ist es für Gemeinden und Agglomerationen wichtig, sich auch schon mit kleinen Projekten selber handlungsfähig zu machen.

Zusammenarbeit und Partizipation stärken

Potenzial bietet die Digitalisierung für die Verbesserung der Entscheidungsfindungen in der Gemeinde, für die Zusammenarbeit zwischen Gemeinden oder mit dem Kanton und nicht zuletzt für eine einfachere und zielführendere Partizipation. Mit detaillierten Daten kann Transparenz hergestellt werden.

So ist zu erwarten, dass mit den heute und künftig vorhandenen Daten Entscheidungsfindungen objektiver gemacht werden können – sowohl für die Politik als auch für die Bevölkerung. Wenn die für einen Entscheid wichtigen Daten zusammengeführt und verglichen werden können, ist es möglich, eine gesamthafte Entscheidung herbeizuführen, die über sektorale Entscheidungen hinausgehen.

Potenzial besteht bei Planungsthemen in Agglomerationen. Hier sind themenübergreifende Fragestellungen – insbesondere die Abstimmung von Siedlungs- und Verkehrsentwicklung bereits stark verankert. Für die Planung sind vielfach gemeinde- oder kantons- und sogar grenzüberschreitende Lösungen nötig. Die Überwindung des „Gärtchendenkens" der Gemeinden ist dabei zentral. Dabei hilfreich sind Simulationen, welche die Auswirkungen von Entscheiden (regionale Zusammenarbeit oder jede Gemeinde für sich) aufzeigen können. Dafür sind aber Daten nötig, die eine regionale Übersicht ermöglichen. Mit regionalen Datenplattformen können solche Informationen gesammelt und zugänglich gemacht werden.

Handlungsspielraum erweitern

Auf Ebene der Gemeinden besteht durchaus die Bereitschaft, Digitalisierung für die Entwicklung der Gemeinde oder Agglomeration zu nutzen. Viele Anwendungen der Digitalisierung können aber nicht oder nur schwer ausprobiert werden, da entweder die gesetzlichen Regelungen – insbesondere auf Bundesebene – dagegenstehen oder die finanziellen oder personellen Ressourcen fehlen. Hier müssten auf regulatorischer Ebene Experimentierklauseln eingeführt werden, die das Ausprobieren fördern, ohne dass Gesetze angepasst werden müssen. Auf Basis dieser Experimentierklauseln könnten diese „Experimente" auch kurzfristig umgesetzt werden. Die Erfahrungen dieser „Experimente" sollten dann Hinweise geben, wie und ob Gesetze verändert werden sollten.

Neben den regulatorischen Hindernissen scheitern Projekte auch an fehlenden finanziellen und personellen Ressourcen. Damit die öffentliche Hand auch künftig handlungsfähig bleibt, sollten Projekte gefördert werden, die es Agglomerationen und Gemeinden ermöglichen, ihre gesetzten Ziele zu erreichen – unabhängig von wirtschaftlichen Interessen.

3.1.3 Thematische Dimension „Daten"

Daten sind „neben Recht und Geld (...) das dritte Gestaltungselement des Staates" (Habbel 2017). Damit das Gemeinwesen dieses Gestaltungselement für die Erfüllung ihrer Aufgaben nutzen kann, muss sie es sich erarbeiten. Dies geschieht in mehreren Schichten der Smart City Onion.

Verfügbarkeit und Qualität von Daten erhöhen

Eine hohe Verfügbarkeit von Daten ist ebenso hoch zu gewichten wie eine gesicherte Qualität dieser bzw. die Nachvollziehbarkeit von Erhebung und Verarbeitung. Aussagen über die Qualität der Daten sind wichtiger als die Qualität der Daten an und für sich. Die öffentliche Hand und die Planung müssen ihre Aufgaben auf rechtssichere und nachvollziehbare Daten stützen.

Die Mehrfacherzeugung ist – soweit möglich – zu vermeiden, stattdessen sind für öffentliche Stellen eine Bereitstellungspflicht generierter Daten zu prüfen und Lehren aus der Opendata-Philosophie zuziehen. Wer Daten bezieht, soll auch Daten liefern (Datenkreislauf). Es gilt vorhandene Datensätze zusammenzuführen und einheitliche Schnittstellen zu schaffen. Dies beinhaltet auch, dass Metadaten standardisiert, Datensätze vereinheitlicht und zugänglich gemacht werden. Eine nachvollziehbare Deklaration (Datenherkunft und -qualität) könnte durch die Einführung von Qualitätsstandards oder Labels erreicht werden. Mindestens eine Koordination zwischen den Akteuren von Bund, Kantonen und Gemeinden ist geboten.

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Nutzung des Raums mittels Daten planen

Die Digitalisierung führt zu mehr Daten und einer höheren Verfügbarkeit von Information über den Raum und dessen Nutzung. Neben den bisher verwendeten raumbeschreibenden statischen Daten (statistisch, hierarchisch und qualitätsgeprüfte Daten i.d.R. herausgegeben von Statistischen Ämtern) stehen immer mehr auch dynamische Daten über die reale (Echtzeit-)Nutzung des Raums (heterogen, zweckbezogen und situativ) zur Verfügung.

Dies bietet auch die Möglichkeit, vermehrt in Szenarien zu denken und mittels Visualisierungen stärker auch kooperative Planungsmodelle oder generative Entwurfsprozesse zu verfolgen. Letztendlich kann so die Steuerung der Raumnutzung von der heutigen Flächenzentriertheit um eine auswirkungsbasierte Steuerung erweitert werden.

Räumliche Datenpolitik etablieren

Nicht nur für Analyse, Entwurf und Planung oder Umsetzung werden Daten benötigt, sondern vor allem für die Steuerung der Raumnutzung. Diese Daten werden weitgehend zweckbezogen und situativ von privaten oder halbstaatlichen Unternehmen erhoben. Bleiben diese Daten der räumlichen Planung nicht zugänglich, kann diese mittelfristig ihre Aufgabe nicht mehr erfüllen. Das Wissen über den Raum und seine Nutzung als Grundlage einer Steuerung wird entzogen.

Um mittelfristig nicht die Handlungsfähigkeit zu verlieren, ist eine räumliche Datenpolitik aufzubauen und zu etablieren. Ob die Lösung in Open Data, einer Datenaustauschpflicht als Bestandteil von Konzessionen oder durch andere Mechanismen erreicht werden kann, wird – neben der Frage des Datenschutzes – Teil der Umsetzung einer räumlichen Datenpolitik sein müssen.

3.1.4 Prozessuale Dimensionen der Smart City Onion

Die drei thematischen Dimensionen erlauben in Schichten jeweils einen projektbezogenen Einstieg, ein konzeptionelles Vorgehen und die (Ver)änderung der jeweiligen Dimension.

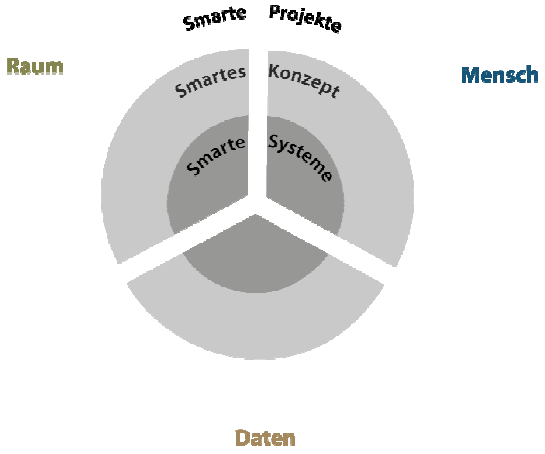

Abbildung 5: Prozessuale Dimensionen der Smart City Onion

Die äussere Schicht der Onion zeigt die Schicht der smarten Projekte mit den thematischen Dimensionen „Erfahrungen sammeln“, „Raumwirksame Auswirkungen koordinieren“ und „Verfügbarkeit und Qualität von Daten erhöhen“. In den drei thematischen Dimensionen beginnen smarte Projekte niederschwellig und sind zeitnah umzusetzen. In der Summe können, aber müssen nicht, sie die Grundlage für Smarte Konzepte bilden.

Die mittlere prozessuale Schicht der Smart City Onion stellt die Schicht des smarten Konzepts . Hier wird aus den Erfahrungen der Durchführung von smarten Projekten ein smartes Konzept erarbeitet. Wenn mehrere (Pilot)projekte Synergien bilden und laufender Austausch zwischen den Projekten stattfindet, können diese in ein Konzept überführt werden. Damit kann auch ein Wechsel vom Agilen zum Konzeptinellen erfolgen. Diese mittlere Schicht der Smart City Onion der smarten Konzepte umfasst die thematischen Dimensionen „Räumliche Qualität auch über die Zeit sichern“, „Zusammenarbeit und Partizipation stärken“ sowie „Nutzung des Raums mittels Daten planen“. Auch thematisch werden in dieser Schicht grundsätzlichere Fragen angegangen als in der äussersten prozessualen Schicht.

Wenn Projekte und Konzepte für Gemeinden und Städte nicht mehr ausreichen, um die Region smart zu machen, mangelt es oft an fehlenden rechtlichen Aspekten. Hier sind smarte Systeme gefragt, die Lösungen auf übergeordneter oder politischer Ebene hervorbringen, damit die Entwicklung zur Smart City vollzogen werden kann. Dies umfasst dann die thematischen Dimensionen „Integrierte Entwicklung schaffen", „Handlungsspielraum erweitern" sowie „Räumliche Datenpolitik etablieren".

4 ANWENDUNG DER SMART CITY ONION

Potenziale der Digitalisierung für eine nachhaltige Entwicklung lassen sich erschliessen, indem im Kleinen Erfahrungen gesammelt und dann konzeptionell übertragen werden. Kleine, kurzfristig zu realisierende – aber auch zu revidierende – Projekte bilden dabei den Ausgangspunkt eines Lernprozesses. Beispielsweise lassen sich im Bereich der Verkehrsplanung vorhandene Angebote wie ÖV und die vorhandenen Verkehrsnetze mit regionalen Mobilitätsdienstleistungen wie Car Sharing oder Bike Sharing verknüpfen.

Bei neuen zeitlich befristeten Infrastrukturen der Digitalisierung wie z.B. KEP-Stationen lassen sich abzeichnende Trends beobachten und Schwellenwerte definieren, um Synergien mit Zentren auszunutzen, aber auch negative Verkehrswirkungen zu vermeiden.

Die sich ändernde Landschaftswahrnehmung aufgrund der virtuellen Wahrnehmung lässt sich in Studienprojekten nachvollziehen und in die Landschafts- und Freiraumplanung übertragen. Daraus können neue technische Hilfsmittel und Instrumente zur Partizipation entwickelt und deren Wirkung durch ein Monitoring der Landschaftswahrnehmung aufgezeigt werden.

Bei diesen Projekten ist der jeweilige Steuerungsbedarf proaktiv auszuschöpfen. So werden sich beispielweise durch die wachsende Flottenzusammensetzung mit Fahrzeugen von höheren Leveln des automatisierten Fahrens in den nächsten Jahrzehnten die Anforderungen an Parken mehrfach verändern.

Daten werden in der räumlichen Planung eine immer grössere Rolle spielen für die Analyse, die Planung und letztendlich auch für die Steuerung des Raums bzw. der Nutzenden. Daten entwickeln sich neben den klassischen Steuerungselementen hin zu einer neuen Steuerungsmacht.

4.1 Anwendung der Smart City Onion in Reallaboren

Die Tauglichkeit dieses Smart City Modells wird derzeit in Reallaboren zum Thema Digitalisierung erprobt. Die Zwiebelringe dienen hier als konzeptioneller Einstieg und die Projektcluster („Raumerlebnis und Besucherlenkung", „Wandelbarer Öffentlicher Raum" sowie „Planen mit Daten") stellen die thematischen Zustiege dar.

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🏆 *reviewed paper*

Walk Your City: Using Nudging to Promote Walking

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1 ABSTRACT

In recent decades, a stagnation or even a decline in pedestrian traffic has been observed in many cities, despite the ambitious efforts of national and international action plans, strategies and initiatives. Our project, which is named “Walk Your City”, addresses this problem by designing, developing and evaluating an innovative behavioural-based pedestrian initiative, with a focus on “nudging” as the applied method. The overall aim is to decisively raise awareness of walking as an active and health-enhancing activity through behavioural approaches such as nudging. The core of our approach is represented by “nudges”, which are triggered via an app as well as offline campaigns. The story refers to a not-so-distant dystopian future where the pilot city of Graz in Austria suffers from pollution and traffic chaos, as well as climate change. Through regular walking, as well as visiting places such as parks or viewpoints, users of the app are rewarded with tokens. Following the idea of crowdsourcing, these tokens can be invested into desired improvements such as parking benches or zebra crossings. Through this unique combination of technological innovation, a fun approach, behavioural concepts and a creative campaign, participants are motivated to explore and experience the city on foot. Walking should be perceived as a genuine and healthy alternative for short distances (<3 km), and the first choice when covering small distances (<1 km). The nudging approach will be iteratively optimized in terms of acceptance, functionality and usability, using focus groups, internal lab tests and expert workshops. This strategy will ensure a practice-oriented project implementation that is tailored to the needs of the different target groups, such as students, commuters and tourists. The mobility and health data obtained during the pilot test will be used to evaluate the suitability and impact of the nudging approach in an academic paper. As the empirical data show, a behavioural change in terms of a larger share of walking in the modal split, as well a positive impact on the interest and awareness regarding the effects of walking, can be observed.

Keywords: Walking, City, Urban Planning, Nudging, Gamification

2 INTRODUCTION

2.1 Pedestrian Traffic

Many cities have experienced a stagnation or even a decline in foot traffic (cf. BMVIT, 2016), which contradicts the ambitious efforts of national and international action plans, strategies and initiatives. Exact statements on the development of pedestrian traffic are difficult to make, however, because short distances on foot are insufficiently recorded in mobility surveys or – with the exception of Switzerland – no stages of the trip are recorded (see KOMOD, 2014; bmlfuw & bmvit, 2015). Statistics on the modal split from 1982 to 2013 show that the share for pedestrians fell from 31% to 19% (Mobility Agency Vienna, 2014; ZIS+P, 2014). A similar picture emerges at the urban level. For example, from the modal split, pedestrian traffic in Vienna in Austria decreased from 33% to 25% between 1995 and 2014, and in other Austrian cities from 27% to 17% on average (bmvit 2016). This negative trend can be observed to a similar extent throughout Europe (cities of Ljubljana and Copenhagen, 2014) and has not been stopped by numerous infrastructural measures (e.g. wider and separate sidewalks, more promenades, meeting zones, seating, floor-level adjustments, crossing aids), which are mostly located at the city district level. This is due to the high degree of motorization, the car-oriented spatial structures and the resulting longer distances (bmlfuw & bmvit, 2015). This makes supportive behaviour-based approaches at the municipal level appear all the more important.

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It has been shown that younger people, up to 14 years of age in particular, walk 28% of their distance travelled, and that older people over 65 years of age walk 25% of their distance travelled. In the age group of 20 to 25 years, this proportion amounts to only 9% of all trips. In all age groups, women have a larger share of walking than men (see bmvit 2016).

For urban and densely populated areas in particular, and for short distances, there is still considerable development potential, as distances of less than 1 km account for about 65% of all journeys on foot and 30% of all car journeys (bmlfuw & bmvit, 2015). Pedestrian traffic, with all its advantages, is currently given too little priority within modern transport systems. In addition, the perception of walking as an independent "means of transport" is still not pronounced. However, promising initiatives (e.g. the 2015 Year of Walking in Vienna, the redesign of "Sonnenfelsplatz" in Graz, the Vienna based ZEUS project for analysing the needs of pedestrians, and the annual Walk-Space Conference in Austria) are taking place, and they are helping to deepen the understanding of the needs of people when walking, to identify barriers and obstacles and to promote the development of a "walking lifestyle".

2.2 Health-Related Effects of Walking

Internationally and nationally, efforts to promote active, health-promoting and sufficient mobility are increasingly becoming the focus of attention. This is being triggered by, amongst other things, a growing lack of exercise, intensified climate protection efforts and the increasing burden of motorized private transport (e.g. the increase in pollutant emissions, land sealing, noise and traffic jams). Walking, as the most natural form of active mobility, conserves resources, is socially just, promotes health, is rarely associated with injuries and is self-sufficient. According to the latest physical activity guidelines (U.S. Department of Health and Human Services (2018), individuals should undertake at least 150 minutes of exercise per week.

Walking is affordable for everyone, no additional sports equipment is required, no special movement skills are needed and walking can be practised by the majority of the population at any time. In a systematic review article, including a meta-analysis (Oja et al., 2018), the authors showed that inactive adults who participated in walking interventions achieved increased fitness and decreased body weight, BMI, and systolic and diastolic blood pressure. Based on the scientifically well-documented health effects of regular physical activity, the Austrian Health Promotion Strategy's Framework Health Goal 8 is: "To promote healthy and safe physical activity in everyday life by appropriately shaping the living environment." (Federal Ministry of Health and Women, 2016.)

3 THEORETICAL FRAMEWORK

3.1 Transtheoretical Model

Mobility management deals with the question of how the behaviour of people can be changed through measures or interventions. In general, individuals should organize their daily activities (e.g. work, education, shopping) in an efficient manner, in terms of cost, energy saving and environmental protection. To achieve these objectives, a wide range of different interventions have been used. Some studies have investigated interventions which have had a positive effect on mobility behaviour by sharing information and practical knowledge (Staats, Harland & Wilke 2004); by the specifications of goals (Locke & Latham, 2002); by comparison and competition with other players; or by rewards and punishments via feedback (Fujii et al., 2009; Taniguchi & Fujii, 2007; Cairns et al., 2008; Froehlich, 2011). However, many of these "soft" interventions are insufficiently embedded in a comprehensive behavioural theoretical concept for us to be able to evaluate their effectiveness.

In order to change human behaviour, it is necessary to understand the underlying behavioural processes. Many theories of motivational psychology and behavioural science have attempted to describe and explain mobility behaviour, including the theory of planned behaviour (Ajzen & Fishbein, 1975 & 1980), the norm-activation theory (Schwartz, 1977) and the self-regulation theory (Bamberg, 2012). In line with Prochaska and DiClemente (1982), the self-regulation model of Bamberg (2012) claims that behaviour changes through a time-ordered sequence of stages. Each stage involves various cognitive and motivational difficulties occurring throughout the process of behaviour change. Bamberg (2010) described the following qualitatively different stages:

- Precontemplation: In the first stage, individuals are not yet aware of their own behaviour. By self-focusing their behaviour, they still have to choose an overall goal amongst competing wishes (i.e. goal setting), and they still have to consider the feasibility and desirability of the relevant outcomes. Before choosing a goal (i.e. goal intention), the subjective probability of achieving it is evaluated.
- Contemplation: In this stage, individuals consider the pros and cons of the different options and choose the most suitable means for reaching their goal.
- Preparation/testing: Individuals form a concrete plan of when, where and how they can implement the new behaviour. The first practical steps are taken.
- Maintenance: In the final stage, individuals have a new behavioural pattern. Since the new habit has substantial benefits, relapse into the old behaviour can likely be avoided.

3.2 Nudging

The term "nudge" or "nudging" originally derives from the field of behavioural economics and describes a soft type of influence, with the goal to elicit a certain behaviour. Thaler and Sunstein (1975) defined nudging as a positive intervention that stimulates a voluntary change in behaviour without including external (negative) consequences. The idea of nudging has been booming in the USA in recent years, whereas very few initiatives are known in Europe, where the focus is generally on the creation of politically motivated interventions, and is particularly anchored in the field of health prevention (Quigley, 2013). Nudging, in itself, is based on motivational psychological models and shows parallels to the principle of gamification. However, in contrast to gamification, stimulus-response chains in the sense of incentives and penalties fade into the background, and subtle strategies and positive interventions for decision optimization come to the fore. Nudging strategies make behavioural alternatives more visible, in the area of physical activity; for example, by making stairs more attractive than a lift (Hollands et al., 2013).

Nudging has also been successfully used in the context of active mobility; for example, to promote cycling in cities (Wunsch et al., 2015). The methods used here are similar to the "persuasive technology" principle. In both cases, the aim is to promote certain behaviours or options through targeted measures in terms of the design of places, processes and graphic interfaces (Fogg, 2009). Nudges can further be seen in a similar way to gamification, or as a relevant part of gamification, in the form of the game mechanics of achievements. (Pfeiffer, 2018).

3.3 Research Questions

The primary aim of the "Walk your City" research project is to increase the awareness of the positive effects of walking, the acceptance of walking as a means of mobility and the implementation of walking as a habit, which will primarily support the subsequent ambitious transport and health policy strategies.

The research questions are as follows:

(1) Can changes in walking behaviour be determined after the field test compared to before?

(2) Is the applied nudging framework able to alter the attitude towards walking, the knowledge of the positive effects, as well as the behaviour, in terms of the implementation of walking as a habit?

(3) Are participants progressing through the stages of the transtheoretical model in terms of a "level-up"?

(4) Do participants report increased fitness levels after participating in the field test?

(5) How is the app rated in terms of usability and fun of play?

4 METHOD

4.1 Nudging Framework

Numerous innovative features were used, which were intended to intrinsically motivate players to walk more, in an enjoyable and behaviour-oriented way. The applied nudging framework was a central component in this context, and was used both virtually and at local events. The framework integrates four different types of behavioural interventions or nudges:

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- Informative and awareness-raising nudges: Push notifications via smartphone for educating users about the positive health- and traffic-related effects of walking, and a web dashboard with tracking statistics.
- Social nudges: Activities such as guided walking tours in the course of local campaigns.
- Rewarding and enjoyable nudges: Token-based reward system, street games.
- Stabilizing and preventive nudges: Daily walking targets, statistics/visualizations of the positive effects of walking.

4.2 Mobile App

The native "Time2Walk" app was developed as a central hub for conveying the nudges and for raising the players' awareness of the benefits of pedestrian mobility. Through the game mechanics, players are motivated to discover beautiful places and the hidden corners of Graz on foot, and to experience activities on site. Figures 1 to 5 show a few screenshots from the app.

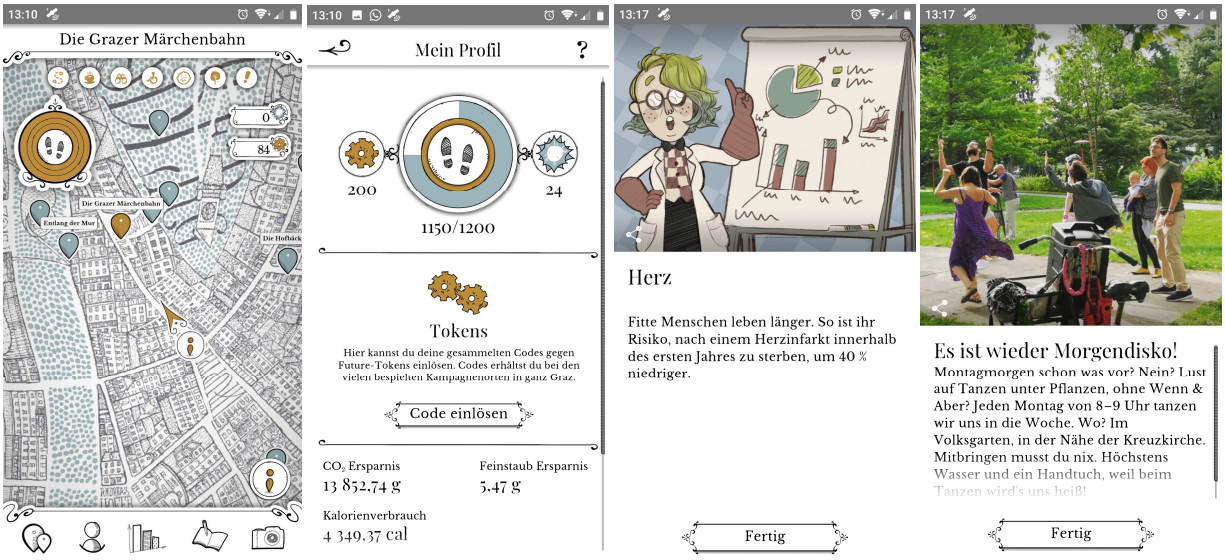

Fig. 1: Start scree, Fig. 2: Personal profile, Fig. 3: Push notification as an informative and awareness-raising nudge, Fig. 4: Push notification as a call to attend an event

The landing page of the app is shown in Figure 1. All event locations (points of interest) are located there as an icon on a hand-drawn city map. The pedometer is prominently placed in the upper-left area. The navigation bar is located in the lower area, from which players can get an overview of:

- all the venues that the player has already visited;
- the personal profile, in which the steps and savings achieved can be checked (see Figure 2);
- statistics, where a comparison with other players is possible;
- the journal, in which the game history and all push notifications can be read;
- and the augmented reality mode.

Figure 3 gives an example of a push notification designed to increase awareness of a healthy lifestyle through physical fitness. Figure 4 shows how a push notification is used to notify the player of an upcoming event.

4.3 Field Test

As a preparatory measure for the field test, players were recruited via social media, press releases, advertising material and personal contacts (see Figure 5).

The field test ran from 16th of September to 16th of October 2019 in the city of Graz in Austria. During this period, it was possible for individuals to download and to play the Time2Walk app via the Google Play Store and to take part in the accompanying events in the city of Graz. Local campaigns took place at several different locations that could be visited on foot. In addition to the app, there was also a printed map of the

playing area with the event locations, so that individuals who did not want to use the app or who were less tech-savvy could also take part in the campaign. By applying both digital (via app) and real nudges (via local campaigns), it was ensured that a wide variety of target groups could be addressed.

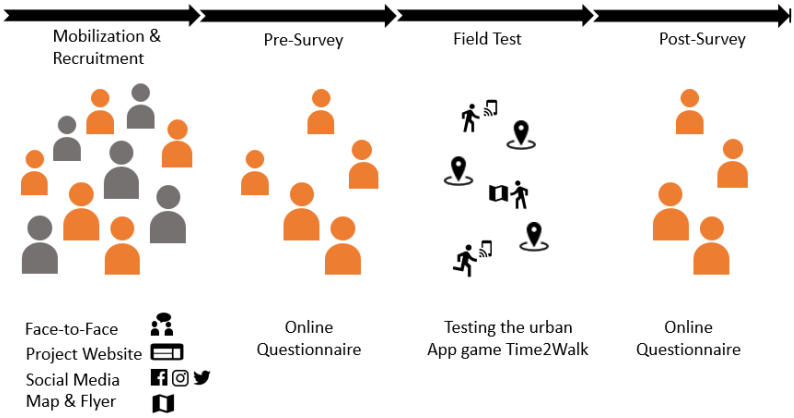

Fig. 5: Overview of the research design

4.4 Data Collection

The data were collected using online surveys and the tracking system integrated in the app. The two standardized online surveys (pre-/post-survey) were implemented with a survey tool. When defining the question types, special attention was paid to ensuring that the different question types were easy to read and could be displayed on both a PC and smaller smartphone displays, thus enabling a responsive experience. The survey was conducted anonymously, in accordance with data protection regulations.

The personal data collected (e.g. age, education) did not allow for a clear identification of the person. Since GPS tracking of the footpaths (e.g. for determining the number of steps) was dispensed with, it was not possible to draw conclusions about the exact whereabouts (e.g. place of residence/work) of the participants. After the evaluation of the field data was finished, all personal data, such as addresses, were deleted. In addition, the participants could at any time arrange for their data to be changed or deleted during the field test, in compliance with the EU General Data Protection Regulation (GDPR).

4.4.1 Examined Variables

A pre-post single-group design was used to demonstrate the behavioural changes. Identical questions regarding mobility settings and mobility behaviour – especially walking behaviour – were asked before and after the field test using the same sample (a within-subject design). Thus, the achieved effects of the nudging framework could be analyzed at an individual level. In addition to questions about the impact, other aspects such as usability and gameplay were also surveyed.

The study design of the first questionnaire included questions on sociodemography, environmental attitudes and playing behaviour. In addition, the motives for increased walking, as well as questions about personal health and lifestyle, were also assessed. The second questionnaire raised questions about the gameplay, the usability of the app, as well as questions referring to the local campaigns.

4.4.2 Sample

In the course of the field test, 238 people used the Time2Walk app. For the detailed analysis, only survey data in the tracking system for the 120 players with a walking time of at least 5 minutes (corresponding to approximately 500 steps) were considered.

After processing the data, 145 persons from the pre survey and 48 persons from the post survey could be analyzed in detail. This corresponded to a response rate of 33%. Since the testing of the app and its evaluation could be considered as a considerable effort in the everyday life of an individual, the response rate can be deemed satisfactory. Above all, a representative survey was not central to the research project. A variety of strategies were pursued, with the aim of keeping the dropout rate as low as possible. For example, the two surveys and the competition were announced several times via newsletters and push notifications triggered by the app. The joint progress within the game, as well as an individual comparison with other

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players, could be called up in real time, while motivating campaign activities were advertised at an early stage via social media. The majority of the participants in the field test were female (pre-test: 66%; post-test: 71%). The age range was from 11 to 72 years. Most players were between 21 and 40 years old (pre-test: 76%; post-test: 74%). Overall, few players were under 21 years of age (pre-test: 8%; post-test: 3%) or over 60 years of age (pre-test: 3%; post-test: 0%). The sample included an above-average number of persons who had attended a university, college or university of applied sciences (pre-test: 57%; post-test: 65%).

5 RESULTS

The analysis of the results involved a comprehensive mix of methods, and the samples were described by means of descriptive statistics. In order to investigate the statistical relationships between variables, bivariate correlations, linear regressions and analyses of variance were applied. By means of t-tests for dependent samples, changes in attitude and behaviour were investigated.

5.1 Usability

For the usability analysis, the standardized "System Usability Scale" (SUS) questionnaire, established in the field of usability research (Brooke 2013 & Bangor et al. 2008), was used for calculating a SUS score. With regard to the gameplay and usability, positive ratings could be observed. A differentiated view of the SUS score suggests that the Time2Walk app is particularly quick and easy to learn (SUS=73/100).

The vast majority (85%) enjoyed playing Time2Walk. The pedometer scored particularly well (M=1,6[1]), through which the daily progress could be followed directly. The illustrated positive effects of walking were also very popular (M=1,9), as was the possibility of discovering new places (M=2,0). Local campaigns were visited by 26% of players. Almost 40% of all the players that used the Time2Walk app never normally used their smartphone for gaming applications.

The subjective level of fitness of the participants was rated as good (pre-test: 36%; post-test: 39%). In total, 9% described their state of health as "not good" or "bad" in the first survey, while this was only 6% in the second survey. This suggests that the fitness level of the participants increased as a result of the field test.

5.2 Impact

To analyze the impact of the nudging framework, the collected quantitative tracking data were compared with the subjective self-assessment of the players. By comparing the statements before and after the field test, changes could be identified on an individual level.

	Sum	**Mean**
Global step count	10.635.000	88.625
App starts	1810	15
POI check-ins	312	2,6
Check-ins at points of interest	218	-
Check-ins at local campaigns	94	-
Positive effects		
Reduction of CO_2	1.016.157 g	8.467,98 g
Reduction of fine particulate matter	400,90 g	3,3408 g
Calories burned	319.046 kcal	2658,72 kcal

Table 2: Tracking data

5.2.1 Tracking Data

On average, each day, each player walked 1,437 steps (or 14 minutes) more than indicated at the beginning of the field test. This is because the self-estimated average walking time per player was 54 minutes, while the actual recorded walking time at the end of the field test was 68 minutes. This corresponds to an increase of about 26%. In order to illustrate the effects of such an increase, the difference is shown in terms of CO_2, fine particulate matter reduction and calories burned in Table 2. The CO_2 and particulate matter savings are based on the assumption that car journeys were saved during the walking time. The effects were calculated by

[1] Measured with a 5-point Likert scale, ranging from 1 = very good to 5 = deficient

taking the basic assumption of "no active movement" as a starting point, as is the case with car journeys. In total, players completed 10 million steps and visited 218 points of interest.

On an average day, a player took 6,837 steps, which roughly corresponds to a walking time of about 68 minutes. If this empirically determined value is compared with the self-estimated average walking time of 54 minutes, which was requested when the app was first opened, an increase of 14 minutes per day and player can be observed. Compared to the self-estimated initial duration, an increase of about 26% can be observed over the course of the field test.

Fig. 6: Number of steps and players during the field test

5.2.2 Subjective Impact

The subjective impact was evaluated by the determined changes in interest for climate-friendly travel options, the awareness of the positive effects of walking, as well as health-related knowledge and well-being. Regarding the self-assessed changes, no significant results were obtained in a t-test with paired samples ($p>0.05$). Only with regard to the item "I would like to find out (more) how I travel in a more climate-friendly way" was there a statistical significance. Thus, the interest of the players was increased by the interventions in the field test ($M_{pre-test}=2.26$, $M_{post-test}=1.97$; $p>0.05$).

On a descriptive level (no statistical significance reached), increased values for all variables (interest, perception, knowledge, participation and behaviour) between the pre- and post-test could be observed. This means that there was more interest, an increased perception, more knowledge, more desire to participate and more willingness to walk.

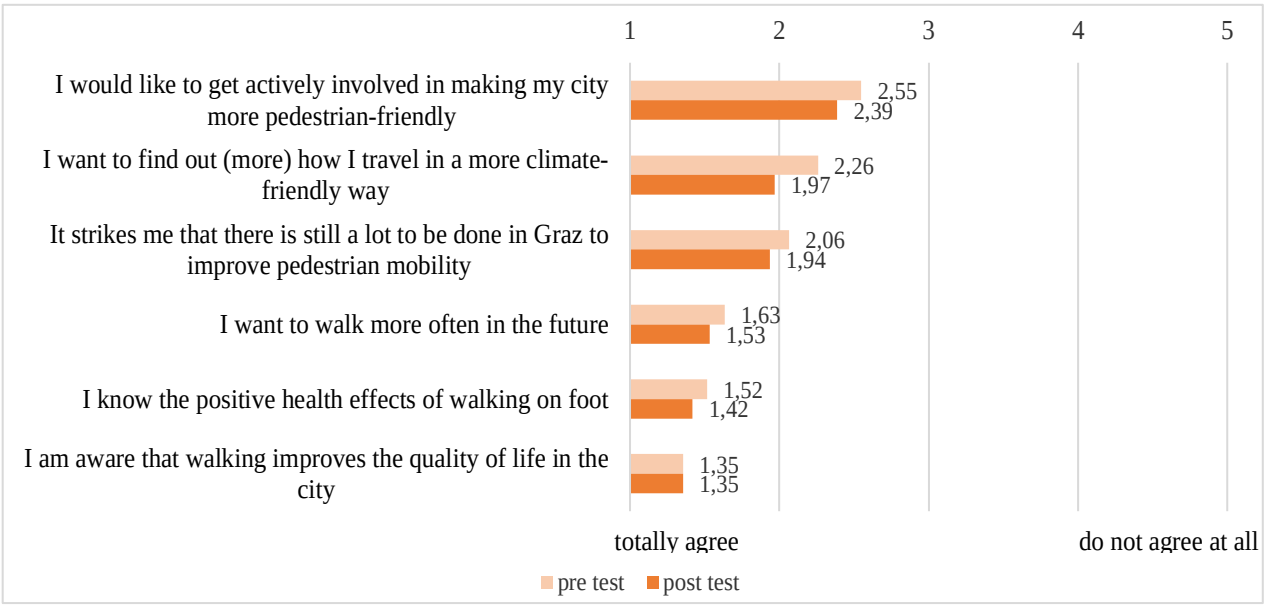

Fig. 7: Impact on interest, awareness and knowledge (pre-test: N=145, post-test: N=48)

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5.2.3 Behavioural Impact

To compare the characteristics of the transtheoretical model between the two test points, cross tables were created in order to calculate the significance using chi-squared tests. The last stage was split up depending on the time frame in which participants stated that they walked for at least 150 minutes per week. In principle, a positive development is evident: after the field test, fewer subjects are assigned to the first stage, in which there is no intention to walk more. In the last stage, however, in which a disposition for action can be spoken of, i.e., in which the behaviour is consolidated, an increase can be observed. Based on the expected and observed frequencies, as well as the standardized residuals, statistically significant differences arise at the third stage, in the form of behavioural intention. This means that after the field test (17%), plans for regular walking are more likely to be made than before (6%). According to this finding, the volatile third stage shows a particularly positive influence, leading to a "level-up" (see Figure 8).

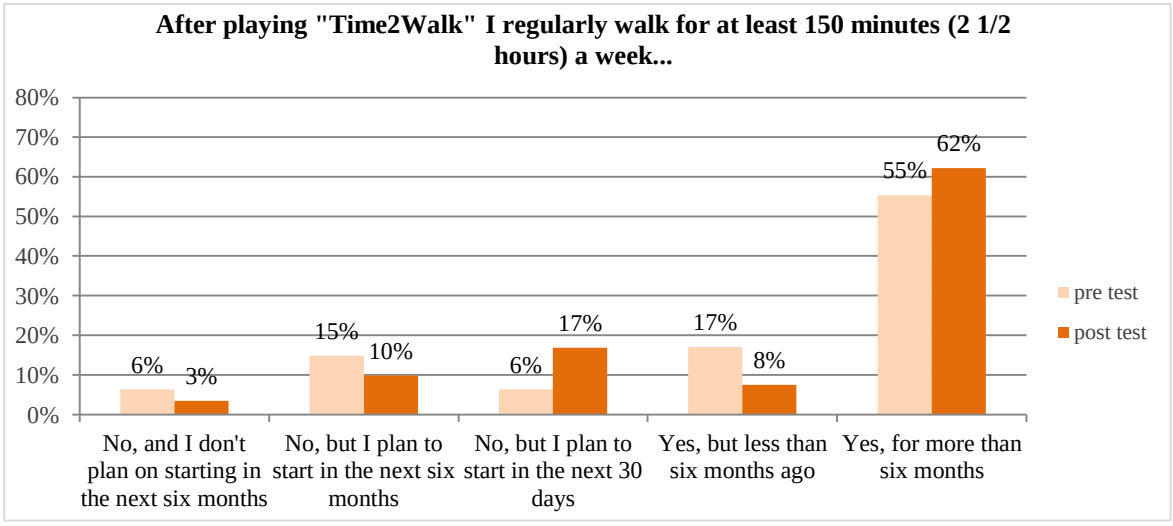

Fig. 8: Impact on the stages of the transtheoretical model (pre-test: N = 145, post-test: N = 48)

With regard to the choice of means of transport, a comparison between the pre-test and the post-test shows a shift away from motorized individual transport. While 54% stated that they walked daily before the field test, the percentage rises to 66% after the field test. This difference is statistically significant ($F=2.91$; $p<0.001$). An increase was also achieved for the 5–6 days per week group. For cars, there is a reduction in daily usage, which is no longer present in the second survey. The use of bicycles is identical, apart from a slight deviation, and there is a slight decrease in the use of public transport (see Figure 9).

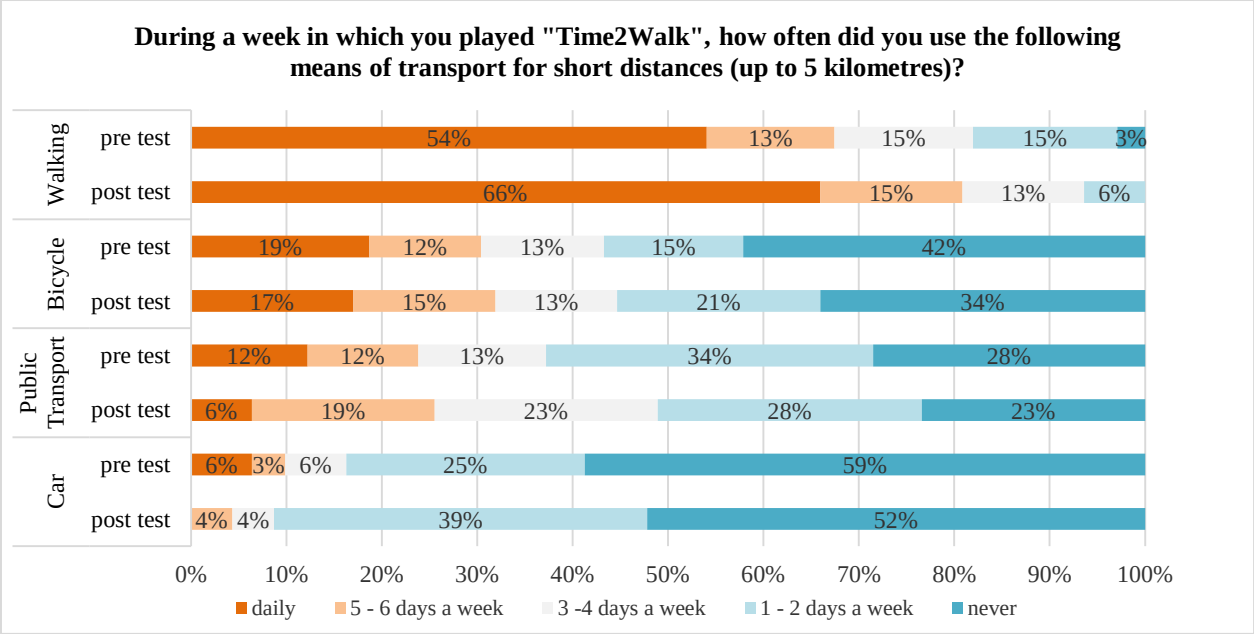

Fig. 9: Modal split (pre-test: N=145, post-test: N=48)

6 DISCUSSION

Over the course of the field test, established behavioural patterns (e.g. regular car journeys) were partially reversed, while attitudes towards climate-friendly mobility were demonstrably strengthened. This means that participants now pay more attention to environmentally friendly travel, especially travel on foot, and would like to find out how they can travel in a more climate-friendly way. Furthermore, the participants now have a better understanding of the positive effects of walking on their personal health. In the post-test, the effects on individual mobility behaviour were also significant. When looking at the individual level, a positive trend could be observed, i.e., the average of 54 walking minutes per day which the players stated at the beginning was increased by 26% to 68 walking minutes per day. According to the observed modal split, cars were no longer used daily by any of the players on short distances of less than 5 km, while, at the same time, the share of pedestrian traffic was demonstrably increased. In reference to the transtheoretical model, the most volatile stage 3 showed a positive influence, leading to more participants planning to walk more in the future.

The limitations of this study include the small sample size for the post-test, as well as the elaborate test design, which would be difficult to reproduce. Through a variety of different measures, an attempt was made to keep the dropout rate as low as possible. Despite these measures, the local campaigns were only visited by a quarter of the participants, mainly because of time constraints. This was despite the fact that an attempt was made to locate the venues in such a way that they could be easily visited during a workday routine – both in terms of time and location.

Future concepts could further emphasize the modular approach and highlight key features such as the step counter, the daily targets, as well as information on the positive effects of walking.

7 CONCLUSION

In the Walk Your City project, a behavioural and game-based pedestrian initiative with a focus on the nudging method was designed, developed and evaluated. Through the unique combination of online nudges triggered via the Time2Walk app and offline nudges provided through local campaigns in lively places, participants were motivated to explore and experience the city Graz on foot. Walking was to be perceived as a healthy means to cover short distances, with the ultimate goal being to anchor walking as a stable habit. The applied nudging framework was able to influence attitudes towards walking, as well as increase knowledge about the positive effects of walking, and to change the existing mobility behaviour patterns.

8 ACKNOWLEDGEMENTS

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Wohnungsnot und Siedlungsentwicklung in wachsenden Metropolregionen – Planspiel für politische Entscheidungsträgerinnen und Entscheidungsträger

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1 ABSTRACT

Städte wie Stadtregionen in Deutschland sehen sich zunehmend mit einer neuen Wohnungsnot konfrontiert – insbesondere in wachsenden Ballungsregionen wird es eng. Laut Prognosen und Vorausberechnungen wird sich diese Entwicklung in Zukunft weiter fortsetzen. Spannungen auf den jeweiligen Wohnungsmärkten äußern sich marktwirtschaftlich in teils extrem gestiegenen Miet- und Immobilienpreisen in der Region. Auf Grund anhaltender sozioökonomischer und demographischer Entwicklungen mit sich verändernden Bevölkerungs- und Haushaltsstrukturen verschärfen sich dabei in dicht besiedelten Stadtregionen die Diskussionen um die Schaffung notwendigen zusätzlichen Wohnraums auf der einen und dem „Flächen sparen“ auf der anderen Seite.

Mit Blick auf Wohnungsnot und das im Rahmen der nationalen Nachhaltigkeitsstrategie formulierte Ziel „30 Hektar minus X“ bis hin zur Flächenkreislaufwirtschaft ergibt sich ein scheinbarer Konflikt zwischen der notwendigen Schaffung neuen Wohnraums zur Linderung der Wohnungsnot und der ebenso notwendigen Reduzierung der Flächeninanspruchnahme.

In den durch „Wachstumsschmerzen“ gekennzeichneten Stadtregionen stehen sich dabei unterschiedliche Akteure der Stadt- und Regionalentwicklung sowie politische Entscheidungsträgerinnen und Entscheidungsträger von den unterschiedlich geprägten Kommunen mit ihren Positionen und Motivationen im Bereich der Siedlungsentwicklung in multiplen Konstellationen gegenüber. Die derzeitigen Verfahren, Konzepte und Planungsinstrumente der Raumplanung zur Sicherung einer nachhaltigen Siedlungsentwicklung scheinen an ihre Grenzen zu stoßen und einer Ergänzung unter anderem durch persuasive Instrumente zu bedürfen, um in politischen Entscheidungsprozessen die Konzepte überzeugend zu vermitteln.

Ein mögliches persuasives Instrument ist ein Planspiel, mit dem eben diese Rolle der überörtlichen Raumplanung, mit einem zusätzlichen Fokus auf Moderation, Beratung und Integration in politischen Entscheidungsprozessen „gelebt werden“ kann. Ein solches Planspiel wurde im Rahmen eines Masterprojekts von Studierenden der Masterstudiengänge „Stadt- und Regionalentwicklung“ sowie „Umweltplanung und Recht“ am Fachbereich Raum- und Umweltplanung der Technischen Universität Kaiserslautern zur beschriebenen Problematik in wachsenden Ballungsregionen entwickelt und soll in diesem Beitrag vorgestellt werden. Es adressiert die politischen Entscheidungsträgerinnen und Entscheidungsträger der Gemeinden eines Regionalverbands und bietet als spielerisches Instrument eine Möglichkeit, die Diskussion der Themen Wohnungsnot und Flächeninanspruchnahme verständlich zu gestalten und zu einer Bewusstseinsbildung anzuregen. Die Durchführung kann darüber hinaus zu einer nachhaltig verbesserten interkommunalen wie regionalen Kooperation beitragen. Gleichzeitig wird in diesem Artikel dargelegt, wie es im Rahmen der universitären Lehre darüber hinaus als Lehrmethode eingesetzt werden kann.

Keywords: Siedlungsflächenentwicklung, Regionalplanung, Regionalentwicklung, Bauleitplanung, politische Entscheidungsträgerinnen und Entscheidungsträger

2 WOHNUNGSNOT UND SIEDLUNGSENTWICKLUNG – VERÄNDERTE ANFORDERUNGEN AN DIE PLANUNG

Die Steuerungsansätze der Raumplanung zur Siedlungsentwicklung bestehen auf Basis gesetzlicher Vorgaben im Wesentlichen aus planerischen Festlegungen in der Regional- und Bauleitplanung mit einer unterschiedlich stark ausgeprägten Abstimmung und integrierten Vorgehensweise der örtlichen und überörtlichen Ebenen, wobei sich der Vollzug der von Stadt- und Regionalplanung „gewünschten“

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Siedlungsentwicklung auf kommunaler Ebene unterschiedlich darstellt. Die fehlende Nutzung planerisch vorbereiteter und gesicherter Flächen sowie ein fehlendes Bewusstsein für den Wohnraummangel seitens der politischen Entscheidungsträgerinnen und Entscheidungsträger und eine nicht ausreichende Übernahme von Verantwortung für die Schaffung von Wohnraum sind hierbei als Hemmnisse zu nennen. Problematisch stellen sich zudem eine oft unzureichende stadtregionale Kooperation, eine zunehmende „NIMBY-Haltung" seitens der Bürgerinnen und Bürger, schwierige Eigentumsverhältnisse und die unzureichende Aktivierung bei Potentialflächen sowie ein fehlendes Bewusstsein über die Wirkungen der Flächeninanspruchnahme dar.[1] Der Einfluss der Regionalplanung ist hierbei oft begrenzt. So können Kommunen nicht zur Ausweisung von Flächen gezwungen, sondern eher Ausweisungen an suboptimalen Standorten verhindert werden. „Die formalen Instrumente der Regionalplanung erweisen sich als effektiv, wenn es darum geht, Wachstumsbestrebungen einzelner Gemeinden auf ein aus überörtlicher Sicht vertretbares Maß zu begrenzen."[2] Es fehlt somit an stadtregionalen Sichtweisen, an der Akzeptanz regional aufgestellter Siedlungskonzepte sowie einer allgemeinen Bewusstseinswende. Schon seit einigen Jahren wird die Notwendigkeit und die Leistungsfähigkeit von, die planerischen Festlegungen ergänzenden, „persuasiven Instrumenten" zur Beratung, Überzeugung und Konfliktmoderation in solchen Problemsituationen diskutiert.[3]

2.1 Regionalplanung und kommunale Bauleitplanung im Spannungsfeld von Flächensparen und Wohnungsnot

Prägend für das System der räumlichen Planung in Deutschland ist die föderalistische Staatsordnung mit den Ebenen des Bundes, der Länder und der Kommunen. Kompetenz- und Aufgabenverteilung entsprechen dabei einem System dreier Planungsebenen rechtlicher, organisatorischer und inhaltlicher Abgrenzung, welche zugleich durch vielschichtige Informations-, Beteiligungs-, Abstimmungs- und Verbindlichkeitsnormen miteinander vernetzt sind. Wesentlich ist zudem das für alle Ebenen geltende Gegenstromprinzip.[4]

Landes- und Regionalplanung entwickeln überörtlich eine Strategie für eine nachhaltige Siedlungs-, Freiraum- und Infrastrukturentwicklung. Auf kommunaler Ebene erfolgt die Konkretisierung und die Schaffung von Baurecht als wesentliche Voraussetzung zur Realisierung von Vorhaben.

Auf Ebene der Regionalplanung bestimmt basierend auf der Nachhaltigkeitsstrategie des Bundes das Ziel „30 Hektar minus X" mit perspektivischer Flächenkreislaufwirtschaft als handlungsleitendes Prinzip die Steuerung der Siedlungsentwicklung. Der Begriff der „Flächenkreislaufwirtschaft" beschreibt dabei einen strategischen, langfristigen Politikansatz unter dem Leitbild der nachhaltigen und ressourcenschonenden Raumentwicklung mit Etablierung des Kreislaufgedankens bei der Flächennutzung und -entwicklung sowie der Entwicklung und des Einsatzes integrierter Strategien und Instrumente einer dauerhaft umweltgerechten kommunalen und stadtregionalen Bodenpolitik.[5]

Gleichzeitig sieht sich die Regionalplanung insbesondere in den Wachstums- und Ballungsregionen mit der Aufgabe ausreichende Siedlungsflächen für die Schaffung von Wohnraum zu sichern konfrontiert.

Probleme ergeben sich hier jeweils an der Schnittstelle zur örtlichen Ebene, da auf dieser die notwendige Konkretisierung durch die Bauleitplanung erfolgt. So findet sowohl bei der Begrenzung der Flächeninanspruchnahme durch quantifizierte Zielvorgaben als auch bei der Forcierung einer kompakten Siedlungsstruktur durch erhöhte Siedlungsdichten die konkrete Ausgestaltung im Rahmen der kommunalen Bauleitplanung statt. Entsprechend haben die Akteure der kommunalen Ebene eine zentrale Bedeutung in diesem Handlungsfeld.

Die Gestalt neuer Wohngebiete wird wesentlich durch die Wohnwünsche der Bevölkerung beeinflusst, wobei höher verdichtete Strukturen im eigenen Umfeld in der Regel meist abgelehnt werden. Als Folge

[1] vgl. UBA (unveröffentlicht): Kompakte, umweltverträgliche Siedlungsstrukturen im regionalen Kontext; S.9
[2] HEMBERGER, Christoph; KIWITT, Thomas (2018): Gute Bremsen, aber kein Gaspedal!, In Akademie für Raumforschung und Landesplanung (ARL) (Hrsg.): Nachrichten der ARL 01/2018, S. 33
[3] vgl. zum Beispiel: PRIEBS, Axel (1999): Räumliche Planung und nachhaltige Siedlungsentwicklung, In: Raumforschung und Raumordnung 4/1999
[4] vgl. TUROWSKI, Gerd (2005): Raumplanung, In: Akademie für Raumforschung und Landesplanung (Hrsg.): Handwörterbuch der Raumordnung, S. 895-898
[5] vgl. BBR (2006): Perspektive Flächenkreislaufwirtschaft, Band 1, S. 28

werden auch von den kommunalen politischen Entscheidungsträgerinnen und Entscheidungsträgern weniger dichte Strukturen angestrebt. Die jeweils zu Grunde liegenden kommunalpolitischen Eigeninteressen basieren dabei häufig auf kurz- bis mittelfristigen Finanzüberlegungen auch fehlt es oft an mittel- bis langfristigen strategischen Überlegungen zur Siedlungsentwicklung. Für die Umsetzung kompakter, umweltverträglicher Siedlungsstrukturen ebenfalls hemmend wirken zudem interkommunale Konkurrenzen.[6]

Neben dem häufig fehlenden Bewusstsein seitens der politischen Entscheidungsträgerinnen und Entscheidungsträger für die Thematik einer sparsamen Flächeninaspruchnahme fehlt es weiterhin an einem regionalen Bewusstsein für Wohnungsnot für die verschiedenen Nutzergruppen in wachsenden Ballungsräumen. Dies drückt sich dadurch aus, dass regionalplanerisch ausgewiesene Siedlungsflächenpotenziale unzureichend genutzt bzw. aktiviert werden. Dieses Phänomen haben Hemberger und Kiwitt plakativ mit der „Null Bock auf Bauland"-Haltung beschrieben[7]. Verschärfend wirken zudem die oft geringe regionale Kooperation und der auf den eigenen Wirkungsbereich beschränkte Blickwinkel („Kirchturmdenken"), wobei die Rolle der eigenen Kommune zur Lösung der Wohnungsnot häufig nicht problemadäquat wahrgenommen wird.[8]

Neben den zumeist eher restriktiv wirkenden Festlegungen der Regionalplanung zur Steuerung der Siedlungsentwicklung, hat die Regionalplanung auch einen Entwicklungsauftrag, der von den Planungsträgern bundesweit sehr unterschiedlich ausgefüllt wird. Dieser Entwicklungsauftrag bietet die Möglichkeit neben den weitgehend formalisierten Festlegungen zur Steuerung der Siedlungsentwicklung auch Formate der Information, Kooperation und Bewusstseinsbildung zu nutzen, um einen regionalen Konsens über die künftige Siedlungsentwicklung zu erzielen. Die Stärkung interkommunaler und regionaler Kooperationen bildet in diesem Rahmen ebenso wie der Aufbau von Vertrauen einen wesentlichen Anhaltspunkt bei der Reduzierung der Flächeninanspruchnahme und kann das klassische Instrumentarium der Regionalplanung sinnvoll ergänzen. Ein möglicher Ansatz zur Realisierung dieser Anforderung an die Planung und Ergänzung des klassischen Instrumentariums können Planspiele sein.

2.2 Planspiele in der räumlichen Planung

Planspiele dienen der Abschätzung einer Entscheidung bzw. eines Eingriffs in ein System und haben mit Strategie- und Kriegsspielen ihren Ursprung im militärischen Bereich. Etabliert hat sich die Methodik zudem in den Sozialwissenschaften sowie im ökonomischen, politischen und pädagogischen und im Unternehmensbereich.[9] Im deutschsprachigen Raum werden so aktuell rund 300 Beschreibungen von Planspielen für den Einsatz in der schulischen und außerschulischen politischen Bildung in einer online verfügbaren Datenbank der Bundeszentrale für politische Bildung gelistet.[10]

Innerhalb der Planungswissenschaften erlebte die Methodik bereits Ende der 1960er Jahre ihren Höhepunkt. Sie ist damit nicht neu, erfährt aber seit den 1990er Jahren eine Renaissance als Lehrmethode sowie zur Antizipation möglicher Konflikte in der Planung. In der Politik fanden Planspiele in der Vergangenheit z.B. bei Erlass und Novellierung von Rechtsvorschriften Anwendung. Zweck ist zumeist die Bewusstmachung oder Prüfung von Verhaltensweisen und Auswirkungen von Entwürfen, wozu den Teilnehmerinnen und Teilnehmern an Hand eines Modells der Realität entsprechende Handlungsentscheidugen abverlangt werden.[11] Durch Abstraktion erlauben Planspiele damit die realitätsnahe Simulation komplexer Gesamtabläufe und Zielkonflikte, bei der teamorientiertes, ganzheitliches und vernetztes Denken und Handeln im Vordergrund stehen. Die Teilnehmerinnen und Teilnehmer profitieren durch aktives Handeln und Ausprobieren von Entscheidungen in Teamsituationen, der Wahrnehmung eigener Qualitäten und

[6] vgl. UBA (unveröffentlicht): Kompakte, umweltverträgliche Siedlungsstrukturen im regionalen Kontext, S. 9-13
[7] HEMBERGER, Christoph; KIWITT, Thomas (2018): Gute Bremsen, aber kein Gaspedal!; In Akademie für Raumforschung und Landesplanung (ARL) (Hrsg.): Nachrichten der ARL 01/2018, S. 34
[8] vgl. HOFFMANN, Renée; MAERTENS, Raphaela; RÖHRICH, Alena; ROOS, Lukas (2017): Unveröffentlichter Bericht des Master-Projekts im SoSe 2017, S. 1-3
[9] vgl. DIEKMANN, Peter; LEPPERT, Heribert (1978): Planspiel und Planspiel-Simulation in der Raumplanung, S. 4
[10] vgl. Website Bundeszentrale für politische Bildung, abgerufen am 18.01.2020 unter: http://www.bpb.de/lernen/for-mate/planspiele/65585/planspiel-datenbank
[11] vgl. SCHOLLES, Frank (2001): Planspiel, In: Fürst, Dietrich / Scholles, Frank (Hrsg.): Handbuch, Theorien + Methoden der Raum- und Umweltplanung, S. 326-328

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Kernkompetenzen[12] sowie der Entwicklung eigener Diskussions- und Entscheidungsstrategien und Problemlösungen.[13]

Bedingt durch den hohen Aktivierungsgrad erzeugt die Methodik zudem Verhalten bzw. Verhaltensmuster, die auch im beruflichen Alltag der Teilnehmerinnen und Teilnehmer beobachtet werden und selbst in die Analyse und Entscheidungsfindung einbezogen werden können. Planspiele eignen sich daher nicht nur als interaktive Lehr- und Lernmethode, sondern ebenso als mögliches Trainings- und Sensibilisierungsinstrument für komplexe Planungs- und Entwicklungsaufgaben.[14] Innerhalb der Planungswissenschaften finden sich neuere Anwendungsfelder für Planspiele z.B. im Rahmen des MORO-Forschungsfeldes „Lebendige Regionen – aktive Regionalentwicklung als Zukunftsaufgabe“[15] sowie als MORO-Planspiel „Anpassung peripherer Siedlungsstrukturen“[16] zum strategischen Rückzug aus von Leerstand betroffenen Einzellagen und Ortsteilen wieder. Klassischerweise beinhaltet ein Planspiel drei Komponenten:

- die Modellierung einer ausgewählten Realität (Setting),
- wesentliche Akteure der (Teil-)Realität (Rollen) sowie
- zuvor festgelegte Spielregeln (Aktionsmöglichkeiten der Spielerinnen und Spieler).

Der Spielrahmen kann dabei fiktiv oder einer realen Situation entlehnt sein, die Festlegung erfolgt gemeinsam oder durch die Moderation. Sie bildet zudem die erste Spielphase, woran sich der Spielverlauf an sich und die Nachbereitung mit Auswertung und Transfer anschließen.[17] Der Spielverlauf gliedert sich zudem in mehrere Planspielzyklen mit den Elementen Simulation, Reflexion und Neuorganisation.[18]

3 KONZEPTION DES PLANSPIELS

3.1 Adressaten und beabsichtigte Lernziele

Ausgehend von den zuvor skizzierten Hemmnissen im Spannungsfeld von Regionalplanung und kommunaler Bauleitplanung sowie der fehlenden überörtlichen Sichtweise der politischen Entscheidungsträgerinnen und Entscheidungsträger auf die beiden Themenfelder Reduzierung der Flächeninanspruchnahme und Behebung der Wohnungsnot, adressiert das entwickelte Planspiel politische Entscheidungsträgerinnen und Entscheidungsträger an der Schnittstelle von überörtlicher und örtlicher Planung. Potenzielle Teilnehmerinnen und Teilnehmer stellen die jeweiligen Lokalpolitikerinnen und Lokalpolitiker der Mitgliedsgemeinden eines regionalen Planungsverbandes dar. Gemeinsam stellen diese die politischen Schlüsselakteure zur Reduzierung der Flächeninanspruchnahme bei gleichzeitiger Linderung der Wohnungsnot in wachsenden Metropolregionen dar.

Entsprechend der komplexen Problematik verfolgt das Planspiel mehrere Zielsetzungen innerhalb der beiden Zielbereiche „Wohnungsnot“ und „Reduzierung der Flächeninanspruchnahme“. Wohnungsnot soll demnach grundsätzlich als gemeinsame, das bedeutet regionale Problematik, erfasst und dieser mit einer regionalen Strategie begegnet werden. Insbesondere für die sich oft nicht unmittelbar betroffen fühlenden Umlandgemeinden – Wohnungsnot wird häufig vorwiegend als ein Problem der Kernstadt der wachsenden Metropolregion angesehen – wird ein Lerneffekt zu Gunsten eines stärkeren Beitrags zum Wohnungsbau beabsichtigt. Allgemein soll dabei das Bewusstsein für eine regionale Strategie und Verantwortung gefestigt werden.

[12] vgl. ÖAR-Regionalberatung GmbH (2002): Systemische Instrumente für die Regionalentwicklung, Endbericht, S. 100f
[13] vgl. BISCHOFF, Ariane; SELLE, Klaus; SINNING, Heidi (2005): Informieren Beteiligen Kooperieren, S. 246f
[14] vgl. ÖAR-Regionalberatung GmbH (2002): Systemische Instrumente für die Regionalentwicklung, Endbericht, S. 100f
[15] vgl. Bundesministerium für Verkehr und digitale Infrastruktur (BMVI) (Hrsg.): Lebendige Regionen – aktive Regionalentwicklung als Zukunftsaufgabe, MORO Informationen Nr. 16/2, 2017, S. 11ff
[16] Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) im Bundesamt für Bauwesen und Raumordnung (BBR), abgerufen am 27.01.2020 unter: https://www.bbsr.bund.de/BBSR/DE/FP/MORO/Studien/2017/anpassung-siedlungsstrukturen/03-ergebnisse.html
[17] vgl. BISCHOFF, Ariane; SELLE, Klaus; SINNING, Heidi (2005): Informieren Beteiligen Kooperieren, S. 246f
[18] vgl. SCHOLLES, Frank (2001): Planspiel, In: Fürst, Dietrich / Scholles, Frank (Hrsg.): Handbuch, Theorien + Methoden der Raum- und Umweltplanung, S. 326-328

Die gegenseitige Vermittlung unterschiedlicher kommunaler Sichtweisen soll dabei ebenso gefördert werden wie die Erkenntnis, dass das Problem der Wohnungsnot nicht alleinig durch die Kernstadt gelöst werden kann. Letztlich sollen der Aufbau eines regionalen Bewusstseins und gegenseitigen Verständnisses zu einem Ablegen des gemeindlichen „Kirchturmdenkens“ beitragen.[19]

Im zweiten Zielbereich soll zur Reduzierung der Flächeninanspruchnahme zunächst ein Bewusstsein für die Thematik geschaffen werden. Zur möglichst flächenschonenden Schaffung neuen Wohnraums ist dazu die Sensibilisierung der Teilnehmerinnen und Teilnehmer hinsichtlich der Erhöhung von Wohndichten und Nachverdichtungen im Bestand beabsichtigt, auch soll das generelle Erfordernis des „Flächensparens“ vermittelt werden. Über diese beiden inhaltlichen Zieldimensionen hinaus eröffnet das Planspiel die Möglichkeit eines zusätzlichen Kommunikationskanals, welcher mittel- bis langfristig über die Zusammenführung der Kommunen hinaus einen interkommunalen Austausch fördern und das Thema der regionalen Siedlungsentwicklung neu positionieren soll.

Darüber hinaus gewährt das Planspiel Einblick in die Komplexität der regionalen Siedlungsflächenentwicklung und zeigt auf, mit welchen Restriktionen sich die Regionalplanung konfrontiert sieht. Ausgehend von den genannten Lernzielen steht das Planspiel unter dem Slogan „Regional denken. Strategisch planen. Gemeinsam entwickeln“.

Die Durchführung des Planspiels kann sowohl während der Aufstellung des Regionalplans zur Entwicklung oder Vermittlung und Akzeptanzprüfung einer regionalen Strategie zur Siedlungsflächenentwicklung als auch nach Planbeschluss zur Akzeptanzstiftung und Förderung der Umsetzung einer regionalen Strategie zur Siedlungsflächenentwicklung erfolgen. Während der Aufstellung können die Kommunen jedoch maßgebenden Einfluss auf die Planinhalte nehmen, potentielle Rollen der jeweiligen Kommunen in der Region können im Spiel verdeutlicht und gestärkt werden. [20]

3.2 Spielbeschreibung und -ablauf – „Setting“ des Planspiels

Den Spielrahmen bildet die fiktive Region „Viveratal“ mit der Kernstadt „Viverach“ und einer Reihe unterschiedlich großer Umlandgemeinden. Die Fläche der gesamten Region beträgt 2.500 km² und beherbergt bereits etwa zwei Millionen Einwohnerinnen und Einwohner, davon rund eine Million in der Stadt Viverach. Ziel des Spiels ist die Erarbeitung einer regionalen Strategie zur Bereitstellung weiterer 250.000 Wohneinheiten in der Region. Auf Grund attraktiver Rahmenbedingungen ist der Siedlungsdruck in der Kernstadt enorm, kann aber nur abgefangen werden, wenn auch im Umland Baulandpotentiale aktiviert werden. Gleichzeitig stellt sich der umgebende Landschaftsraum als sehr hochwertig dar, woraus sich das Erfordernis einer möglichst geringen Flächeninanspruchnahme ableitet.

Gespielt wird, abhängig von der Teilnehmerinnen und Teilnehmerzahl, in drei bis vier Gruppen zu vier bis sechs Personen an jeweils eigenen Gruppentischen. Die Teamspielerinnen und Teamspieler spielen explizit miteinander und sind dazu angehalten, eine gemeinsame Strategie zur Bereitstellung der zusätzlichen 250.000 Wohneinheiten zu entwickeln. Jedes Team erhält dazu ein gemeinsames Spielbrett, welches in Abbildung 1 dargestellt ist.

Bei der Gruppeneinteilung ist auf eine gemischte Zusammensetzung zu achten, für einen optimalen Erfahrungsaustausch nehmen, bei Teilnahme von zwei Vertreterinnen und Vertretern einer Kommune, diese in jeweils unterschiedlichen Teams teil. Die Durchführung des Planspiels obliegt einer externen Moderation, welche im Spielverlauf als Ansprechpartnerin oder Ansprechpartner fungiert und durch die Veranstaltung führt. Zu Beginn der Veranstaltung ist eine allgemeine Einführung in die Themen „Wohnungsnot“ und „Flächeninanspruchnahme“ vorgesehen, bei der die beiden Begriffe kurz eingeordnet und in deren Rahmen auch die Aufgabenstellung und Spielregeln erläutert werden. Für die Einführung ist etwa eine halbe Stunde, für die gesamte Veranstaltung sind – ohne Vorbereitung und inoffiziellen Ausklang – rund 2,5 Stunden angesetzt.[21]

[19] vgl. HOFFMANN, Renée; MAERTENS, Raphaela; RÖHRICH, Alena; ROOS, Lukas (2017): Unveröffentlichter Bericht des Master-Projekts im SoSe 2017, S. 2f

[20] vgl. HOFFMANN, Renée; MAERTENS, Raphaela; RÖHRICH, Alena; ROOS, Lukas (2017): Unveröffentlichter Bericht des Master-Projekts im SoSe 2017, S. 2-4

[21] ebenda

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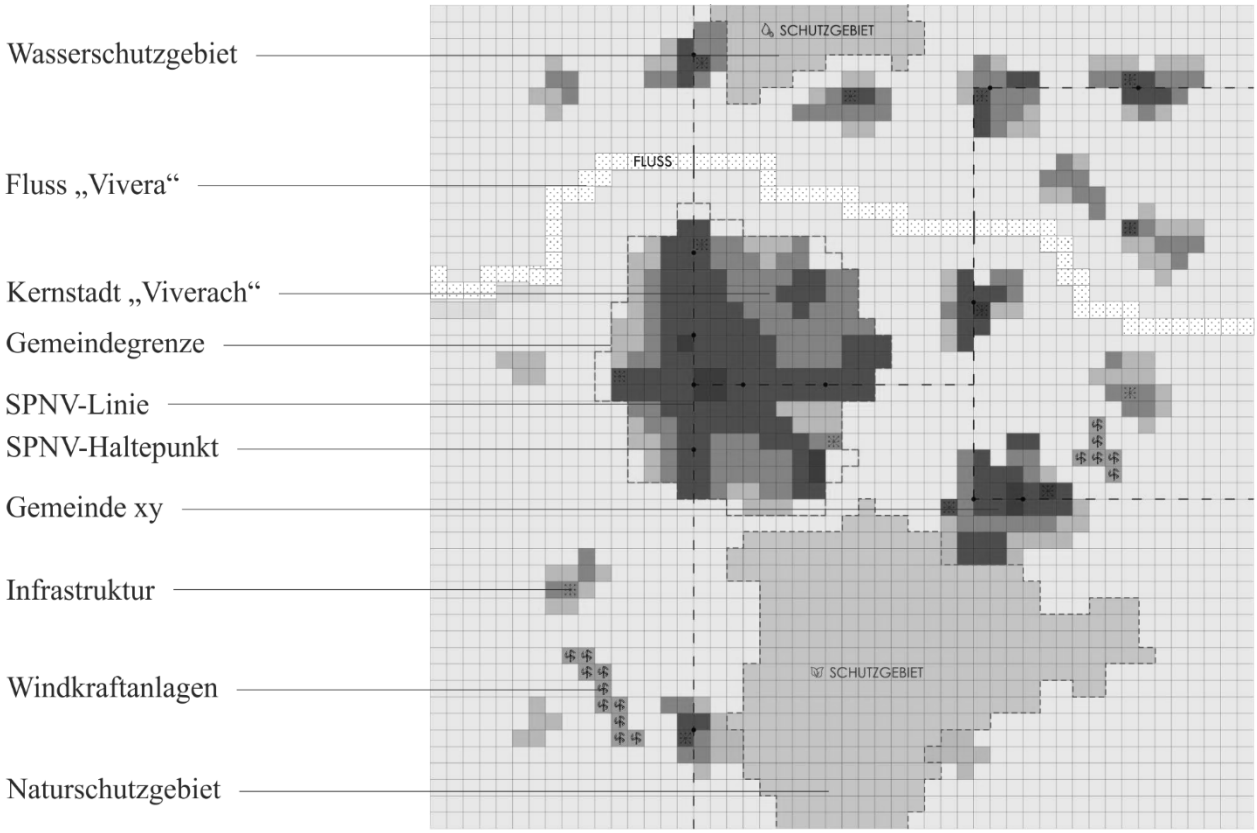

Abb 1: Planspiel für politische Entscheidungsträgerinnen und Entscheidungsträger – Spielfeld[22]

In einer ersten Spielrunde, für welche etwa 45 Minuten angesetzt sind, sind die Teams aufgefordert, den in der Region zu deckenden Wohnungsbedarf von 250.000 Wohneinheiten durch Legen der erhaltenen Neubauplättchen in der Region zu verteilen. Relativ schnell werden die Teilnehmerinnen und Teilnehmer dabei merken, dass die im Starterset enthaltenen Spielplättchen weder innerhalb der Siedlungsgrenzen der Kernstadt noch auf dem Spielfeld insgesamt untergebracht werden können. Im Rahmen einer zur Verfügung stehenden Tauschbörse müssen die Teilnehmerinnen und Teilnehmer daher ihre erhaltenen Spielplättchen in Spielplättchen höherer Siedlungsdichte oder Nachverdichtungsplättchen eintauschen.

Nach Abschluss der ersten Spielrunde, in welcher die Teams ihre jeweilige Siedlungsstrategie erarbeitet haben, erfolgt eine erste Reflexion des Spielstands anhand der Zwischenfragen:

- Welche regionale Strategie hat das Team verfolgt?
- Inwieweit trägt der Lösungsvorschlag dem Ziel eines sparsamen Umgangs mit Fläche Rechnung?
- Inwieweit wird dem Anspruch die Wohneinheiten in der Nähe von ÖPNV-Haltestellen zu verorten Rechnung getragen?

Ziel dieser Fragen ist die Anregung einer kritischen Reflexion des bisherigen Spielstands, welche den Teams eine Anpassung ihrer Strategie ermöglichen soll. Angeregt werden soll zudem ein stark vereinfachter Prozess der Abwägung, welche als planerische Kernkompetenz in der Regionalplanung eine zentrale Rolle einnimmt. Für politische Entscheidungsträgerinnen und Entscheidungsträger ist der Abwägungsprozess häufig nicht nachvollziehbar und tranparent, da sie sich bei den Stellungnahmen im Rahmen von Planungsprozessen lediglich mit den kommunalen Eigeninteressen der durch sie vertretenen Kommune beschäftigen und nicht direkt in einen Kommunikations- bzw. Aushandlungsprozess mit anderen Interessensvertreterinnen und Interessensvertretern (Fachplanungen, Verbänden etc.) eintreten. Für Anpassung und Weiterentwicklung ihrer Strategie steht den Teams anschließend eine zweite Spielrunde von 30 Minuten zur Verfügung.[23]

[22] Eigene Darstellung nach: HOFFMANN, Renée; MAERTENS, Raphaela; RÖHRICH, Alena; ROOS, Lukas (2017): Unveröffentlichte Moderationsvorlage zum Planspiel des Master-Projekts im SoSe 2017, S. 6

[23] vgl. HOFFMANN, Renée; MAERTENS, Raphaela; RÖHRICH, Alena; ROOS, Lukas (2017): Unveröffentlichter Bericht des Master-Projekts im SoSe 2017, S. 4f

Abschluss der offiziellen Veranstaltung bildet eine finale Diskussionsrunde zur Einordnung der verschiedenen Strategien zur regionalen Verteilung der Wohneinheiten. Dazu werden die Spielfelder mit den Ergebnissen aufgehängt und zusammen mit der zu Grunde liegenden Strategie von den jeweiligen Teams in der Runde vorgestellt. Durch die Moderation sollen an dieser Stelle erste Vergleiche gezogen und konstruktive Kritik geäußert werden. Im Anschluss erfolgt eine anonyme Abstimmung, bei der die Ergebnisse von allen Teilnehmerinnen und Teilnehmern hinsichtlich verschiedener Kriterien bewertet werden:

- Anbindung möglichst vieler Wohneinheiten an den ÖPNV
- Flächensparsame Siedlungsflächenentwicklung
- Dichte der Wohneinheiten
- Versorgung der neuen Wohneinheiten mit Infrastrukturen
- Entlastung der Kernstadt „Viverach“ und damit regionale Strategie der Siedlungsentwicklung.

Die Abstimmung kann mittels klassischem Moderationsmaterial oder digitaler Abstimmungsgeräte erfolgen. Letztere erleichtern die anonyme Abstimmung und zeigen diese direkt in der Präsentation an. [24]

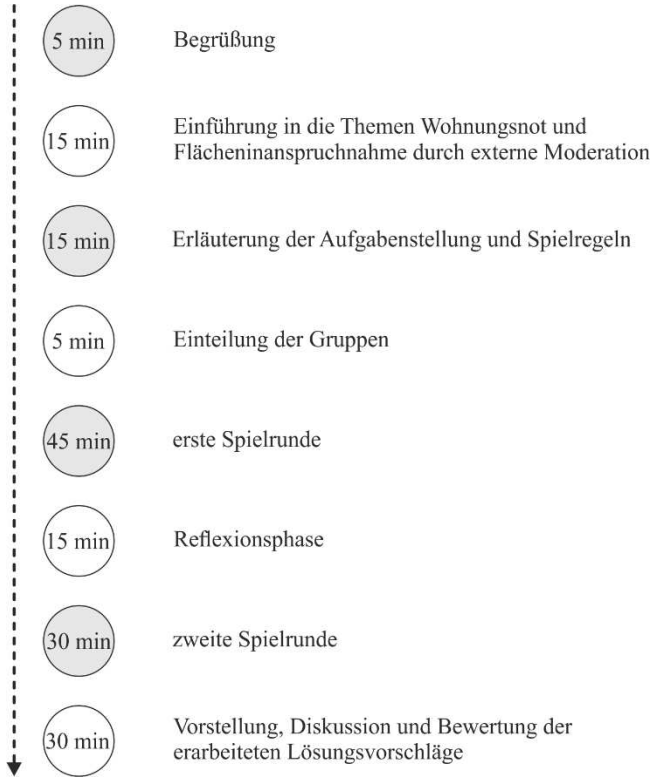

Abb. 2: Planspiel für politische Entscheidungsträgerinnen und Entscheidungträger – Ablaufdiagramm für eine Abendveranstaltung

3.3 Spielelemente

Das Planspiel besteht aus mehreren Komponenten und Arbeitsmaterialien. Dies sind zum einen magnetische Spielbretter im DIN A0 Format, welche neben dem Spielfeld mit Siedlungsstrukturen, Naturschutzgebiet, Wasserschutzgebiet, dem Fluss Vivera, SPNV-Netz, Windkraftanlagen und Infrastruktureinrichtungen auch einen Überblick zu den Spielregeln, Restriktionen und Dichtewerten beinhalten. Letztere werden durch Fotos entsprechender Baustrukturen beispielhaft aufgezeigt. Die magnetischen Spielplättchen decken jeweils einen Quadratkilometer ab und passen genau auf die gerasterte Spielfläche. Für Neubauplättchen bestehen hierbei verschiedene Dichtewerte von 20, 40, 60 und 100 Wohneinheiten pro Hektar. Nachverdichtungsplättchen haben einen pauschalen Dichtewert von 20 Wohneinheiten pro Hektar. Weiterhin enthalten sind ein frei legbares Infrastrukturplättchen zur eigenständigen Schwerpunktsetzung bei der Siedlungsentwicklung und eine Restriktionsschablone zur Wahrung der Abstandsflächen und Filterung vorhandener Potentialflächen.

[24] vgl. ebenda

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Die Moderation erhält zudem eine Umrechnungsmatrix für die Durchführung der Tauschbörse sowie ein umfassendes Moderationsheft. [25]

3.4 Spielregeln

Jedes Team erhält zu Beginn des Spiels ein Starterset mit jeweils 61 Spielplättchen unterschiedlicher Dichte zum Bau neuer Wohngebiete, einem Infrastrukturplättchen sowie einer Schablone zur vereinfachten Anwendung der Regeln. Die Summe der Spielplättchen ergibt 250.000 Wohneinheiten und verteilt sich auf

- 4 mal 100 WE/ha,
- 14 mal 60 WE/ha,
- 20 mal 40 WE/ha sowie
- 23 mal 20 WE/ha.

Spielregeln bestehen hinsichtlich dem Bauen auf der „Grünen Wiese“ und der Nachverdichtung bestehender Siedlungsstrukturen. Insgesamt steht die Vermittlung der zuvor beschriebenen Lernziele im Vordergrund. Beim Legen von Neubauplättchen bestehen dabei Restriktionen durch Abstandsflächen zu Windkraftanlagen oder ausgewiesenen Schutzgebieten. Auch das System der zentralen Orte, wird durch die Ausrichtung an bestehenden Infrastrukturkapazitäten vermittelt. Weitere Regeln beziehen sich auf das Einfügen in die nähere Umgebung sowie den Schutz von Grünzäsuren zwischen benachbarten Siedlungsbereichen. Die Spielregeln zum Neubau werden, wie in Abbildung 3 gezeigt, zur besseren Verständlichkeit für die Teilnehmerinnen und Teilnehmer auch graphisch erläutert[26]

Entsprechend der real begrenzten Potentialflächen im Außenbereich ist der Neubau von Wohnungen auf der „Grünen Wiese“ an der Kernstadt im Planspiel durch die Gemeindegrenze beschränkt. Außerhalb der Grenze sind Neubauten daher nicht mehr zulässig, worauf der Fokus auf eine Innenentwicklung gelenkt und auch der gesetzlich geltende Vorrang der Innenentwicklung vermittelt wird.

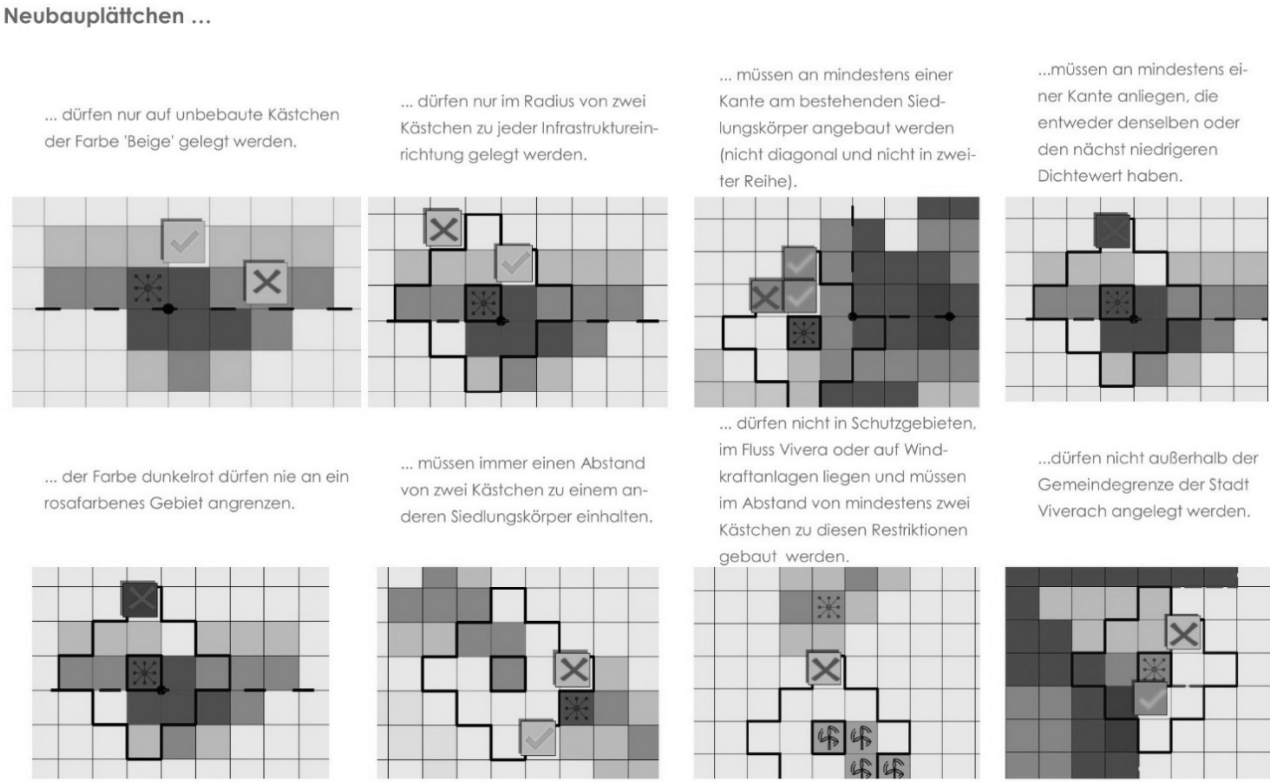

Abb 3: Planspiel für politische Entscheidungsträgerinnen und Entscheidungsträger – Regeln zur Verortung von neuen Wohneinheiten[27]

[25] vgl. HOFFMANN, Renée; MAERTENS, Raphaela; RÖHRICH, Alena; ROOS, Lukas (2017): Unveröffentlichter Bericht des Master-Projekts im SoSe 2017, S. 5f
[26] vgl. ebenda
[27] ebenda, S. 12

Bei einer Nachverdichtung finden die für den Neubau geltenden Einschränkungen durch Restriktionen wie Abstandsflächen oder die Beachtung von angrenzenden Dichteeinheiten bestehender Siedlungsstrukturen keine Anwendung. Diese wird daher innerhalb des Planspiels gegenüber einer nach außen orientierten Siedlungsentwicklung bessergestellt, wodurch eine entsprechende Diskussion und darüber Sensibilisierung der Teilnehmerinnen und Teilnehmer erzielt werden soll. Gleichzeitig ist das Nachverdichtungspotenzial in der Kernstadt begrenzt, um ein regionales Konzept einzufordern, welches nicht einseitig die Kernstadt zur Bereitstellung neuen Wohnraums in die Pflicht nimmt. Die Spielregeln zur Nachverdichtung sind ebenfalls graphisch dargestellt und werden in Abbildung 4 gezeigt.[28]

Nachverdichtungsplättchen sind nicht Teil des Startersets, welches alle Teams zu Spielbeginn erhalten. Sie können jedoch beliebig und ohne mengenmäßige Beschränkung im Rahmen einer Tauschbörse bei der Moderation gegen Neubauplättchen getauscht werden. Menge und Art der getauschten Spielplättchen richten sich stets nach der Summe der jeweiligen Wohneinheiten, so dass gewährleistet ist, dassam Ende des Spiels alle Gruppen ein Konzept zur Verteilung der 250.000 Wohneinheiten in der Region entwickelt haben.[29]

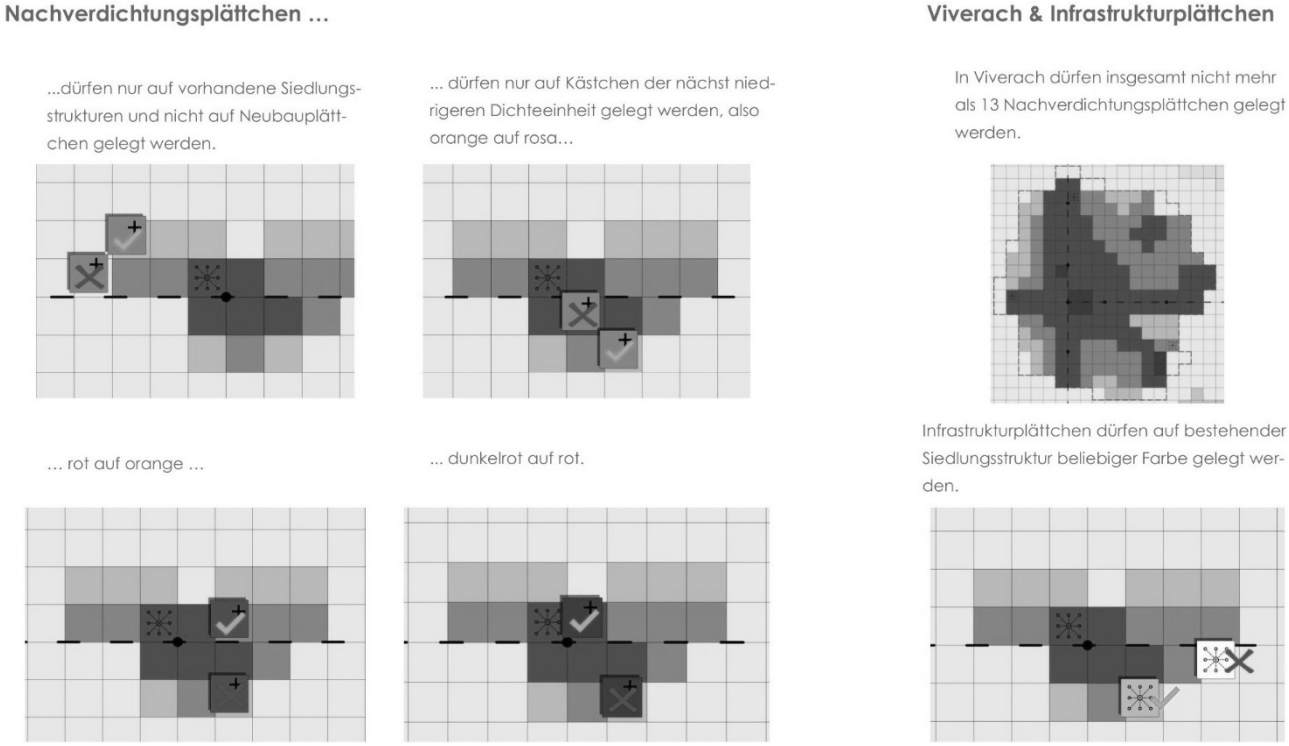

Abb 4: Planspiel für politische Entscheidungsträgerinnen und Entscheidungsträger – Regeln zur Nachverdichtung und Verortung des Infrastrukturplättchens[30]

4 ERFAHRUNGSBERICHT UND FAZIT

Das für politische Entscheidungsträgerinnen und Entscheidungsträger konzipierte Planspiel wurde als Testlauf im Rahmen der Ausbildung von Bachelorstudierenden der Raumplanung erprobt. Im Rahmen der Lehrveranstaltung „Strategien und Konzepte der Raumordnung“ wurde das Planspiel zweifach mit Studierenden des dritten Semesters durchgespielt. Sowohl die Durchführung des Planspiels an sich als auch die anschließende Diskussion und Bewertung der Spielergebnisse und Strategien zur Siedlungsentwicklung erfolgten nach dem im Beitrag beschriebenen Aufbau und Vorgehen.

Die Studierenden waren hierzu aufgefordert, ihr Vorgehen bei der „Lösung“ der Aufgabe zu beschreiben, darzulegen ob und gegebenenfalls welche regionale Strategie gewählt wurde, die Egebnisse entsprechend zu begründen und hinsichtlich der zuvor gelernten Siedlungsstukturprinzipien einzuordnen.

Anknüpfungspunkte bildeten etwa das Vorgehen anhand einzelner Restriktionen oder die Überlegung einer stringenten Gesamtstrategie sowie die grundsätzliche Haltung zur Nachverdichtung bestehender

[28] vgl. ebenda.
[29] vgl. ebenda
[30] ebenda, S. 14

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Siedlungsstrukturen und die Platzierung des Infrastrukturplättchens. Abweichend von der Konzeption des Planspiels erfolgte die Bewertung jedoch nicht anonymisiert, sondern mittels offener Abfrage und Abstimmung mit Klebepunkten. Grundlage bildeten die Fragen:

- In welcher Strategie wird am wenigsten Fläche neu in Anspruch genommen?
- Welche Strategie verfolgt eine klare Orientierung an ÖPNV-Haltepunkten?
- In welcher Strategie wurde das Infrastrukturplättchen am sinnvollsten eingesetzt?
- Welche Strategie ist am sinnvollsten bei der Nachverdichtung vorgegangen?
- Welche regionale Strategie erscheint Ihnen insgesamt am nachhaltigsten?

Einen Auszug der Spielergebnisse sowie die Bewertung an Hand verschiedener Kriterien zeigt Abbildung 5.

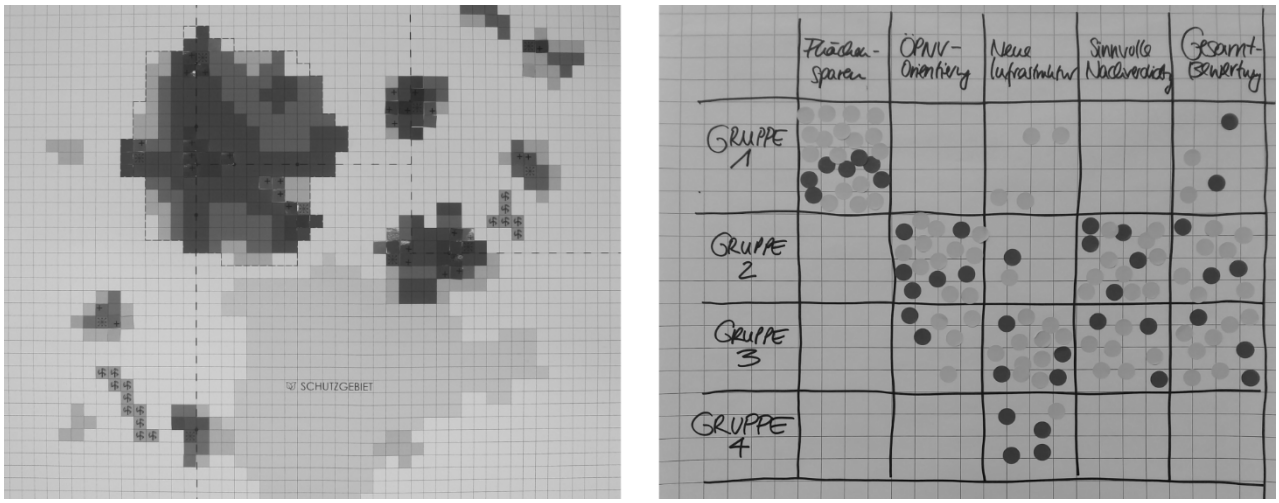

Abb 5: Planspiel für politische Entscheidungsträgerinnen und Entscheidungsträger – Spielergebnis einer Gruppe und Bewertung aller erstellten Strategien[31]

Nach praktischer Anwendung erscheint das konzipierte Planspiel unter mehreren Gesichtspunkten für den Einsatz in der Lehre sinnvoll. So erfordert die Methode nicht nur eine allgemeine Auseinandersetzung mit der Thematik und trägt schon damit zur Bewusstseinsbildung bei, auch führt die Forderung nach Auswahl und Argumentation eines zu wählenden Strategieansatzes zur generellen Diskussion um die Anwendung und Umsetzung unterschiedlicher Siedlungsstrukturprinzipien auf regionaler Ebene sowie zu der Entwicklung einer eigenen Haltung und Kompetenz zur Formulierung, Darstellung und Begründung einer entsprechenden regionalen Siedlungsstrategie. Die fachliche Vertiefung in der Lehre erfolgte unter anderem noch durch eine weiterführende Diskussion darüber mit welchen Instrumenten der Raumordnung – insbesondere mittels welcher Festlegungen in Regionalplänen – eine entsprechende Siedlungsentwicklung gefördert werden könnte. Die unterschiedlichen Handlungslogiken verschiedener Akteure in diesem Spannungsfeld konnten ebenfalls – anhand der praktischen Erfahrungen aus und in der Spielsituation – vertiefend reflektiert werden. Hierzu wurde für die zweite Spielrunde eine Modifikation vorgenommen, welche in der praktischen Anwendung mit politischen Entscheidungsträgerinnen und Entscheidungsträger bereits immanent ist – die Vergabe spezifischer Rollen zur verstärkten Auseinandersetzung und Kommuniation eigener Zielvorstellungen. Als Rollen vergeben wurden dabei diverse Bürgermeisterinnen und Bürgermeister, eine Naturschützerin oder ein Naturschützer und eine Regionalplanerin oder ein Regionalplaner.

Nach den Erfahrungen aus der praktischen Test-Anwendung des Planspiels lässt sich sagen, dass es für die ursprünglich konzipierte Zielgruppe als ein geeigneter Baustein zur Bewusstseinsbildung und regionalen Diskussion angesehen werden kann. Die hinterlegten fachlichen Prinzipien funktionieren in der praktischen Anwendung und fördern eine Diskussion – auch über „Defizite“ der fiktiven Region, beispielsweise das eher zu geringe Netz an schienengebundenem Nahverkehr.

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Active Mobility as a Response to Physical Inactivity in Cities

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1 ABSTRACT

In an era of increasing urbanization intertwined with growing motorized transport modes, one of the main challenges that both developed and developing countries face is physical inactivity and sedentary lifestyle of people, which may negatively affect their health due to overweight and obesity. Since the built urban environment both concentrates human activities and shapes activity patterns, its characteristics can have a significant mediating role in reducing or enhancing physical activities as well as active mobility of residents such as walking and cycling. To stimulate physical activity and active mobility across all social groups, planners and policymakers should address context- and people-specific health-related aspects in planning and governing the built environment in cities and urban neighborhoods, defined as health-oriented urban planning. The importance of this approach will be multiplied by considering urbanization as the predominant way of life for most people in the world on the one hand, and active mobility as an inclusive alternative compared to other individual-based interventions in the area of health on the other. On this base, this research aims to explore and explain the relationship between built environment characteristics and the active mobility of residents in urban communities. It will do so by a literature review on how built environment characteristics and context and socioeconomic conditions are associated to enact physical activity/active mobility.

Keywords: Physical Activity, Built Environment, Active Mobility, Health-Oriented Urban Planning, City

2 INTRODUCTION: THE BUILT ENVIRONMENT AND ACTIVE MOBILITY

The built environment can be explained as a physical form of community and its anthropogenic surroundings that provide the setting for human activity, ranging in scale from buildings to neighborhoods and cities. Urbanism is integral to human ecology, and physical activity patterns of human populations who live in urban areas are now affected by forms and functions of cities. Pervasive and rapid urbanization and simultaneously industrialization, mechanization, and motorized transportation, have reduced the level of physical activity (Ulijaszek, 2018).

In return, physical activity has numerous health benefits and is key to preventing or reducing non-communicable diseases, and especially overweight, obesity, and depressive symptom. Adults need 150 min of moderate physical activity per week, and children with less than 18 years old require 60 min of moderate-vigorous physical activity per day (Day, 2018; Lin, 2018). Accordingly, "World Health Organization advocates strategies that target entire populations, including the design of environments to promote physical activity for transportation and recreation as part of everyday life, or active living" (Day, 2018, p. 303).

These strategies have identified active mobility as an alternative for minimizing sedentary lifestyles, reducing risks of consequent chronic diseases such as obesity and diabetes, and improving health standards by increasing physical activity levels (Gao et al. 2018; Vich, Marquet, and Miralles-Guasch, 2019). Unlike passive travel, active travel, concerns which includes the physical activity of locomotion such as walking and biking, have environmental benefits such as a decrease in carbon emission and reduction of traffic congestions (Helbich, 2017; Lin, 2018). It also has numerous benefits regarding the wellbeing of people, including happiness, contentment, engagement, and relaxation (Bornioli, Parkhurst, and Morgan, 2019).

Meanwhile, improvements in built environment characteristics can be a good part of this transition through health-oriented urban planning. Poor quality of sidewalks, limited access to recreational facilities, and lack of available nearby destinations are possible causes of inactivity by decreasing physical activity/active mobility. Besides, built environments have long lasting, positive or negative, effects on the health outcomes of entire populations (Day, 2018; Sallis et al. 2018). On the other hand, built environment characteristics vary in

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supporting physical activities, including active mobility and especially walking. Bornioli, Parkhurst, and Morgan (2019) state that "a strategy to promote active mobility in the built environment can be constructed around safety, comfort, and moderate sensory stimulation" (p. 200).

Therefore, active mobility, which relates to health, physical activity, and chronic disease prevention, has been considered increasingly in transportation and urban planning studies aimed at alternatives for motorized transport. Hence, many studies show evidence of the relationship between neighborhood-scale built environmental characteristics, such as density, land-use, and connectivity, and travel behavior centered on active transportation modes. The pervasive effect of density, land-use, type of urban fabric, and slope of terrain on urban mobility, especially concerning automobile travel reduction and non-auto trip encouraging, are some of the findings that are being assessed by these studies. Safe walking and cycling accessibility about well-connected streets, walking paths, sidewalks, bike infrastructures and bike lanes, traffic safety, and less motorized traffic are other neighborhood features that have been considered (An et al. 2019; Ferrer and Ruiz 2018; Gao et al. 2018; Helbich, 2017; Lindelow et al. 2017).

In short, there is a crucial opportunity for urban planners to plan and design cities and neighborhoods which are conducive to physical activity, especially by active mobility. Nevertheless, this great goal would not be realized without significantly understanding the relationship between built environment characteristics and physical activity patterns, especially active mobility. The quality and nature of diverse types of neighborhood scale-built environment may diversely affect active lifestyle among residents (An et al. 2019). Thus, findings must be assayed more to gain more insight into the associations between built environment characteristics and the active mobility of residents in urban neighborhoods (Gao et al. 2018). Supplementing with neighborhood scale-built environment measures could acquire more reliable and valid understanding and filling the knowledge gap concerning the context and socioeconomic based significant relationship between environmental characteristics and active mobility. Therefore, facing the challenge of increasing physical inactivity and subsequently overweight and obesity, yet it is necessary to explain the role and impact of the built environment, aimed at increasing physical activity and active mobility and reversing that growing threatening tendency in terms of motorized transport and passive lifestyle (Lin, 2018).

This paper aims to explore and explain the relationship between built environment characteristics and active mobility of residents in urban communities. It carries out a literature review to find the answer to the critical question as, "how do the built environment characteristics affect the active mobility as physical activity in urban neighborhoods?" Thus, we focus on recent scientific articles that are more significant to the topic regarding the relationship between the built environment and active mobility. The selection was made by reviewing the title, abstract, and content among some of the sources and to reach an initial theoretical framework for presenting at the conference and getting feedback from the audience.

3 ASSOCIATION BETWEEN THE BUILT ENVIRONMENT AND ACTIVE MOBILITY

Relationships between physical activity and health status are more and more recognized in the literature (Ulijaszek, 2018). Successful health advance includes educational supports as well as environmental backgrounds concerning the behavior as a function of both personal factors and environmental necessities (Poortinga et al. 2011). The built environment plays a vital role in supporting both recreational and utilitarian physical activity behavior in terms of going walking or walking to a destination (Chaudhury et al. 2016). The walkable community encourages active mobility by walking or bicycling to destinations and accordingly contributes to residents' physical activity (Sallis et al. 2018). Lindelow et al. (2017) say that "the travel behavior of residents in a neighborhood can partly be explained by the fact that residents have selected to live in a neighborhood that they perceive lives up to their preferences of, for instance, walkability. Consequently, neighborhoods with a large share of walking could be understood as consisting of residents that have chosen to live where they perceive walking to be feasible, pleasant, etc., in addition to the built environment itself encouraging walking" (p. 520-521).

Lee at al. (2015) believe that "there is growing evidence that neighbourhood environment, such as green space, parks and pedestrian environment, is associated with physical activity and various health outcomes, especially obesity-related diseases. However, among the possible factors contributing to physical activity and obesity-related diseases, little is known about the urban neighbourhood environment, such as slopes or street patterns, and trigger factors that encourage residents to walk" (p. 1205). So, all the factors should be

evaluated in two mutual hypotheses. The first hypothesis demonstrates that obesogenic environments[1] in terms of low-walkable and automobile-oriented neighborhoods with few facilities for physical activity may direct residents to be inactive based on spending more time in their cars or doing more sedentary recreation, including television viewing and computer gaming. Regarding increasing physical activity as a key health-based strategy, the second hypothesis as an alternative indicates the physical activity as a possible mechanism for achieving health outcomes influenced by the neighbourhood environment. Nevertheless, socioeconomic status disparities in built environment variables are essential as effect modifiers of the relationship between built environment characteristics and health-related outcomes (Lee, 2015; Sallis et al. 2018).

According to focus on walking and cycling as suitable types of physical activities for all age groups, which allow them to change the inactive and sedentary lifestyles through their favorite intensity, three classifications are possible concerning purposes, factors and characteristics, and the mechanism of impact. Regarding the purposes, these two modes of active mobility can be further divided into two categories of transport, aims at reaching a destination, and leisure, addresses achieving entertainment. Moreover, it is necessary to identify and distinguish between personal and social factors as well as natural and built environmental characteristics that have a significant role in this regard. Meanwhile, some physical built environment conditions and features act as motivators or incentives, and some act as barriers or obstacles to physical activities. The motivators and barriers that affect each other are as following (Wang, Chau, and Leung, 2016):

(1) Motivators or incentives: Opportunities including availability and suitability of facilities and shortening the distance, Safe accessibility such as improving personal security, and improving transport safety, and Physical setting in terms of increasing comfort level and provision of supporting facilities;

(2) Barriers or obstacles: Opportunity barriers such as limited foot and cycling paths and lack of land for recreation, Accessibility barriers including travel distance, poor access to the facilities, and no interesting destinations, Safety barriers in terms of unsafe foot or cycling paths, traffic safety, and security of exercise place, and Physical setting barriers such as lack of pleasant routes, discomfort, and no supporting facilities.

Further, regarding the widely accepted influence of environmental factors on usual physical activity, the conceptual framework should be contextualized to local conditions, and local targeting of health-based policies might be more effective in promoting active mobility. So, it is necessary to analyze the area-specific significant association between built environmental and socioeconomic factors and active mobility in forms of walking and cycling to or from work, in different locations. The socioeconomic levels or individual factors of the environment are expected to be related to physical activity as well as active mobility. They can be considered as a percentage of foreign residents, unemployed, part-time workers, university graduates, homes occupied by their owners, car owners, households with a parking space, and median income. The built environment factors which are associated with transportation-based physical activities are as following (Feuillet et al. 2015):

(1) Land use and facilities including the percentage of area covered by individual housing, collective housing, vegetation cover, as well as proximity facilities density;

(2) Level of walkability and bikeability such as walk and bike paths conditions and bike-sharing facilities;

(3) Public transport availability in terms of the distance to the nearest subway, bus or train station from each home;

While many research studies provide evidence for the relationship between neighborhood design and active mobility, the impacts happen at the neighborhood level. Ferrer and Ruiz (2018, p. 111) believe that “in addition to meso-scale (or neighborhood scale) built environmental factors such as residential density, land use mix or street connectivity, special attention should be given to micro-scale (or street level) built environment characteristics, such as the presence of trees, the width of the sidewalks, and the quality of the streets, as the roles of micro-scale elements are not well understood due to limited data availability”. They

[1] Obesogenic environments descibe specific aspects of living environments which facilitate overeating relative to need and partaking in sedentary activities. They are characterized as involving a great preponderance of motorized transport and sedentary occupations and encouraging the consumption of high-fat and energy-dense foods (Poortinga et al. 2011; Ulijaszek, 2018).

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have analyzed factors of the built environment affecting the decision to walking in the form of a short trip as less than 30-45 min walking distance. On this base, main characteristics of the built environment influencing walking as an active mobility are safety from crime (street lighting, people's presence, cleanliness), traffic safety (traffic volume and speed and times of crossing waiting), walking facilities (sidewalk width, obstacles), aesthetics (green elements, buildings, noise), convenience, and other perceptions (car parking availability, hills, and pedestrian volume, open and wide spaces, and length). Meanwhile, they are also could be classified as barriers or deterrents and facilitators or motivators to walking. Insecurity from crime (absence of people, inadequate lighting at night or walking along a conflictive area), the density of traffic lights, walking along large avenues, lack of sidewalks, and steep streets are the main barriers or deterrents to the decision to walking. On the other side, lack of car parking space at the destination, pleasant walking routes, city with short distances, pedestrian streets and hard to drive (driving restriction zones or stress due to traffic congestion) are the primary facilitators or motivators to the decision to walking (Ferrer and Ruiz, 2018).

In another study, Zandieh et al. (2016) indicated that outdoor walking level is the most common type of health-beneficial physical activity associated with the built environment in a residential neighborhood. However, most previous analyses have considered macro built environment characteristics as inclusive design and structure, including residential density, mixed land-use, and route connectivity. Accordingly, it is necessary to focus also on micro built environment characteristics, which can be modified more easier than macro ones. They include safety (well lighting, people's presence, and crime rate), pedestrian infrastructure (traffic condition, sidewalk condition, and amenities) and aesthetics (trees, attractive sights, and buildings) in the neighborhood. Moreover, spatial inequalities in perceived built environment characteristics may affect disparities regarding neighborhood support for walking (Zandieh et al. 2016). In addition to the walking, studies show the association of the individual or sociodemographic attributes as well as the built and natural environmental characteristics with cycling transportation as a type of physical activity. However, it seems that this relationship is context-specific, primarily based on small, medium, and large-sized cities and urban areas. Besides, the purposes of cycling transportation are different, as travel-related cycling and recreational cycling. Gender, age, household structure, household income, education, ethnicity, and car ownership are the main individual variables concerning the significant relationship between environment and cycling. Address density, land use diversity, street density, number of bus stops, and distance to train station are important built environmental variables. Finally, the proportion of green space (parks, agricultural and natural areas), water spaces, daily max air temperature, daily precipitation sum, and daily average wind speed are the critical natural ones in this regard (Gao et al. 2018).

4 CONCLUSION

There is no doubt about the key role of the everyday living environment in personal and public health. This issue has become more and more important in recent decades due to the predominance of mechanized life and sedentary lifestyles. The built environment can motivate the physical activity of individuals as an inevitable necessity or demotivate them as a serious challenge. Active mobility as a type of physical activity is one of the critical areas in this vision due to its multiple roles and functions in addition to promoting health through physical activity. Therefore, focusing on active mobility is a vital opportunity for researchers in various fields, including urban planners and designers, who also need to analyze the mechanism of its effectiveness and improvement as a great response.

Accordingly, it is necessary to explore and explain the significant association between the built environment characteristics and active mobility. To this end, the first step is to develop a conceptual framework for addressing and clarifying the various aspects of this relationship. Based on the literature review, it is possible to achieve this framework at the theoretical level by considering some areas. First, active mobility as the most usual physical activity can be regarded as walking, cycling, and other forms based on a human-powered street vehicle. Second, Active mobility can have different purposes as utilitarian transport or travel for reaching a destination and attractive leisure or recreation for achieving entertainment. Meanwhile, if we focus on the association between active mobility and substantial characteristics, categorizing factors into two categories of motivators, incentives, and facilitators and barriers, obstacles, and deterrents can well direct us to achieve the practical results.

Besides, focusing on the factors requires a few critical points to consider. On the one hand, socioeconomic or sociodemographic attributes such as gender, age, household structure, education, income, and car ownership are important that differently affect the relationship between the built environment and active mobility. On the other hand, there are significant environmental characteristics that encourage or inhibit the tendency for active mobility. These characteristics can be analyzed in two distinct ways, with the possibility of integration. In the first approach, we can scrutinize the built environmental aspects such as residential density, route connectivity, safety, and sidewalk condition than the natural ones, including slope, air temperature, and presence of trees. Meanwhile, we can peruse all of them from the perspective of macro and meso characteristics which act at the city or neighborhood scale such as residential density, route connectivity, slope, and air temperature than micro ones which have a role at the place or street level including safety, sidewalk condition, and presence of trees. The ultimate key to this approach is acceptance and belief in the fact that the association between the built environment characteristics and the active mobility is context-specific, which leads to disparities in the evidence concerning distinct urbanism and various lifestyle. So, performing numerous and repeated empirical studies in different and diverse contexts completes this path. Efficient and innovative solutions, rather than general and perhaps ineffective, will be the consequence of this orientation.

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A Historic Institutionalist Research on the Protection of Plot Pattern in Chinese Historic Cities, taking Nanjing as an Example

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1 ABSTRACT

Land plots are widely recognised as an essential conservation element of historic cities. However, the protection of plot pattern was in a long time neglected in Chinese urban conservation. China's historic cities have experienced drastic transformation since the socialist revolution of 1949, resulting in a fundamental change in traditional urban forms. Based on historic institutionalism theory, the research explores the transformation of protection of plot pattern in Nanjing, a typical Chinese historic city. According to the changes of main institutions, including land development system, regulatory planning system and conservation planning system, the changing roles of plot in urban conservation can be divided into three stages. The three main attributes of plot, including a morphological element, a control unit of land use and a unit of property, have different performances in each stage. However, a path dependence has been formed through the institutional transformations.

Keywords: urban morphology, plot pattern, conservation planning system, urban transformation, China

2 INSUFFICIENT PROTECTION OF PLOT PATTERN IN CHINESE HISTORIC CITIES

Land plots are widely recognised as an essential conservation element of historic cities. The Washington Charter of 1987 proposed that a primary principle for the protection of historic urban areas is to protect the urban pattern composed of plots and streets. However, the protection of plot pattern was in a long time neglected in Chinese urban conservation. China's historic cities have experienced drastic transformation since the socialist revolution of 1949, resulting in a fundamental change in traditional urban forms.[1] In addition to damage to traditional street patterns and building footprints,[2] the historic plot pattern has also been heavily damaged by constant urban renewals and oversized plots in particular have become a prominent feature of contemporary historic urban areas.

The insufficient protection of plot pattern has promoted questions about the role of plot in Chinese urban conservation system. Plot is not only one of the fundamental elements of urban form but also a key apparatus in land development system and planning control which have significant influences on urban conservation. Affected by a series of institutional changes since 1949, the role of plot in Chinese urban conservation had a great transformation, which has fundamentally determined the protection effect of historic plot pattern. Under this background, this research discusses the development and problems of the protection of plot pattern in Nanjing, a typical Chinese historic city. A historic institutionalist framework is established to analyze the changing roles of plot in Nanjing's urban conservation system, and the path dependence of protection of plot pattern generated in the process of change.

3 A HISTORICAL INSTITUTIONALIST FRAMEWORK IN UNDERSTANDING THE ROLES OF PLOT IN URBAN CONSERVATION SYSTEM

3.1 Three attributes of land plots and the essence of plot pattern protection

Although land plot is one of the fundamental elements of urban form within the field of urban morphology, as it is used to refer to several things, it has multiple attributes. According to existing research, there are three main attributes of plot, including a morphological element, a control unit of land use and a unit of property.[3] First, in the field of urban morphology, plot pattern together with street pattern and building footprints constitute three basic morphological elements of a town plan.[4] Despite being invisible, plot pattern reflects

[1] Deng, He, & Hu, "Exploration on integrated conservation of historic city in the new period-the case of Ningbo"; Lin, "Conservation of historic and cultural cities in the context of the new normal"

[2] Chen, " Study on urban morphological evolution of contemporary Suzhou"; Li & Dong, "An integrated research approach on city map decoding based on reshaping decoding of ancient map of Hangzhou city"; Li & Zhao, " The loss and revival of place characters in urban morphology"

[3] Kropf, " Plots, property and behaviour".

[4] Conzen, "Alnwick, Northumberland: A Study in Town-plan Analysis"; Whitehand, "British urban morphology".

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the land property structure of a city, which is the basis of its urban form.[5] Second, with the property right attribute, plot pattern is obviously affected by urban development policies, land development systems, and various urban codes. Third, plot is widely taken as a basic control unit of urban codes such as zoning system, construction planning and conservation planning, taking control of land use, land development intensity, physical form, protected physical entities (such as buildings or open spaces) and so on.

The protection of plot pattern is closely related to the morphological attribute and property right attribute. The traditional plot pattern of Nanjing old city, formed under private land ownership, is basically composed of a large number of small-scale plots, mostly for residential and commercial uses and is characterized by land subdivision. In fact, plot pattern together with street pattern constitute a morphological framework of a historic city, in which land plot defines the scale of urban renewals. Because of such structural importance, plot pattern has longer and stronger impact on the preservation of historic urban form than building fabric. This is the essential reason why plot pattern should be protected in urban conservation system; specifically, the essence of protection is to preserve the morphological framework molded by subdivision of land property. However, despite plot often serving as a basic control unit in urban planning systems, plot pattern itself, in morphological and property right terms, is not necessarily or effectively protected, which can be shown in many cases.[6]

3.2 A historical institutionalist framework in understanding the roles of plot in urban conservation system

Historical institutionalism (HI) is a social science methodology focusing on the innovation, continuation and change of institution in different times. HI concepts and methods has been increasingly more applied to research agenda for planning history, land development, and urban conservation. It includes three relevant definitions including path dependence, critical junctures, and incremental change processes.[7] Above all, critical junctures involve arguments about crucial founding moments of institutional formation; path dependence suggests that institutions continue to evolve in response to changing environmental conditions and ongoing political maneuvering but in ways that are constrained by past trajectories. For city planning there are two sets of institutions that are closely related: institutions of property, and institutions for creating and managing public space and infrastructure.[8] Institutions are not just rules, but include both formal and informal norms, shared understandings, and standard operating procedures. The interdependencies between co-evolution processes among institutions reinforces path dependence; but ideas provide important resources that help actors interpret existing conditions and to frame and advocate alternative approaches.

Based on these theories, a historic instituionalist framework is established to analyze changing roles of plot in urban conservation system (Fig.1). It consists of four components: critical junctures, incremental change processes of main institutions, changing roles of plot in urban conservation system, and path dependence of the protection of plot pattern. The protection of plot pattern in Chinese historic cities are significantly influenced by three institutions, including land development system, regulatory planning system and conservation planning system. Above all, the property attribute is largely defined by land development system; plot serves as a basic unit of regulatory planning system, taking control of urban development; conservation planning system, directly influencing the protection of plot pattern, is a significant component of the master plan and provides a legal basis for historic city conservation.[9] According to critical junctures of the three main institutions since 1949, the transform of roles of plot in urban conservation system is divided into three stages: (1). From 1949 to 1990, a period when land nationalization, planned economy, and urban conservation system was established and implemented in China; (2). From 1990 to 2010, a period when land use right system (LURs) and regulatory planning system were established and developed; (3). After 2010, a period witnesses developments of conservation planing system in Nanjing due to progresses of conservation ideas.

The research aims to answer three questions: (1). The roles of plot in urban conservation system in different stages and their characteristics; (2). The path dependence of the protection of plot pattern in response to

[5] Stimmann, “Berliner Altstadt”.
[6] Whitehand, Gu, Whitehand & Zhang, “Urban morphology and conservation in China”.
[7] Sorensen, “Taking path dependence seriously”.
[8] Sorenson & Xu, “Interview with Andre Sorensen”.
[9] Guo, “Reflections on the Conservation of Historic City of Nanjing”.

changing institutional conditions; (3). The influence mechanism of three main institutions on the protection of plot pattern.

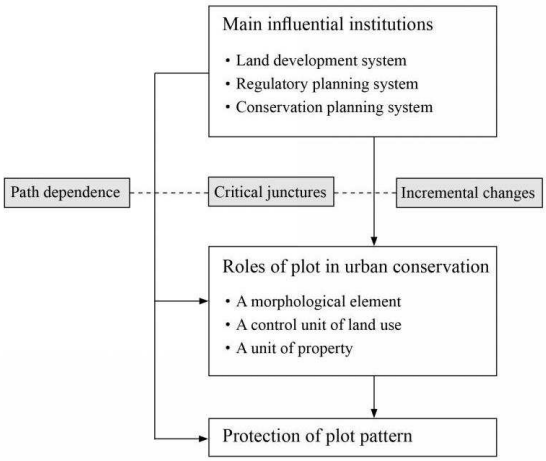

Fig.1 The historic instituionalist framework to analyze changing roles of plot in urban conservation

4 THE CHANGING ROLES OF PLOT IN NANJING'S URBAN CONSERVATION SYSTEM

4.1 Erasing the property right attribute of plot (1949–1988)

China established a command economy and state-owned land system in the 1950s. As the role of the market in distributing land resources had been extinguished, administrative land allocation became the only form of land supply. Until the end of the 1980s, China had no established regulatory planning system or specific plot division procedure for land development; detailed planning, specifically made according to a development plan proposed by the local government, served as the main tool in controlling physical form. Under this background, the role of land plots both as a unit of property and as a unit of control were deprived. They were only regarded as the boundaries of land development, with little impact on the physical form.

Nanjing's conservation planning system was established in 1984 when it was selected as the firstly ratified National Historical and Cultural Cities. In the first conservation plan, four main conservation elements were proposed, including the environment and landscape, urban pattern, architectural style, and protected monuments and sites. However, the focus of conservation was mainly put on protected monuments and landmarks in practices. Plot pattern, deprived of the attribute of property and control unit, was not regarded as a factor significant to the protection of historic urban from.

The conservation and reconstruction of Confucius Temple area started in the middle 1980s was the earliest conservation practices in Nanjing (Fig.2). This area was long as the cultural and commercial center of Nanjing old city, characterized by a landmark cityscape composed of the Confucius Temple complex and the adjacent riverfront commercial and residential area. This historic urban landscape was heavily damaged in the Second World War and reconstructed with modern style buildings after 1949. The conservation program emphasized the restoration of cultural relics and the reconstruction of the landmark building complex according to historic images. However, a majority of traditional commercial and residential buildings in the area were not taken as important components for protecting the historic urban landscape and were demolished for redevelopment. Correspondingly, the historic plot pattern in the area was eliminated and redivided, despite a protection of the traditional street pattern. The general plot width increased to 60m, while a typical traditional plot width in this area was no more than 16m. The plot amalgamation further led to a great reduction in the subdivision of land plots in a block.

4.2 The increasing importance of plot as a unit of control (1988–2010)

The establishment of the Land Use Rights (LURs) system in 1988 reconstructed the land market, greatly promoting the rapid economic growth of China since the 1990s. Chasing economic growth became a primary goal for the local government during this period[10], which was reflected as large-scale land development and

[10] Zhang & Chen, "Understanding Chinese Urban Planning in the Growth-first Politics".

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urban renewal in the old cities. Originally established in early 1990s, the Chinese regulatory planning system was largely regarded as a tool to promote growth and control land development.

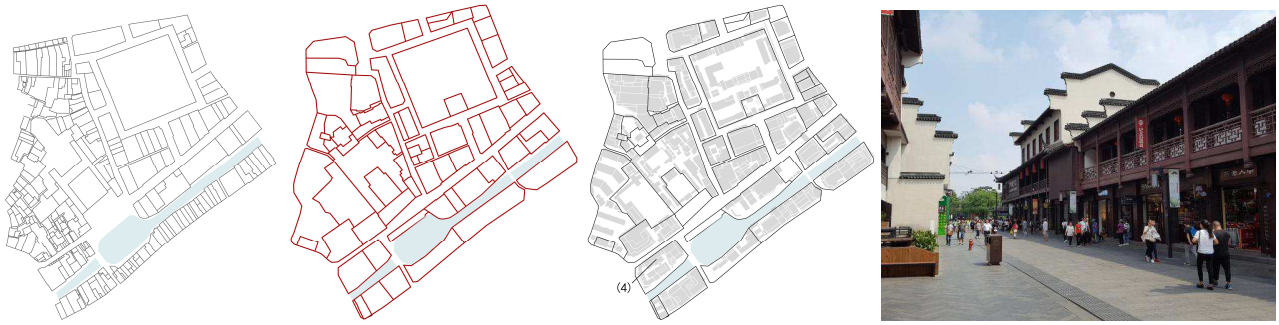

Fig.2 Morphological transformation of Confucius Temple area. Grey lines: original plot pattern; red lines: megaplots as control units; grey mass: building footprints. (1) The original plot pattern, (2) The plot pattern after redevelopment, (3) Overlapping of plot pattern and building footprints after redevelopment, (4) Commercial redevelopment led to an amalgamation of original small scale plots.

Plot serves as a basic unit of regulatory planning to control land use, land leasing, intensity of land development, and physical form of the resulting area. However, in a context of 'growth supremacism', regulatory planning system emphasized the control of land use, land leasing and intensity of land development, while the control of physical form was considered inadequate.[11] First, the principle of plot division are very pragmatic[12], emphasizing the integrity and coordination of land use, and convenience of land leasing. Second, regulatory planners created megaplots in order to attract investment. In Nanjing Old city, a majority of renewed plots are larger than 5000 m², which has caused significant damage to the historic plot pattern.[13] Third, minimum control was exerted over the physical form of urban (re)development. Compared with zoning systems in the United States, for example, many fewer morphological indexes for plot division – for instance, plot size, plot width, and rules of plot arrangement – were well developed in the Chinese regulatory planning system.

Under the background of large-scale renewal of old cities, the urban conservation system in Nanjing had a remarkable progress since the 1990s in which area-based conservation, especially the ideas of historic-cultural conservation areas(HCCAS) was established and became the main approach. The largest progress of HCCAS approach was to recognize the significance of protecting the historic cityscape. Apart from the protected monuments and sites, conservation elements were expanded to historic buildings and structures, historic street pattern and environmental elements. This indicated an expansion of conservation scope; according to the definition of HCCAS, the core conservation scope should be larger than 1ha. In Nanjing Old South area, several vernacular residential areas were designated as HCCAS. Even so, historic plot pattern was not regarded as a conservation element, indicating that its significance as a morphological framework in molding urban form had not yet been fully recognized.

Similar to regulatory planning, plot serves as a control unit in conservation planning. In the HCCAS, some historic buildings are designated for protection; other buildings can generally have a major restoration or even reconstruction. According to the regulation of HCCAS, the proportion of listed monuments and historic buildings should take up at least 60% of the whole area. However, this proportion was much lower in many practical cases. This means a small number of historic buildings together with their plots are designated for protection; the other land plots in HCCAS are merged into several megaplots as control units for reconstruction. As a result, buildings, streets and other environment elements within the control units of reconstruction substantially cannot be effectively protected. As the the historic plot pattern is erased, an inherent morphological framework is lost. Therefore, the reconstruction scheme of street pattern, building layout and building forms tend to be very volatile, far from an authentic historic conservation.

This problem was fully shown in the case of Nanbuting area where the conservation and reconstruction started from 2001 (Fig.3, Fig.4). This is a typical residential historic district, characterized by the national

[11] Huang & Tian, " Morphological division theory and its application in China's old cities"; Gao & Ding, " Correlation analysis on urban morphology and related urban laws and regulations in China".
[12] The technical regulations of Nanjing Regulatory Planning in 2005.
[13] Liu, "Smart Plot Division".

protected monument, Ganxi's former residence.[14] In this case, plot served as a basic control unit of the conservation plan, regulating the conservation phase, listed historic buildings, and urban design of reconstruction. From 2001 to 2010, three phases of conservation and reconstruction had been completed. The whole area was designated into 5 megaplots; in each phase the conservation or reconstruction were carried out on 1 to 2 plots.

In the first phase, Ganxi's former residence with an area of 12000 m² , the most important cultural building relics in Nanbuting area was renovated and re-utilized as a folk museum. The second and third phases were renovation and reconstruction of the periphery area, aiming at commercial redevelopment. Apart from few listed historic buildings, a majority of vernacular buildings, taken as bad conditioned, were demolished for reconstruction. The historic plot patterns were totally erased and amalgamated into megaplots. Above all, the plot size of the second phase was about 8000 m²; and the third phase was about 13000 m². The urban design of reconstruction was based on the megaplots, generating new street patterns and building layouts and integrating antique building with few historic buildings. However, as the conservation plan protected too few historic buildings and neglected the importance of historic plot pattern as a morphological framework, the reconstructed urban pattern showed big differences with the original one. In fact, this is an essential reason why the HCCAS approach in many practical cases failed to protect the historic urban landscape.

Fig.3 Morphological transformation of three stages' conservation work in Nanbuting area. First phase, renovatoin of Ganxi's former residence; second phase, reconstruction of Xi'nan Li district; third phase, expansion of Xi'nan Li district; plot pattern and building footprints of Nanbuting area. Grey lines: original plot pattern; red lines: megaplots as control units; black mass: building footprints

Fig. 4: The megaplot based reconstruction of urban pattern in Nanbuting area shows big differences with its original form (Source: http://www.njcjjt.com.cn/pic/?97_555.html). Birdview of first and second phase renovation; Birdview of third phase reconstruction.

4.3 Rediscovering the morphological importance of plot pattern (2002–)

The conservation plan of Nanjing historical and cultural city was made in 2010 when the vast majority of historic cityscape has been heavily damaged by large-scale urban renewals since the 1990s. The shrinking historic cityscape showed the inefficiency of HCCAS approach in protecting the overall historic urban form. Faced with this problem, the conservation plan of 2010 designated three historic urban areas within Nanjing

[14] Originally built in early 19th with an area of 12000m2, it is the largest traditional residential building complex preserved in Chinese cities.

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old city so that ensemble-scale conservation and restoration could be applied. Specifically, the "ensemble-scale conservation" has emphasized three points: first, a structural conservation of morphological elements, including overall street pattern, river network and the city wall; second, an expansion of the conservation scope from small-scale HCCAs to other general areas, even redeveloped areas; third, a recovery of traditional streetscape and limitation of redevelopment intensity. The ensemble-scale conservation also indicated that the onefold building-centered way of conservation must be changed. As plot pattern not only has direct relationship with the building fabric but also provides a morphological framework for a meso-level historic urban area, its morphological importance was rediscovered and applied into the conservation plan.

Of the three historic urban areas, the Old South historic area, with an area of 6.9 km2 preserves a large number of historic sites—monuments and typical traditional cityscape of Nanjing. In the conservation plan of the Old South historic area, a renewal unit strategy was proposed. The principle of this strategy was to recover the role of plot pattern as a morphological framework of the historic urban area, in which small-scale and gradual urban renewals and restorations could be promoted. Renewal unit has six types with different building types and conservation level, including unit of protected buildings, unit of historic buildings, unit of traditional buildings, unit of general buildings, unit of multi-storey buildings and unit of reconstruction. The scope of renewal unit is generally based on the plot boundary of existing buildings; it defines the maximum scale of renewal that could be made within the unit boundary. In fact, renewal unit serves as the role of morphological framework as the plot pattern, with which large-scale renewal is considered to be prevented and historic urban fabric could be continued. Considering the functional and development requirements, an appropriate amalgamation of neighboring units are allowed on the premise that the courtyard-based feature of building footprints can be maintained.

Renewal unit strategy played a critical role in the reconstruction of Changledu district in the Old South area. This district had been demolished in 2006 and was reconstructed as a high-class residential and commercial area after 2010. As the district is located within the scope of historic core, the reconstruction was planned to restore the damaged urban fabric with antique buildings filled into the pattern of renewal units. The reconstruction was characterized by three aspects: (1). recovering traditional street pattern based on the historic map; (2). recovering morphological characteristics of land subdivision through renewal unit strategy; (3). recovering traditional cityscape through a set of design guidance. The reconstruction was essentially based on a 6 ha megaplot, but the renewal unit strategy largely promoted the subdivision of the megaplot at design level. A majority of renewal units kept the traditional scale of plot width about 10m, but developed a relative small plot depth and north-south orientation in order to meet requirements of contemporary building codes and usage habits. Although the scale and form of new antique buildings were in some parts different from the tradition, efforts were made to keep the courtyard-style building footprints so that new buildings could be well integrated into the historic urban pattern.

As the transformation of street pattern, plot pattern and building footprints shown in Fig.5 and Fig.6, the reconstruction of Changledu district was not a complete return to the traditional urban plan. Through the renewal unit strategy, the significance of plot pattern as a morphological framework was re-introduced into urban conservation system, improving the possibility of small-scale urban renewals. In this sense, renewal unit strategy shows a progress of HCCAS approach. However, renewal unit is only a urban design strategy simulating land subdivision, it did not necessarily lead to a subdivision of land property. As the land development mode and regulatory planning system have no fundamental changes since the early 2000s, the attribute of plot as a unit of property is still not reflected in conservation planning system.

Fig.5 Reconstruction of Changledu district (Source: Fig.5.4 is from Planning Bureau of Nanjing, 2011). (1) Original plot pattern; (2) Renewal unit pattern within a megaplot; (3) Original building footprints; (4) Reconstruction of building footprints.

Fig. 6: Although the building footprints constrained by renewal units simulates the tradition, the building form has significant changes in the megaplot based reconstruction of Changledu district.

Main institutions	-1949	1949-1990	1990-2010	2010-
Land development system	Private land ownership	State-owned land system ; Administrative land allocation system	Establishment of LURs; Establishment of Land banking system	
Regulatory planning system		Detailed planning taking control of physical form	Establishment of regulatory planning system	Improvement of control on physical form with integrating urban design
Conservation planning system		Establishment of conservation planning system; Focusing on protected monuments and landmarks	Establishment of HCCAS approach, namely area-based conservation	Ensemble-scale conservation of historic urban areas ; Renewal unit strategy
Roles of plot in urban conservation	Morphological framework of urban form	Erasion of the property right attribute; Marking boundaries of land development	Plot as a control unit in both regulatory planning and conservation planning	The morphological importance of plot pattern was rediscovered; Renewal unit as a urban design strategy without subdivision of land property right

Tab.1 Changing roles of plot in Nanjing's conservation planning

5 PATH DEPENDENCE: PROTECTING PLOT PATTERN WITHOUT SUPPORT OF LAND PROPERTY RIGHT

The changing roles of plot in Nanjing's urban conservation through the three stages has shown a gradual improvement on the protection of plot pattern. However, a path dependence has been formed since 1949; the protection of plot pattern is a long-term lack of support of land property right. The binding effect of land plot in both morphological and property right terms on urban development can be seen from the historic plot pattern that was formed under private land ownership. As the property right attribute of plot has been deprived because the nationalization of land ownership since 1949, the significance of plot pattern as a morphological framework can not be fully performed in urban development. In addition, conservation strategies without support from land property can not be essentially effective.

Affected by the path dependence, the protection of plot pattern has shown several problems: First, there is a dislocation between the boundary of control unit and that of property unit. As conservation planning tends to exert its control via dividing a historic district into few megaplots, the original small-scale land plots can hardly be recognized and protected, which makes a gradual and bottom-up way of urban renewal very difficult to be carried out. (2). Learning the way of plot division from regulatory planning, conservation planning also designates oversized plots and encouraged reconstruction of antique buildings in most cases, which has led to an extinction of historic subdivision-based plot pattern. (3). The absence of a morphological framework and the megaplot based reconstruction in many cases make the restoration schemes volatile and lack of historic authenticity.

The path dependence essentially results from interdependencies between co-evolution processes among land development system, regulatory planning system and conservation planning system. First, the land nationalization since 1949 erased the property right attribute of plot, which promoted the prevalence of administrative land allocation system and planned economy in the next forty years. Specifically, Chinese historic conservation planning system was established during this period, inherently influenced by the institutional conditions and neglected the significance of plot pattern. Second, the establishment of LURs and regulatory planning system largely reinforced the role of plot as a control unit. In the 1990s and 2000s, plot became a significant tool of conservation planning in applying HCCAS approach, but its morphological attribute and property right attribute were largely neglected. Third, the ideas of urban conservation had big progresses after 2010, which promoted conservation planning to recognize the significance of plot pattern as a morphological framework of urban form. The renewal unit strategy improved the planning control of physical form, but it was in lack of a support from property right level. In addition, plot pattern has yet been

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listed as a protection element in conservation planning system. Consequently, the path dependence still has strong an influence on the protection of plot pattern in Chinese historic cities.

6 CONCLUSION

Based on historic institutionalism theory, the research explores the transformation of protection of plot pattern in Nanjing, a typical Chinese historic city. According to the changes of main institutions, including land development system, regulatory planning system and conservation planning system, the changing roles of plot in urban conservation can be divided into three stages. The three main attributes of plot, including a morphological element, a control unit of land use and a unit of property, have different performances in each stage. However, a path dependence has been formed through the institutional transformations; the protection of plot pattern is a long-term lack of support of land property right. Although the morphological significance of plot has been paid more attention in recent years, due to the erasion of the property right attribute, the conservation strategies are not effective. Therefore, the protection of plot pattern lies in a coupling control of morphological elements and property rights ; in order to exert an effective control on the property right, conservation planning system should be more effectively integrated with regulatory planning system and land development system.

Although an institutional change is generally difficult, a progress of ideas about urban conservation can promote the protection of plot pattern in historic cities. In recent years, the Conzenian school of urban morphology, founded by geographer M.R.G. Conzen, has been introduced into China. This theory developed a very detailed, micro-scale framework for analysis largely organised around the plot. Applying this theory, some research explore the morphological transformation of Chinese historic cities,including the changes of plot pattern, and the value of this theory in urban conservation has drawn more and more attentions.[15] These theoretical development will hopefully further stimulate the sense of protecting plot pattern in Chinese urban conservation practices.

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Building the Case for Nature-Based Solutions: Enablers and Barriers in Data-Driven Solutions for Climate Adaptive Developments

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1 ABSTRACT

Global climate change, urbanisation and increasing demand for limited resources are primary challenges facing the sustainable, long-term development of cities. Traditional mitigation of flooding and stormwater management focused largely on technical and infrastructural solutions (e.g. larger pipes, underground storage, 'out-of-sight / out-of-mind' mentality). Yet these 'trusted' conventional infrastructure systems are proving to be neither safe nor cost-efficient solutions for managing the effects of climate change (e.g. flash floods, extreme heat, extended drought) and mitigating the resultant impact on liveability as well as ecology.

In response to the need for more effective, 'climate adapted' tools, blue-green infrastructure (BGI), otherwise widely recognised as nature-based solutions (NBS) – or tools which echo or mimic natural systems and ecosystem services while providing the functional requirements of grey infrastructure such as pipes – have emerged in recent years as suitable measures to for complementing or replacing conventional solutions.

Current available methods for integrating climate adaptive solutions such as NBS and BGI within the urban planning practice are insufficient and lacking when compared to the complexity of city planning today. Calculating the impact of design concepts today is still a highly manual process. The lack of resources both in terms of personnel and finances limits the capability to efficiently test and validate optimal solutions. Often, methods utilized in practice for simulating the effect of climate adapted solutions take too long to get to meaningful results or largely stems from guesswork and assumptions. Viewed in parallel with observations that 1) the loss of green areas to urban development has further challenged the capacity of conventional engineering solutions to the point of failure; 2) global temperatures, heat waves and urban heat island effects will intensify in coming years, leading to issues with water scarcity and drought; and 3) planning cities of the future requires coordinating a diverse group of stakeholder interests, our conclusion that a new method for planning and design is deemed necessary.

We set out to answer the following questions: can the plethora of digital data available be used to create meanginful solutions that can manage, mitgate and adapt to the effects of climate change in the built environment? What barriers must one consider when utilising data-driven, software-based technology as decision-support tools in the field of urban planning? More specifically, what enables the acceptance and applicability of such methodologies compaerd to traditional planning and design processes?

These observations and research queries, combined with the experience of testing tools in the field; retesting and validating the results; and lastly reapplying the results again within professional practice led to the establishment of 'GreenScenario', a rapid iteration and software-based decision-support tool for simplifying climate adaptation planning. The following paper details this path by firstly describing the concept of nature-based solutions in relationship to climate adaptation. Secondly, the results of the 9-year+ R&D process that eventually led to the establishment of GreenScenario are detailed in relationship to the basis for the decision-support tool. Lastly, observations from practice regarding potential enablers and barriers to implementation of data-driven decision-support tools are summarised and compared to the initial results of implementing GreenScenario as a decision-support software, tool and process for urban planning and design.

Keywords: Process-Driven Software Collaboration, Data-Driven Decision Making, Nature-Based Solutions, Blue-Green Infrastructure, Climate Adaptation

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2 INTRODUCTION

2.1 Global conditions and effects of climate change on the urban environment

Urban mega-trends pre-COVID predicted that there would be an increase of movement from rural into urban areas thereby increasing land scarcity, natural resource depletion and climate change issues. Globally, it is estimated that by 2050, approximately 70% of the world's population will live in cities; 80% of global inhabitants could still be living in unplanned settlements with the highest growth rates coming from Africa and Asia; the largest age group will be senior citizens; and population rates could grow by 12% resulting in approximately 8.5 billion people by 2030 (Department of Environmental and Social Affairs, 2017: 1; Revedin, 2014: 8; Stylianidis et al, 2017: 119). Although cities only occupy 3% of the Earth's land, they generate 80% of global gross domestic product (GDP) while responsible for 70% of global energy use and greenhouse gas emissions (United Nations, 2016: 24). By 2050, the cost of 'doing nothing' to mitigate climate change effects in cities is estimated to incur costs in the EU alone in the range of 100-150 billion Euros per year every year, dependent on the climate scenario (COACCH, 2018). The near and long-term effects of COVID-19 will also need to be considered when planning any future development.

2.2 Nature-based solutions (NBS), blue-green infrastructure (BGI)

'Nature-based solutions' (NBS), or similarly 'Blue-Green Infrastructure' (BGI) offer mitigation tools and measures that can adapt to the effects of climate change at the urban city and district planning level. NBS can be defined as 'actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits' (IUCN, 2019). NBS have the capability to complement or even replace traditional grey infrastructure solutions (e.g. pipes) by offering multi-functionality as opposed to monofunctionality (i.e. green roofs or rain gardens not only improve environmental and aesthetic conditions, they satisfy infrastructural requirements and functions while enhancing spatial quality and liveability).

For example, rain gardens are an NBS that can simultaneously manage stormwater, reduces run-off and improve water quality; they provide similar functions as piped solutions. Aesthetically, they are planted, visible and offer an open space element in the urban environment. Additionally, NBS provide ancilliary benefits or 'co-benefits', what could be also be termed as added values that are typically not considered in cost-benefit assessments but are added benefits that can be monetised or quantified in relationship to their effects. Examples include how NBS can directly or indirectly impact health, energy security or ecocsystem rehabilitation as a result of direct impacts to improve microclimate or increased biodiversity rates. These multi-functional advantages are diverse, validating how NBS provide the same functional requirements that hidden infrastructure (e.g. pipes) provide while summarily enhancing the experiential quality of spaces, especially when these elements are visible or tangible (Iwaszuk, Rudik, Duin, Mederake, Davis, Naumann and Wagner, 2019). While there are fine distinctions between the two terms BGI and NBS, for this paper, the term 'Blue-green infrastructure' will be used interchangeably with 'Nature-based solutions' as they both derive from ecosystem service principles. 'BGI integrates hydrological and biological water treatment trains into systems [that] …strengthen urban ecosystems by evoking natural processes in man-made environments and combine the demands of sustainable water and stormwater management with the demands of urban planning and urban life…[BGI] have positive impacts of the urban metabolism of natural resources (added green values) and on the experience and behaviour of people using these infrastructures (added social values).' (Ramboll Foundation, 2016). A comprehensive literature review of BGI was provided by Ghofrani, Sposito and Faggian (2017). BGI tends to be used in literature synonymously with terms such as sustainable urban drainage SUDS, low impact development LID or water sensitive urban design WSUD, terms can potentially vary dependent on country-specific terminology (See Fletcher, 2015).

3 FOUNDATIONAL RESEARCH PROJECTS

As aging city infrastructure fails and extreme weather events increase in intensity and frequency, it is critical that future planning not only plan climate resilient and adaptive but even more so with a climate first approach. This would additionally require integrating such nature-based solutions together with man-made technology (e.g. grey piped solutions), and this from the very beginning of the integrated process. Testing the technical feasibility and economic resiliency of the full range of planning solutions is critical especially at the pre-planning feasibility stage when decisions matter most, as Forziere et al (2018) predict that climate

change has the potential to increase damage to infrastructure caused by extreme weather events ten-fold by the end of the 21st century.

Although several notable research projects related to NBS have been conducted, widespread application of NBS tools is still limited, especially in view of the lack of changes in governmental regulations or construction standards (OECD, 2020). The United Nationa's Sustainable Development Goal 11 supports this assertion – Make cities and human settlements inclusive, safe, resilient and sustainable – and points to the necessity of an integrated, non silo-based process for multi-stakeholder involvement in urban planning.

The following section discuss three key events undertaken by Ramboll / Ramboll Studio Dreiseitl in the exploration of methods to utilise decision-support tools in practice, and are ultimately precursors to the development of the GreenScenario platform.

(1) The Copenhagen Cloudburst Masterplan and subsequent pilot project implementation: this masterplan serves as the official strategic planning element for local area plans in Denmark. It was initiated as a result of large-scale flooding in the Danish capital in the summer of 2011 that caused over USD $ 1 billion damage (GDV, 2019), and was a primary initiator in combined large-scale / small-scale approaches to climate adaptation strategies in view of climate change effects on cities.

(2) The BMBF (German Federal Ministry of Education and Research) funded 'KURAS' project (Konzepte für urbane Regenwasserbewirtschaftung und Abwassersysteme / Innovative concepts for urban stormwater management and sustainable wastewater systems): conducted from 2013-2016.

(3) The subsequent follow-up BMBF funded 'netWORKS4' project (Resilient Networks: Beiträge von städtischen Versorgungssystemen zur Klimagerechtigkeit / linking blue-green-grey infrastructure and their multi-functional benefit for citywide infrastructural systems, climate adaptation, and climate justice): conducted from 2016-2019.

3.1.1 Key results Copenhagen Cloudburst Masterplan (See Leonardsen, 2013; Read, Nyerup Nielsen and Leonardsen, 2013; Ramboll, 2019)

- Establishment of methodological process for managing issues with stormwater, flooding and cloudburst events for an entire city in response to design, engineering and economic principles.
- Integration of risk modelling and design iteration beyond municipal boundaries and borders.
- Inclusion of economic cost-benefit cost-of-doing-nothing assessments early in the planning process.
- Inclusion of 'co-benefits' to understand the full range of opportunities and potentials from BGI.
- Creation of a 'Toolbox' of suitable BGI elements flexible for use on multiple sites (e.g green roofs, green facades, changing street profiles, integrating with existing infrastructure and pipes, etc.)
- Acknowledgment of the important role played by stakeholders in the co-creation process.
- Current status: identification of approximately 300 pilot projects across the whole city to be implemented over a period of 30 years, with early projects including Sankt Anna Plads renovated in 2018 and Kokkedal Urban Renovation completed in 2019. These project aim at decoupling 30-40% of stormwater from the mixed sewer system in order to balance the expected increase of up to 40% more extreme rainfall over the next century.

3.1.2 Key results KURAS research project (See Matzinger et al, 2014; Bundesministerium für Bildung und Forschung, 2014; Madichati, Möller and Otterpohl, 2019)

- Through the involvement of academia, industry and municipalities the KURAS project pooled the multifaceted expertise of wastewater system and stormwater management technology and expertise to develop a standardised planning methodology applicable for integrated stormwater management (e.g. green roofs, swales, etc.) in urban arears.
- Results showed that a targeted combination of measures across various levels of interventions (from smaller building and plot scales moving up to the district, neighbourhood and up to the urban catchment area) have a positive effect on both the environmental quality as well as the less tangible yet equally important social quality enhancement for residents and visitors.

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- Effects were made quantifiable via modelling, simulation as well as qualitative observation; the results have become a part of Berlin-specific planning with stormwater and water resources.

3.1.3 Key results netWORKS4 as they relate to establishing basis for the decision-support tool (See DIFU and ISOE websites (Networks 4, 2019); Roualt et al, 2019; Winker et al, 2019).

- Creation of communication material for expanding awareness related to the topic of BGI in the format of 'Info-Cards'. These info-cards are physical instruments that have been tested n real-life case studies with cities to develop concensus-based development plans.
- These practice-based tests allowed for a refinement of the planning process that was first established during the KURAS project. The 3-phase systematic planning process was revised to include Phase 1 (data collection, analysis, setting of project goals); Phase 2 (selection of suitable tools, testing and development of options); and Phase 3 (optimisation and refinement of solutions).
- Communication with stakeholders both internal and external was a key result of this research project. The two project sites, Berlin and Norderstedt, had stakeholders with varying levels of awareness of BGI as well as diverse interests. By testing the viability of the revised planning methodology on the real-life projects, the feedback and input of stakeholders could be utilised in the design process.
- netWORKS4 PLUS is a follow-up research project initiated that will continue research on the topic of blue-green-grey infrastructure, and will be supplemented by Horizon2020 RECONECT.

4 ESTABLISHING THE COLLABORATION PLATFORM GREENSCENARIO

4.1 Key research questions as basis for exploration

Various research questions regarding the barriers and enablers for planning with NBS and BGI tools began formulating in 2017 following the end of the KURAS research project and the start of the netWORKS4 project. In 2018, through trial-and-error testing in Berlin and Norderstedt as the two pilot project sites for netWORKS4, three concrete research questions were formed which have served as the basis for exploring and testing methods best suited when planning with digital decision-support tools and platforms.

(1) Why are elements for planning climate adaptive often adapted less frequently and implemented as exceptions rather than standards?

(2) What practical methods, material and information or data is necessary in order to properly communicate and convey the complex requirements of climate adaptive planning?

(3) How can we enable informed decisions to be made early in the overall planning process and thereby reduce risks when investing in blue-green infrastructure or nature-based solutions?

Armed with these three questions, we entered long-term experiment that combined practice and theory that focused on how to support climate adaptive planning and design by utilising innovations in digital decision-support tools. The three steps are listed below and further explored in the following section.

Step 1: refine the planning methodology necessary by testing in practice

Step 2: ideate, explore and develop

Step 3: build, test and implement in the field

4.2 Step 1: refine the planning methodology necessary by testing in practice

The commencement of Step 1 can be concretely attributed with the process and results of the Copenhagen strategy enacted in 2011, which then systematically progressed with the start of R&D projects in 2013. In step 1, multiple tests for refining the planning methodology were conducted on actual projects with local stakeholders, moving beyond theoretical boundaries. Step 1 draws on the results of four selected municipality planning processes and include the cities of Mannheim, Neu-Ulm and Berlin (shown here twice). By refining the planning methodology, an understanding was developed for which key steps would be required. Additionally, the technical tools of climate adaptation could be examined and refined in terms of requirements and specifications. Combined with the observations, experiences and direct feedback from stakeholders as well as the results of several projects started or implemented since the Copenhagen strategy in 2011, the basis was formed from which the research questions began to develop in 2017 (see above).

Test City and Result	Timeframe and Notes
Mannheim: for the creation of an integrated water management strategy for city of Mannheim (Spinelli Baracks Development, as part of the BUGA 2023 program), a hybrid KURAS/netWORKS planning method was adapted for local stakeholders and utilised in both a larger and smaller setting. Firstly, a large stakeholder workshop for goal setting, tool selection and development of concepts suitable for the local site conditions was conducted. Subsequently, a series of monthly roundtable sessions were conducted over a period of approximately one year to ensure that the decisions undertaken in the initial workshop would be implemented in future stages. Stakeholders included city officials (planning, construction, streets, open space/green areas); utilities (water); investors (private); climate change and environment department.	Fall/Winter 2018-Fall/Winter 2019: Project planning has since been accepted and is moving into the planning permitting stages
Berlin 1: as part of a development for a new sustainable development near the Berlin-Tegel Airport (Schumacher Quartier) a sustainable stormwater management strategy was created utilising a hybrid planning method informed by both the KURAS and the netWORKS method. Stakeholders included city officials (planning, construction, streets, open space/green areas); utilities (water); investors (private); environment department.	Fall 2018-Fall 2019 Project planning has since been accepted and is moving into the next level of detailed planning
Neu-Ulm: for the creation of a sustainable stormwater management strategy for a residential mixed-use district in the German state of Bayern (Iller Park), the KURAS method and the netWORKS enhancements were used and adapted for local stakeholders. Stakeholders included city officials (planning, construction, streets, open space/green areas); utilities (water); environmental department.	Fall/Winter 2017-Fall/Winter 2018 Project planning is entering the construction documentation phase
Berlin 2: as part of the netWORKS4 research project, 6 case studies were selected in the city district of 'Pankow' within the approximately 80 hectare development area of Michelangelostraße / Greifswalderstraße. Three separate workshop were held utilising the netWORKS method as an extension of the previous KURAS method. Stakeholders included city officials (planning, construction, streets, open space/green areas); utilities (water); investors (private); environmental department; and specific to these projects, impacted end-users including school teachers, local municipal and distict level officials, and building operation administrators / facility management ('Hausmeister').	Early 2017-End 2019 Project planning in the review period.

Tab. 1: summary of case study tests prior to start of dedicated development (Source: Ramboll Studio Dreiseitl)

4.3 Step 2: ideate, explore and develop

Following the accumulated results of the four listed projects and the establishment of three research questions, an internal incubator program for startups commenced within the architecture and engineering consultancy Ramboll. Successful teams progressed from an initial selection of 250 ideas to 5 selected teams. This led to the start of Step 2 (ideate, explore and develop), and was a phase characterised by exploration and discovery. Several mock-ups of the product were reated; large-scale interviews were conducted; and research questions were tested direct with potential users via surveys, interviews and product engagement. Following the Lean Startup method (Ries, 2011), the process was guided by Rainmaking (2019). A timeline of key events and their timeframe for the concentrated ideation and start-up period as part of conceptualisation of the idea are shown below.

Event Description (Phase 1, 2, 3)	Timeframe
Phase 1: Start of Conceptualisation Period within incubator program 'Innovation Accelerator' Phase 1 including interview, customer development, ideation and discovery lab (1 month)	February 2019
Phase 2: Transition from phase 1 to phase 2 on focused customer development including prototyping and piloting (4 months) with additional market testing and stakeholder feedback (3 months)	March-June 2019 / July-September 2019
Phase 3: Innovation Accelerator process ends, shifted focus to dedicated product development and market activities	October 2019-August 2020

Tab. 2: description of events in timeline of development (Source: Ramboll Studio Dreiseitl)

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Following the principles of the Lean Startup Methodology (See Rainmaking, 2019; Ries, 2011; Blank, 2006, 2013; Taney, 2017), which is characterised by a process of rigorous measurement and customer-focused development by testing multiple hypothesis through a triangle-based model entitled Build-Measure-Learn (BML), for Step 2, we focused on taking the lessons learned from the multiple project tests in practice and working directly with the potential target group (municipalities as well as developers with development projects) to understand the needs, requirements and limitations. Within Step 2, we conducted a wide-scale case study interview process to understand the requirements of stakeholders involved in the development planning process when integrating climate resiliency and adaptation. When asking approximately 35 people in over 18 different cities over a two-week period, three common trends were identified as barriers to implementation including: 1) limitations in acceptance are a result of a lack of quantitative justification of the pros/cons, leaving decision-makers skeptical, uninformed or unaware of the tools available at their disposal ('nature-based solutions are not new but I need an argument that is clear and based on facts'; 2) are burdened by limited resources in personnel and finances ('the planning process today takes too long already'); and 3) cannot translate the complexity of solutions into viable options for development ('I need to address a wide range of stakeholders with varying and oft competing interests').

Following the first stage of interviews conducted in Step 2, we developed a concrete idea based on the results of the discussions, and determined an early thematic focus on simplifying planning methods to manage extreme rain events or cloudbursts. A second round of interviews, focused on selected pilot cities (Norderstedt, Mannheim, Düsseldorf) led our team to pivot our thematic focus to a more specific yert broader focus on not just extreme flooding but the wider impacts of climate change on urban developments. Through a series of workshops with these selected pilot cities including 1-to-1 interviews and telephone calls, stakeholders engaged with us to co-develop and critique a variety of early prototypes for the eventual decision-support tool.

The results of the workshops led the identification of three key points: climate adaptation was the correct thematic focus; local requirements and site-specific simulations would be necessary so that the results matched specific conditions; and that the process of development would be a determining factor as much as any digital tool creation.

4.4 Step 3: foundation and continued development

In August 2020, final development of the market-ready version of the decision-support tool was reached and GreenScenario was officially released. This follow an approximate 11 month development track and a previous 9 month startup period. As of September 2020, several projects have either been completed or are in progress utilising the GreenScenario method.

Based on the results of Steps 1 and 2, GreenScenario a rapid iteration design tool and software-based solution for simplifying climate adaptation planning. Through a hybrid form of tech-enabled consultancy that combines people with a data-driven process, GreenScenario supports planning decisions taken by municipalities, property developers and designers responsible for planning residential, commercial or mixed-use development project. By using a data-driven software engine based on a combination of Rhino+Grasshopper programming code, GreenScenario evaluates the effects of all potential planning scenarios early in the design process and identifies exactly which tools are most suitable for the given development as well as most cost-effective for enabling a climate adapted design.

Suitable for early stage concept design, feasibility studies and master planning potential options, GreenScenario utilises a data set based on recognised standards (e.g. DIN, DWA, EPA, etc.) and norms as well as site-specific climatic data to run rapid simulations. The data sets are flexible, able to adapt to locally applicable standards while being evaluated based on a rigorous and standardised set of key performance indicators and metrics. This ensures a consistent evaluation framework that can be applied across borders yet remains robust enough to adapt to local requirements and variables, especially in relation to climatic data.

Lastly, based on a cross-section of climate adaptation topics – including water, heat and microclimate and open space quality combined with green areas, – are holistically and simultaneously examined, and evaluated based on quantitative metrics. The results are paired together with economics, thus providing a framework for validating and comparing the costs and benefits of multiple solutions. The results are visualised quickly and placed on a dashboard. By working together, changes can be made and the effects visualised; rather than

working in a blackbox, GreenScenario allows stakeholders to understand the impact of decision based on evidence, facts and data – and not assumptions.

5 ENABLERS AND BARRIERS

The complexity of the topics aforementioned – climate adaptation as it relates to urban planning; process-driven methodologies; software-based solutions, data-driven platforms; nature-based solutions and blue-green infrastructure – places a challenge on not only the technical feasibility of developing a decision-support tool but also on the continuous evolution of the body of knowledge. In combination with the impact of technological innovation both positive and negative, urban planning and design necessitates an approach in response to what Dorst et al terms as 'open, complex, dynamic, and networked problems [that] just do not gel well with the assumptions behind our conventional problem-solving methods' (2016: 12).

5.1 Literature Review related to Enablers and Barriers

Casual online searches today reveal a variety of digitally-supported solutions related to climate change, adaptation or mitigation. Decision-support tools as they relate to climate adaptation projects were researched extensively (See Palutikof, Street and Gardiner, 2018). In the development of the Australian decision-support tool CoastAdapt, Palutikof et al (2018) identified both inherent barriers in the actual use of the tool but also institutional and cultural barriers that could limit or potentially inhibit the acceptance and utilisation of the tool in practice. Often, the barriers were found to be beyond the scope of the decision-support tool itself.

Computational design techniques as they relate to decision-support systems or platforms, while practical at building and plot scales, are particularly challenging to apply at the urban scale due to increased computational expense, difficulty in limiting inputs, and more stakeholders involved in the process (Wilson et al, 2019). This suggests that the effectivity of a data-driven support tool must also remain in a relatively continuous state of development to be useful, pragmatic and relevant.

When considering how digitalisation will impact society in the not-so-distant future, critics warn of the blanket acceptance of technology as a cure-all for managing and curing the problems previously mentioned with cities (See Hollands, 2008; Greenfield, 2013; Graham and Marvin, 2001). The question must be asked not only as to how to utilise the benefits of digital technology but, perhaps most importantly, why such solutions are necessary, who they are impacting and what unintended effect may result, or per Stimmel: 'improved liability is the focus, not how and where the technology is installed' or utilised to enable decision/making (2016: 37). When considering the growing complexity of cities, from not only their physical planning but their administration, management and regulation, and, as digitalisation continues to impact contemporary society, issues and conflicts with governance processes, accountability and compliance, privacy and public citizen inclusion will only continue to rise.

5.2 Relationship to Posed Research Questions

When analysing the initial implementation results of the methodology that led to the creation of GreenScenario, we find causal links for the three initially listed three research questions.

For question 1 ('Why are elements for planning climate adaptive often adapted less frequently and implemented as exceptions rather than standards?') we approached cities, developers and a wide variety of stakeholders to understand their concerns. We saw that from the approximately 35 people contacted across 18 different organisations or cities over a concentrated two-week period, key responses were that it was due to complexity and the extended length of the planning process today (80% of respondents); the lack of evidence to present arguments that there are clear benefits when planning with 'new' tools such as NBS (65%); and lastly the missing link between tools and (socio)economic considerations in an easy-to-understand matter (45%) continued to be major barriers. While the desire to plan towards what can be termed a liveable city philosophy was confirmed through the interviews (90% of respondents), further issues with permitting and regulations as well as finding funding sources for NBS were the next implementation barriers.

For question 2 ('What practical methods, material and information (data) is necessary in order to properly communicate and convey the complex requirements of climate adaptive planning?') and question 3 ('How can we enable informed decisions to be made early in the overall planning process and thereby reduce risks when investing in blue-green infrastructure or nature-based solutions?'), we could find causal links between between the success of the projects conducted under the netWORKS4 project in Berlin and Norderstedt

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correlating with the use of a standardised planning methodology, as asserted by Matzinger et al (2014). Physical and visual tools such as the 'info-cards' combined with an integrated stakeholder workshop enabled buy-in early in the process. Continuous discussions and roundtable meetings were necessary to understand project goals, extenuating circumstances and location-specific conditions. With the clear presentation of the results and planning efforts conducted as part of the process, namely how stakeholder feedback informed the decision-making and design process, coupled with visualisations of what benefits planning scenarios would offer in the future (Madichati, Möller, Otterpohl, 2019), there is a strong indication that process was of equal importance to product. By focusing on the communication aspect – collaboration in creating ideas, input when optimising solutions, relating the results to both overarching city objectives as well as localised requirements – as much as the technical requirements, an effective strategy could be tested and validated within the context of a living lab.

5.3 Observations from Initial Implementation in Practice

Yet the three research questions posed have only begun to be answered by the use of the tool in practice. GreenScenario as a method to support smart, data-driven design decision-making is but a first step in utilising innovation in digital technology to transfer expert knowledge (planning, climate adaptation, stakeholder communication) into an open collaboration platform (software). Continued research is necessary.

Initial barriers observed in practice during pilot implementation and further validated by the research conducted by Palutikof et al (2018) include initial apprehension in new, untested methodologies; data-source and quality of data being entered into the system; trust and acceptance; and also financial considerations, especially in consideration the effect COVID-19 has and will have on resources and budgets.

Yet these barriers tend to be more an issue in the initial short-term start up period. One of the more positive consequences as a result of COVID-19 has been the recognition of new working patterns, and has thus been an enabler. Especially for stakeholder groups and workshops, digital tools and a collaboration platform such as that enabled by GreenScenario provide a method to rapidly develop solutions and communicate results, effects.

Can data-driven tools provide a new method of approaching planning climate first with tools such as nature-based solutions or blue-green infrastructure aligned with conventional infrasturcutre to improve our cities today? Research in not only the technical aspects will continue be critical but also in the acceptance, adoption and governance methods for encouraging, co-funding and financing as well as embedding climate-first practices within the planning and urban design field.

We even see that there is widespread potential beyond just a 'collaboration platform'. A recent research effort termed 'Sandworm' (See Hermansdorfer, Skov-Petersen, Fricker, Borg, Belesky, 2020) saw the use of tangible tables (hands-on use of digital sandbox tools or 'augmented reality sandbox') utilising open source software based on a Rhino-Grasshopper set-up. Tested with students, the session utilised real-time visualisation in an interactive workshop format. 'The PhD workshop demonstrated how…'physical' participation [with] the table…can be adapted to different design challenges with relative ease' (Hermansdorfer et al, 2020: 10).

6 CONCLUSION AND EXTENDING RESEARCH THEMES

The complexity of the topics aforementioned – climate adaptation as it relates to urban planning; process-driven methodologies; software-based solutions, data-driven platforms; nature-based solutions and blue-green infrastructure – places a challenge on not only the technical feasibility of developing a decision-support tool but also on thGreenScenario is its early implementation phases. Even with the multi-year research and development periods that preceeded the creation and current application in practice, there are several aspects that will require testing to confirm or disprove enablers and barriers to acceptance, use and implementation. Over the past year, the political situation in Europe as well as globally focused more and more on issues related to climate change. Corona and COVID-19 has led to reexamining values of urban design that were commonly held as standard or given. Listed below are topics that will need to be further considered in future research to determine the viability of GreenScenario being able to positively impact urban planning, encourage collaboration and respond to market requirements.

While GreenScenario is still in its pilot implementation phase, we see data-driven decision-making combined with integrated planning processes key to enabling the acceptance of climate adaptation approaches for the future development of our cities and places.

- More seamless integration within practice and especially as part of the public participation process
- Integration with established sustainability systems such as the German DGNB (German Sustainable Building Council) or LEED from the US Green Building Council, amongst others
- Integration with existing processes in urban planning for Building Information Modelling (BIM)
- Further data review of methodologies and processes, as well as continual management of the database
- Consideration of the creation of a machine-learning databank would utilise further advances in digitalisation with access to a wider array of open source material
- Determining a network of cooperations and partnerships for knowledge sharing and awareness
- Critical consideration of data privacy laws such as GDPR
- Acceptance and awareness for both the application possibilities digital decision-support tools offer in practice combined with governance models for adopting a standardised approach that is locally tailored to site, country or cultural-specific requirements

Fig. 1: GreenScenario's two components: combining process and methodology with software (Source: Ramboll Studio Dreiseitl)

7 ACKNOWLEDGEMENTS

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CentropeMAP und CentropeSTATISTICS – interaktive Zeitreihendarstellung grenzübergreifender statistischer Daten

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1 ABSTRACT

Centrope ist eine grenzüberschreitende Region, die die aneinander grenzenden Bundesländer bzw. Landkreise der vier Staaten Österreich, Tschechische Republik, Ungarn und Slowakische Republik umfasst. Seit nunmehr 15 Jahren sind Geodaten aus diesen vier nationalen Teilregionen in einem gemeinsamen Geoportal (www.centropemap.org) online verfügbar. Eine fünfsprachige Website bietet Basisinformationen zur Region, das Geoportal ist rein in englischer Sprache gehalten.

Seither wird der inhaltliche und funktionelle Umfang stets erweitert, aus einem reinen Geodatenviewer ist mittlerweile ein umfangreiches Werkzeug zur Bearbeitung und räumlichen Darstellung von statistischen Daten geworden. Dafür werden von den jeweiligen nationalen Statistikämtern auf jährlicher Basis Daten bereitgestellt, die in CentropeMAP grenzüberschreitend aufbereitet und als gemeinsame Karte dargestellt werden können.

Anders als bei vielen anderen öffentlich zugänglichen Statistikportalen, die ihre Daten meist nur auf den recht grobmaschigen Betrachtungseinheiten NUTS 3 oder NUTS 2 anbieten, konzentriert sich CentropeMAP auf Daten der Gemeindeebene. Dies schränkt zwar den inhaltlichen Umfang etwas ein, denn nicht alle statistischen Erhebungen werden auf der Gemeindeebene durchgeführt; viele Daten gibt es generell nur in kleinermaßstäbigen Einheiten.

Die neuesten nfunktionelle Erweiterungen, die hier vorgestell werden, sind zum einen die Möglichkeit zur Darstellung von statistischen Daten als Zeitreihe in animierter Form, und zum anderen die direkte Abrufmöglichkeit von Gemeindedaten über die Kartenansicht.

Keywords: Centrope, Geoportal, Statistikdaten, thematische Karten, Zeitreihen

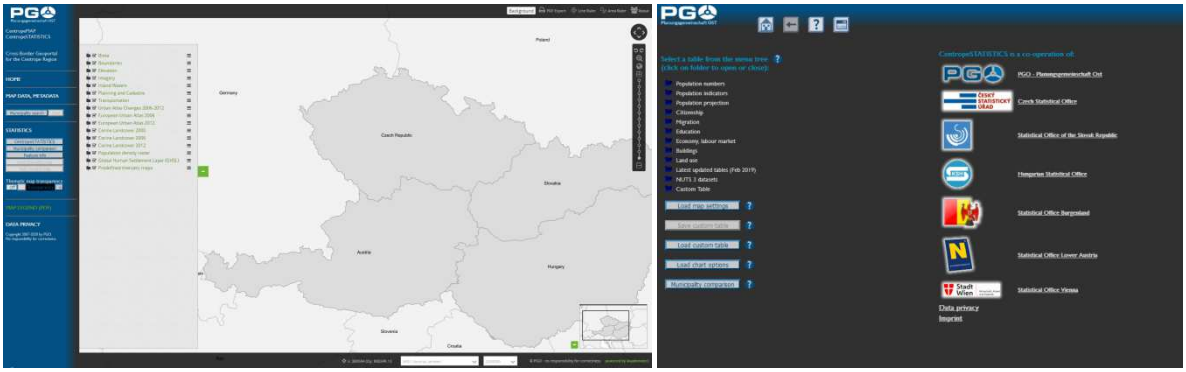

Abb. 1: Einstiegsseite des Geoportals (links), Einsteigsseite des Statistiktools (rechts).

2 HINTERGRUND

2.1 Die Entstehung von Centrope and CentropeMAP

Centrope ist eine künstliche Region, bestehend aus den Bundesländern Burgenland, Niederösterreich, Wien; Jihočeský kraj, Jihomoravský kraj, Győr-Moson-Sopron, Bratislavský kraj und Trnavský kraj.[1] Sie wurde im Jahr 2003 von Politikern und Wirtschaftsakteuren aus den vier Ländern Österreich, Tschechische Republik, Ungarn und der Slowakei gegründet, um die sozialen und wirtschaftlichen Nachteile auszugleichen, die dieser Region in den Jahrzehnten des Eisernen Vorhangs entstanden sind. Damals startete die

[1] In CentropeMAP und CentropeSTATISTICS sind weiters noch Daten aus dem Kreis Vysočina (Tschechische Republik) und dem Komitat Vas (Ungarn) enthalten.

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Planungsgemeinschaft Ost (PGO)[2] das Pilotprojekt „Basiskarte Centrope“, das die Erfassung von Geodaten in der gesamten Centrope-Region zum Ziel hatte.

In den mittlerweile 15 Jahren Laufzeit konnte eine hervorragende Kommunikations- und Austauschbasis zwischen allen Partnern (Geodaten- und Statistikexperten) aufgebaut werden, vor allem durch die regelmäßigen jährlichen Workshops, in denen neueste Entwicklungen diskutiert, neue Ideen ausgetauscht und Datensätze harmonisiert werden. CentropeMAP ist eine webbasierte Anwendung, die keine Software-Installation benötigt, sondern von jedem Standardrechner mit Internetanschluss aus betrieben werden kann.

3 WAS MACHT CENTROPEMAP EINZIGARTIG?

3.1 Geodaten aus vier Ländern

CentropeMAP konzentriert sich auf Datensätze, die für die Raumplanung und verwandte Disziplinen wichtig sind, wie

- grundlegende räumliche Informationen wie Grenzen, Natur, Wasserläufe/Gewässer, Verkehrsinfrastruktur, Landnutzung etc.,
- statistische Daten zu Demographie, Migration, Bildung, Wirtschaft/Arbeitsmarkt etc.,
- Zeitreihendaten zur Analyse der Entwicklung der Region.

CentropeMAP bezieht seine Geodaten direkt von den datenführenden Stellen, das sind vor allem die GIS-Abteilungen der österreichischen Bundesländer Burgenland, Niederösterreich und Wien, das österreichische land- und forstwirtschaftliche Rechenzentrum LFRZ, geoland.at, die Europäische Umweltagentur, die tschechischen Komitate Jihomoravský und Vysočina, die tschechische Umweltagentur CENIA und die slowakische Umweltagentur SAŽP.

3.2 Harmonisierte, grenzüberschreitende Statistikdaten auf Gemeindeebene

Die europaweite Harmonisierung von Geodaten wird derzeit im Rahmen der INSPIRE-Richtlinie vorangetrieben. Allerdings hat dieser Prozess in den letzten Jahren eher langsame Fortschritte gemacht, sodass derzeit noch keine Ergebnisse vorliegen, die in CentropeMAP verwendet werden können. Dennoch behalten wir die INSPIRE-Implementierung in den Centrope-Ländern im Auge und sind technisch bereit, die Ergebnisse in unserem Geoportal zu verwenden.

Was die Statistik betrifft, so ist die Datenharmonisierung auf Gemeindeebene ein schwieriger Prozess. Daten aus den Partnerregionen dürfen nur dann in einer gemeinsamen Tabelle zusammengeführt werden, wenn die Datenerhebung und -verarbeitung in allen Ländern auf die gleiche Art und Weise durchgeführt wurde. Dies ist ganz einfach, wenn es um demographische Daten geht; sobald aber andere Bereiche wie Arbeitslosigkeit oder Haushaltsgröße erreicht sind, entstehen Probleme, weil Begriffe wie „Arbeitslose“ oder „Haushalt“ in den Partnerländern unterschiedlich definiert werden. Auch die Methoden der Datenerhebung sind manchmal unterschiedlich – zum Beispiel wird die Zahl der Arbeitslosen in einem Land nach Fälligkeitsdatum gezählt, in anderen Ländern jedoch nach monatlichen Jahresdurchschnitten. In einigen Fällen ist es möglich, solche Unterschiede durch Datenaggregation zu eliminieren, aber dies kann zu Datensätzen mit schwacher Aussagekraft führen.

Auch wenn es um Daten auf kommunaler Ebene geht, werden Datenschutzrichtlinien zu einem wichtigen Thema. Die Kombination von Attributen in kleinen Gemeinden erlaubt Rückschlüsse auf einzelne Personen, daher sind solche Datensätze nicht in allen Partnerländern verfügbar. Dennoch konzentriert sich CentropeSTATISTICS auf Kommunaldaten, weil nur diese Ebene detaillierte Analysen auf kleinräumiger regionaler Ebene erlaubt. Kleinere Ebenen wie Meldebezirke oder noch detailliertere statistische Einheiten eignen sich nicht für Vergleiche, weil ihre Definition in den einzelnen Partnerländern zu unterschiedlich ist und die Zahlen aus solchen kleinen Einheiten viel zu genau sind, um den Anforderungen des Datenschutzes zu genügen – statistische Rückschlüsse auf einzelne Personen dürfen nicht mit veröffentlichten Datensätzen erfolgen.

[2] Die Planungsgemeinschaft Ost (PGO) ist eine gemeinsame Organisation der österreichischen Länder Burgenland, Niederösterreich und Wien zur Abstimmung, Koordination und Vorbereitung raumplanerisch relevanter Fragen in der österreichischen „Länderregion Ost“.

3.3 Einfache Karten- und Diagrammerstellung

CentropeMAP und CentropeSTATISTICS sind zu einem sehr umfangreichen und komplexen Informationssystem geworden. Dennoch achten wir darauf, dass die Erstellung von Karten und Diagrammen ein einfacher, benutzerfreundlich gestalteter Prozess bleibt, der Schritt für Schritt durchgeführt werden kann, verständlich und gut dokumentiert ist. Jeder statistische Prozess beginnt mit der Auswahl des Themas (Tabelle). Jede Tabelle bietet einige Möglichkeiten, Karten oder Diagramme aus bestimmten Tabellenspalten zu erstellen; es ist auch möglich, Werte aus mehr als einer Tabelle in einer benutzerdefinierten Tabelle zu kombinieren. CentropeSTATISTICS-Benutzer, die Grundkenntnisse in Mapping und Kartographie mitbringen sollten, um eine aussagekräftige Ausgabe zu gewährleisten. Ein umfangreiches Handbuch in Englisch und Deutsch hilft zu verstehen, wie CentropeSTATISTICS funktioniert.

Auf der CentropeMAP-Website haben wir auch einige Beispiele für die Erstellung von Karten und Diagrammen vorbereitet, um zu veranschaulichen, dass es ein einfacher Prozess ist, statistische Zahlen in farbenfrohe Karten und verschiedene Arten von Diagrammen für eine oder mehrere Gemeinden oder Regionen zu verwandeln. Mit "Centrope in Zahlen" (siehe folgendes Kapitel) wird im Laufe des Jahres 2019 eine Fülle zusätzlicher Karten im druckfertigen Layout veröffentlicht werden.

4 VORSTELLUNG DER NEUESTEN FUNKTIONEN

4.1 Animierte Darstellung statistischer Zeitreihendaten

Statistische Zeitreihendaten sind in CentropeMAP zu vielfältigen demographischen Themen verfügbar. Bislang konnten diese Daten entweder als Diagramm der Zeitreihe oder als thematische Karte zu einem gewählten Jahr visualisiert werden. Die mehrfache Erzeugung von thematischen Karten verschiedener Jahre wurde nun als wichtige Zusatzfunktion ergänzt.

Wie bei allen Karten und Diagrammen ion CentropeMAP läuft die Erstellung einer Kartenzeitreihe in einigen simplen Schritten ab:

- Auswahl des Zeitreihentools aus der Tabellenansicht,
- Auswahl des Farbschemas, der gewünschten Anzahl der Klassen und der anzuzeigenden Jahre,
- Auswahl der Klassifikationsmethode (mit Vorschaubild)

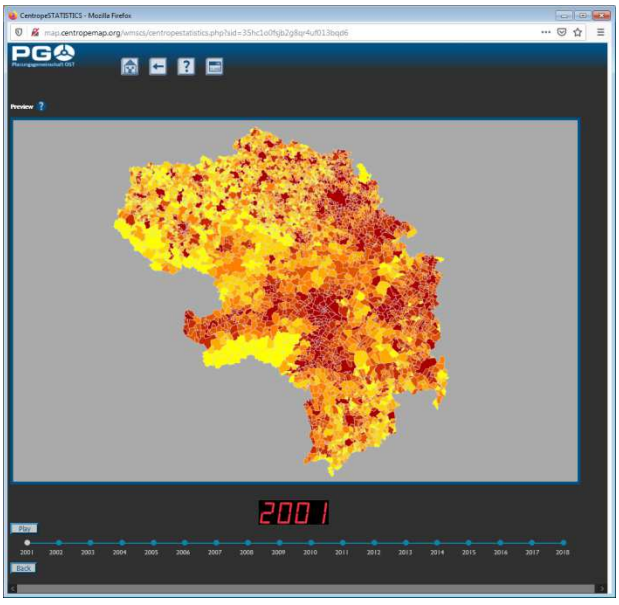

Abb. 2: Zeitreihendarstellung als Animation.

Anschließend werden die Kartenbilder für die einzelnen Jahre berechnet und im Browser angezeigt. Der Benutzer kann entweder die Jahre direkt durch Mausklick aufrufen oder die Zeitreihe als Animationsschleife (ähnlich der aus der Wetterprognose bekannten Satellitenbilder) ablaufen lassen.

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4.2 Abrufen von Statistikinfo direkt aus der Kartenansicht

Das Abrufen von Attributdaten in einer Kartenansicht ist keine neue Erfindung. Unter dem Fachbegriff „GetFeatureInfo“ ist genau diese Vorgangsweise vom Open Geospatial Consortium als Standard definiert. Warum CentropeMAP diese Standardlösung nicht nutzt, liegt an der Komplexität des Geoportals. Daten vieler verschiedener Server werden in einem gemeinsamen Geodatenviewer dargestellt; die wenigsten dieser Server bieten auch Feature-Infomationen an. Diejenigen, die sie anbieten, tun dies nicht in vergleichbarer Struktur und auch nicht in der für unser Geoportal benötigten inhaltlichen Tiefe.

Daher lag es nahe, eine äußerlich an die Funktionsweise herkömmlicher GetFeatureInfo-Requests angelehnte Funktion selbst zu entwickeln. Die technische Umsetzung ist trivial: Beim Einschalten der GetFeatureInfo-Funktion werden die Koordinaten beim Klick auf die Karte abgegriffen. Über die Statistikdatenbank, die auch eine räumliche Tabelle enthält, wird die angeklickte Gemeinde ermittelt, sodass in weiterer Folge beliebige statistische Daten zurückgegeben werden können.

Ist eine zuvor erstellte thematische Karte aktiv, so konzentriert sich die Datenbankabfrage auf die Werte dieser thematischen Karte. In allen anderen Fällen werden Überblicksdaten zur Gemeinde angezeigt und weitere redaktionell ausgewählte Zahlen und Indikatoren stehen auf Abruf zur Verfügung. Zum Anzeigen einer Tabelle ist die jeweilige Überschrift anzuklicken, in der Tabelle befinden sich die Zahlen zu Gemeinde, Bezirk, Land und Gesamtregion sowie Schaltflächen zur Erzeugung von Zeitreihendiagrammen aus den abgebildeten Daten.

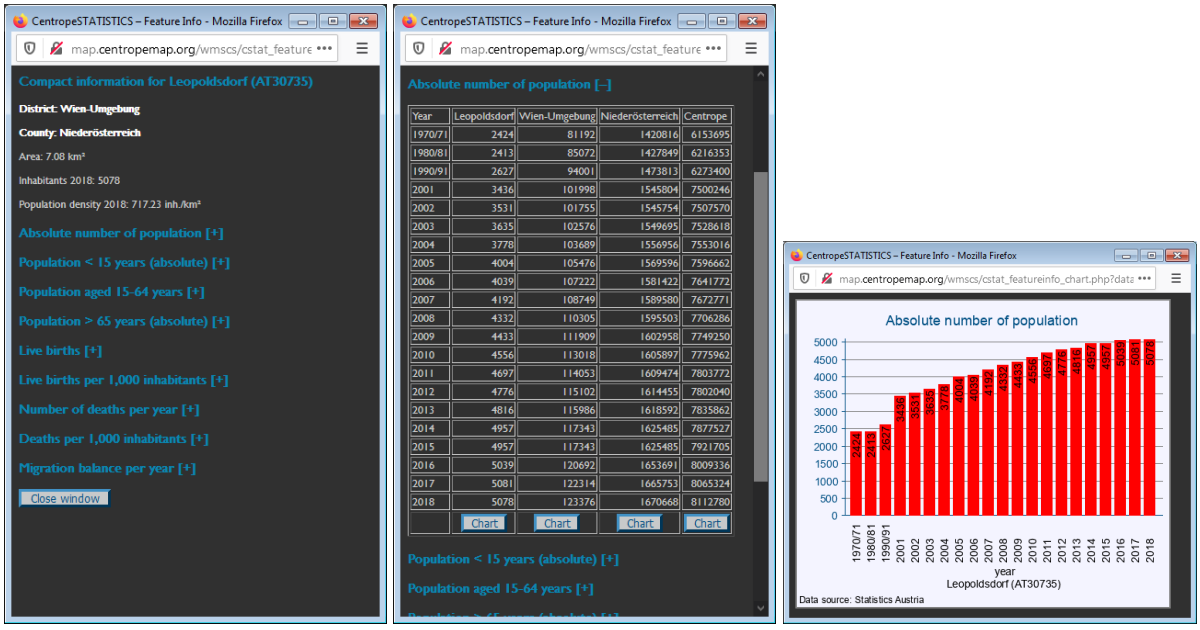

Abb. 3: GetFeatureInfo: von der Basisinformation bis zu den detaillierten Daten.

5 WEBLINKS

https://www.centropemap.org/
http://map.centropemap.org/

City for All: Livable Peripheral Neighbourhoods in Ruse (Bulgaria) through Advanced Mobility Measures

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1 ABSTRACT

Ruse is the 5th biggest city in Bulgaria situated along Danube River. Druzhba is a new peripheral district in Ruse, home for more than 15% of its population, characterised by intense car traffic, poor public transport offer, lack of pedestrian and cycling infrastructure and lack of parking spots. A large share of the citizens living in Druzhba use personal cars and taxi services for these trips thus causing congestion, traffic accidents, air pollution and noise. There are no sidewalks and safety cross walks at the main Druzhba boulevard to the city centre. Pedestrians suffer under the growing road traffic and are very vulnerable to road accidents. Many local children and senior citizens have respiratory diseases.

In 2015 CSDCS invited Ruse to participate as a Bulgarian city in the CIVITAS ECCENTRIC Project and both partners started its implementation in 2016. The overall objective and impacts of ECCENTIC are reached during the project lifetime by demonstration and testing of integrated packages of innovative solutions for sustainable mobility in peri-central 'living laboratory' areas, combining new policies, technologies and soft measures. It could be achieved by improving the quality of public space and road conditions for safe walking, increased participation of citizens and local stakeholders in developing mobility policies, services and traffic safety plans for suburban neighbourhoods, and changing the mobility mind-sets of citizens through direct and dialogue marketing and hands-on trainings, especially focussing on vulnerable groups (older people, school children, disabled).

The paper describes the innovative mobility solutions in the Ruse peripheral neighborhood named Druzhba (Friendship) that clearly contributed to the livability of the city of Ruse.

Keywords: mobility, SUMP, livable city, peripheral district, project

2 THE PROJECT MEASURES FOR LIVABILITY

The behavior of the Ruse decision-makers changed very fast thanks to the training and information campaign held by CSDCS in the beginning of the project. The Local Government realized that this project can improve the quality of life of suburban districts making them more livable through advanced mobility measures that mainly contribute to the public health and safety of citizens. The set of mobility measures implemented in the frames of the project became a part of the new Ruse SUMP that started its implementation in September 2018.

For solving the problems of the peripheral neighborhood, the following specific measures were planned:

- P&R facility in Druzhba district
- Large information and promotion campaign (including media and non-media communication, at least 7 seminars and 3 national conferences)
- Mobile application for PT
- New safe crosswalks in Druzhba
- New sidewalks with cycling lanes connecting Druzhba with city center
- New Ruse transport scheme
- Night line connecting the peripheral area with the city center

2.1 P&R station in Druzhba district

The ultimate goal of this measure was to promote the modal shift towards public transport by reducing the use of cars by commuters and visitors when they want to reach the city centre. The P&R station relieves road congestions along the routes regularly taken from Druzhba to the central part of Ruse. Many PT stops are situated nearby providing easy connections. The measure also helps to reduce the number of cars parked on the public spaces in Druzhba, as well as in the historical centre of Ruse.

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The key challenge of this measure was the identification and selection of a suitable location of the P&R facility. It was not easy to do, as there were not so many free municipal terrains that were close to the entrance of the city, had good connections with PT and were big enough to serve as a P&R station. This issue has been overcome by carrying out an exhaustive analysis of the territory in the laboratory area. The P&R facility was designed and constructed on a municipal terrain as a demonstration measure in order to show how this type of parking strengthens the use of PT. The available surface of only 1178 m2 allowed the construction of 41 slots (4 of them for disabled).

There is a ticket machine situated at the entrance providing drivers with 2 tickets for PT daily for the price of 2.5 BGN (1.3 euro). The parking is free-of-charge if the user buys tickets and visualizes the receipt in the car.

The pilot P&R station was officially opened in May 2019 but the setup of the ticketing system and the deployment of the information and promotion campaign took time, so only during the last quarter of 2019 the facility was functioning with good capacity. Nowadays it is visible that the measure turns out to be a success and we have plans to upscale it by introducing it in other parts of the city (i.e. at the main entrances from Sofia and from Bucharest). It will be done in the frames of the Ruse SUMP (that is actually in stage of implementation) and after the introduction of the new transport scheme of Ruse, because it is important that the new P&R stations are situated closely to the PT stops.

Fig.1.Ticketing machine at the P&R entrance

2.2 New pedestrian infrastructure (safe sidewalks and crosswalks)

Two ECCENTRIC measures have improved the infrastructure for pedestrians and cyclists. The analysis of the existing infrastructure has shown that the existing pedestrian crossings in Druzhba were not secure enough presenting a high risk for accidents, leading to injuries and fatalities. Most people with disabilities and elderly people did not walk on the streets or travel by PT around the city due to the lack of convenient infrastructure.

In the frames of the project new safe crosswalks were designed and two crosswalks were constructed in the central part of Druzhba district. They were secured with LEDs, raised paths and cameras for video surveillance.

Fig.2 New crosswalk at the Druzhba entrance

A construction of safe sidewalks with cycling facilities towards the city centre was planned because the poor state of the existing pavements and cycling lanes in Druzhba district generated a high risk of road accidents involving pedestrians and cyclists. The footpaths on both sides of the main roads, connecting Druzhba with the central areas of Ruse were either incomplete or in a very bad state of disrepair, and were unsafe for walking or cycling.

After a research of good practice and innovative solutions on design of safe pavements (shared with cyclists), new sidewalks were designed and constructed in Druzhba. Their design envisaged the introduction of tactile paving between the walking paths and the cycling lanes of the sidewalks so that conflicts between pedestrians (including blind people) and cyclists were prevented. The total length of the sidewalks designed under ECCENTRIC and planned to be constructed in Druzhba was of 1500 m. The first segment of 300 m was constructed in the frames of the ECCENTRIC project. The three remaining segments will be constructed in the frames of the Ruse SUMP.

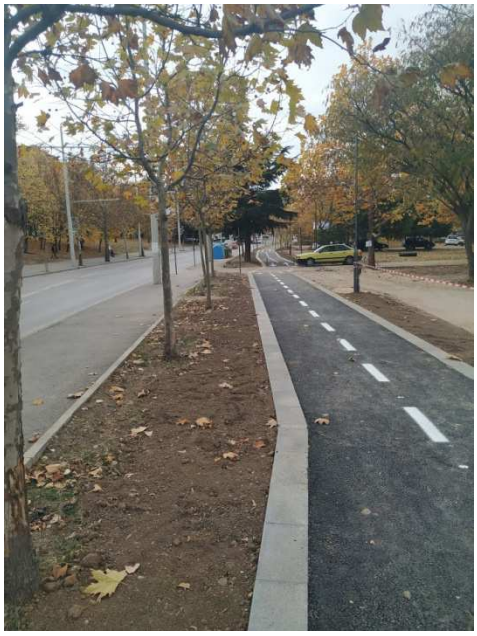

Fig.3 The new sidewalk along "V. Levski" Boulevard

Both measures contributed to achievement of the ambitious goals of the project – to reduce the number of road accidents involving pedestrians and to make walking and cycling a safer and more desirable way of moving in the district and in Ruse. The safe infrastructure for pedestrians, including people with disabilities will further increase the share of walking in the modal split in Druzhba, reduce the number of accidents with pedestrians and strengthen the use of public transport by disadvantaged groups living in the district.

2.3 Night line in Ruse

This measure was planned for the first time in Ruse in order to provide demand-oriented, fast, regular and reliable public transport service during the night for the Druzhba citizens. For this purpose a new PT line named 'Good night' was established in the frames of the ECCENTRIC project connecting the peripheral district with the city centre.

The main challenges faced while developing and implementing this measure so far have been to find the best solution for the vehicles to be used for operating the new line, and to identify an appropriate solution to award the operation of the service. As the municipality didn't have enough resources for purchasing of e-vehicles during the project lifetime, we decided to use the existing trolleybuses. This decision has solved the problem with the operator – the service was assigned to the municipal trolleybus company.

Before launching the new service, a huge research took place aiming at establishing the most convenient itinerary of the new line. The route is from Druzhba district to Central Railway Station with 14 stops and passes through the main streets and boulevards connecting the peripheral area with the central part of Ruse. A large promotional campaign was launched for informing citizens about this initiative and inviting them to use it with the aim to decrease the use of cars and taxis for moving during the night. On 10th of May 2019 the 'Good Night' line was launched and stated operating.

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The measure strongly contributed to the social inclusion and livability in Druzhba. 90% of the citizens accept it and estimate that it will improve their living conditions. 90% are satisfied with the "Good night" line because it gives them possibilities to move in the night and to have access to the Ruse evening attractions thus decreasing the social inequality and improving the quality of life in the peripheral district.

Fig.4 Ruse night line

2.4 The new transport scheme of Ruse

The existing transport scheme of Ruse didn't satisfy the PT demand especially from the citizens living in the peripheral districts. The public transport service connecting Druzhba with the centre of Ruse and its industrial zones (around the city centre) was slow and unreliable. A large share of people living in the peripheral districts like Druzhba used their own cars or taxi services to travel to the city centre or to work.

Initially this measure aimed at providing demand-oriented, fast, regular and reliable public transport services to and from the city centre to the district of Druzhba. The implementation of the measure should include redefining and reorganizing the existing bus and trolleybus lines in order to improve the balance between demand and supply of public transport services.

Later on it became evident that we can't reorganize only one direction of the PT network leaving the rest of the Ruse PT unchanged. The municipality took the decision to reorganize the whole PT-network of the city according to the SUMP developed and approved for Ruse several years ago. With a combination of funding provided by the SF (via OP "Regions in growth") for the SUMP and by ECCENTRIC the task was assigned to a subcontractor that made the analyses of the existing PT-situation and the demand and proposed a new PT scheme.

After a large public discussion, the new PT scheme was approved by the City council in September 2019. Its implementation will start in 2020 after the purchase of new clean PT-vehicles.

2.5 Mobile application for PT

The Mobility as a Service (MaaS) concept is very new for the City of Ruse. Currently, the only service related to MaaS is the developed internet portal and mobile app providing information about the public transport services in the city (such as timetables and route information of bus and trolleybus lines).

By this measure, the City of Ruse will develop an app that will support people in buying and validating public transport tickets, and also allow them to navigate through the system, in general via mobile devices (smart phone/tablet). The mobile app shall be available for more than one smart operating system (Andriod or iOS, as a minimum), and shall ensure the distribution, sale, validation and checking of tickets in the PT vehicles operating across Ruse. The electronic charging system shall be a combination of technical devices, a software application and a link to the PT Control and Management Centre in Ruse. The app's interface will provide information in Bulgarian and English.

Payment shall be possible through debit and/or credit cards. Cashless payment options shall also be available (Paypal, as a minimum). The mobile app will enable the collection of user feedback in the form of a Passenger Assessment of the service 'charging and/or self-scanning via a mobile device'.

This measure is expected to be implemented after the introduction of the new PT scheme and will increase the use of public transport by minimum of 10%.

2.6 Information and promotional campaign

The main objective of this "soft" measure was to create awareness of the benefits of sustainable mobility in Ruse and its importance for increasing the quality of life. One seminar was organised for public transport personnel, six workshops - for citizens and NGOs, three mobility conferences and a large media campaign for stakeholders and the school community. The aim was to encourage the different actors to embrace sustainable mobility habits, to increase the use of public transport, and to make walking and cycling safer and transforming them into a desirable way of moving in the city. A special focus on traffic safety was made, with the aim of sensitizing the population in order to reduce the risk of road accidents.

The final evaluation of the measure shows very encouraging results. The objectives of the measure were successfully achieved at higher level than expected. All important target groups were involved: local authorities, transport professionals, local citizens and their organizations, NGOs, disadvantaged groups, youth, academia and school children. Therefore, the new mobility measures foreseen in the CIVITAS ECCENTRIC project were widely discussed and promoted in order to change the mindset of all stakeholders.

The most important challenges in the implementation were related to the interest of the participants. After so many events since 2000 in the frames of various EU projects that have ended almost without visible results, the Bulgarian stakeholders were tired and disinterested. It was difficult to involve them in further project events.

The most important success factors of our measure were the good cooperation between CSDCS and the municipality, and our participative approach to the events proposing tailor-made seminars for each target group, together with perfect planning and conducting – well-organized distribution of the invitations, attractive agendas and catering and a lot of possibilities for the participants to express themselves and to share their opinion. A long-term co-operation with the local and regional media was also very helpful.

3 INNOVATIVE ASPECTS

Most of the measures are not only new for Ruse but are implemented for the first time in Bulgaria – the night trolley bus line, the P&R facility was a ticketing machine, etc. The other technical measures also contain a lot of innovative elements that will increase their safety and attractiveness.

The huge information and education campaign launched in the city and the strengthened public participation in the planning process contributed to the high level of awareness and acceptance of the new measures. A concept of MaaR (Mobility as a Right) was raised among the citizens of the peripheral urban regions claiming that the sustainable mobility is a human right and should be provided for all citizens, because the cities should be for all.

4 RESULTS AND CONCLUSIONS

In Ruse the main project results are related to enabling safe walking and cycling in Druzhba district, reducing the car traffic and congestions, improving the air quality, decreasing the noise level and increasing the share of public transport use in the modal split. The expected impacts are:

- Reduced CO_2 emissions by 20% thus improving the public health and decrease the respiratory diseases
- Less traffic accidents leading to injuries and fatalities with 20%
- Improved accessibility of disadvantaged groups to public transport
- Increased participation of citizens in developing healthy mobility policies, services and traffic safety plans for suburban neighbourhoods.
- Changing the mobility mind-sets of citizens through direct and dialogue marketing and hands-on trainings, especially focusing on vulnerable groups (older people, school children, disabled, deaf people, etc.).

The Ruse mobility measures are already part of the Ruse SUMP (sustainable urban mobility plan) that is implemented for the first time in Bulgaria. The measures show their positive impact and are easily replicable

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to other Bulgarian cities. The project already has 4 "follower" cities (Varna, Svishtov, Gabrovo and Veliko Tarnovo) that learn from its advanced experience making their neighborhoods more livable.

The city was approved to exchange experience with the Merida municipality (Mexico) under the interurban cooperation work package of the project CIVITAS ECCENTRIC.

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Crowd Flow Analysis for Measuring the Impact of Urban Transformation Actions in City's Heritage Areas

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1 ABSTRACT

In the past years, cities have become more and more interested in shifting from the traditional ideology-based approach to an evidence-based process of policy and decision making. Subsequently, much attention has been given to new tools and technologies for enhancing data collection on the urban transformation practices. With the help of these new tools and technologies, big social, economic and spatial data are collected which allow a more accurate analysis of urban processes in order to create more livable, inclusive and attractive cities.

This paper outlines a data-guided approach shaped by evidence for cultural-led urban regeneration in creative and knowledge cities, tested in the framework of a H2020-funded project (GA 730280), ROCK (www.rockproject.eu). Its elementary concept is based on developing an innovative, collaborative and circular systemic approach for regeneration and adaptive reuse of historic city centres, transferring the circular economy model to the transformation process of urban historic environments. In this project, transformative actions such as adaptive reuse, temporary structures and events are used to transform public spaces and buildings that have heritage value. By these actions, it is aimed to increase the quality, raise awareness of people and attract more visitors to these places.

This paper focuses on how the large-crowd location-based monitoring tool (LBA sense[1]) is contextualised in two of the Role Model Cities involved in the project: Cluj-Napoca (Romania) and Turin (Italy) in order to understand the impact of transformative actions in heritage districts. In a highly dynamic urban environment, people's flow remain the only constant, expressing the lively dimension of changes in the urban fabric (M. Castells, 2000). The paper is based on a systematic analysis on data collected over time in the two cities, using a set of locally-deployed WiFi sensors and providing real-time insights on activity and mobility patterns within the monitored area. It highlights the accessibility dimension to specific contextual data on crowd flows (during ordinary days and extraordinary/ exceptionally events) in different CH locations in the city, related both to traditional heritage spots, as well as to the empty and underused spaces stock, as potential new locations for creative and cultural purposes.

The method used follows an origin-destination matrix approach, aimed at comparing various crowd flows during different times in the two cities in relation to specific events/ happenings impacting the usual/ conventional use of space. Throughout the comparison, the paper showcases many similarities (such as situational-driven people movement between certain locations), despite the self-evident distinction of hotspots spatial distribution within the two cities and the different urban planning and design background and culture. Finally, the analysis proposes a set of policy measures based on informed documentation of the actual use of the urban space during ordinary and extraordinary events impacting the urban environment.

Keywords: Cultural heritage, urban transformation, data-driven knowledge, crowd monitoring, people flow analytics, sensor data

2 INTRODUCTION

2.1 Theoretical framework

Cultural Heritage (CH) is becoming a key asset for local sustainable development actions. The need of defining sustainable development action in post-industrial contexts finds in CH assets and services an

[1] Large-crowd monotirong tool, developed by DRFC (http://www.dfrc.ch/) – the system combines sensors which allow the reading of the crowd's nature, enabling end-users to access demographics figures and mobility patterns on a wider scale, in ordinary and extraordinary conditions (i.e. festivals and events). It is aimed at determining footfall in real-time and change rate in the crowd size, besides dwell time, revisit and flow patterns and distribution, as well as any abnormality, in the overall area under monitoring (https://rockproject.eu/tools).

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opportunity for creating new employment. In this new role of driver for the local economies, CH has to be conceived and understood more broadly. CH states a closer relation with the places' cultural identity which brings back to a multitude of territorial tangible and intangible elements (Graham et al., 1998), contributing to assert a notion of CH which goes beyond historical and conservative value (UNESCO, 2006). CH, as geographical, economic, functional (UNESCO, 2001) and societal topics (UNESCO, 2014, p. 10) permits to promote CH as driver for sustainable development.

A contemporary understaning of CH unfolds a paradigm shift in approaching CH by transforming it from the condition of "identity and memory repository" to a newly one of "aggregator of contemporary innovative uses and services". This change requires the adoption/ and integration of specific tools and technologies in the heritage environment. In order to make this change possible, it is relevant to orient and equip urban planners with specific tools for measuring the impact of actions and policies related to this new interpretation of the CH. For this reason, Evidence Based Planning (EBP) is relevant when we deal with sensitive assets of CH, as it denotes a planning principle committed to replacing ideologically-driven politics with rational decision making. Moving towards evidence based policy requires skills in data analysis, interpretation of causes and effects, developing policies to correctly address complex urban matters. EBP needs to become a key-capacity of planners, policy designers/ makers working with CH. Using 'evidence' supports the tailoring of policy framework to better respond to urban transformation needs.

The ROCK Project is working on determining the conditions for shaping a methodology that opens new perspective for the integrated use of CH at urban scale. Integration has to be meant not just as the necessary activation of multi-stakeholders planning processes in the places of transformation, but even as opening a dialogue with innovative technologies (e.g. use of emotional data) and other urban critical assets (e.g. public spaces design, nature based solutions assets…) that permit to open a field of reflection and design within the broader concept of cultural landscape.

2.2 ROCK project: general framework and identified knowledge gaps

ROCK is an EU-funded project, through Horizon 2020 programme, under the call SC5-21-2016-2017: Cultural heritage as a driver for sustainable growth, GA no. 730280 (www.rockproject.eu). The project focuses on historic city centres as extraordinary laboratories to demonstrate how Cultural Heritage [CH] can be a powerful and unique engine of regeneration, sustainable development and economic growth for the whole city. ROCK believes that CH should not be perceived as static, a vestige from the past, but instead, it could be a driver for bringing new creative energy into the city, by using the past to help building urban futures. The project conceptualises an innovative circular model as an integrated vision of urban regeneration, based on 6 connected pillars (Creative, Cultural, Regeneration, Knowledge, Security and Green) that interconnect to draw the future of cities.

2.2.1 ROCK Circular approach

The Cultural Model shows a continuous effort to recognise the city and its transformation as a heritage and common good, in which all actors interact with the urban transformations, with various degrees of responsibility and awareness, embodying a collaborative and shared approach. Two key concepts that lay the foundation of ROCK are: creative city and city of knowledge. Hence, creativity and knowledge combined with technological innovation are triggers that fuel the economic and social growth of the city, transforming it sustainably through means of cultural heritage-led regeneration. Likewise, urban regeneration efforts go hand in hand with ROCK attempts to minimize the impact on the environment, leading to environmental sustainability and contributing to the resilience of communities to climate change.

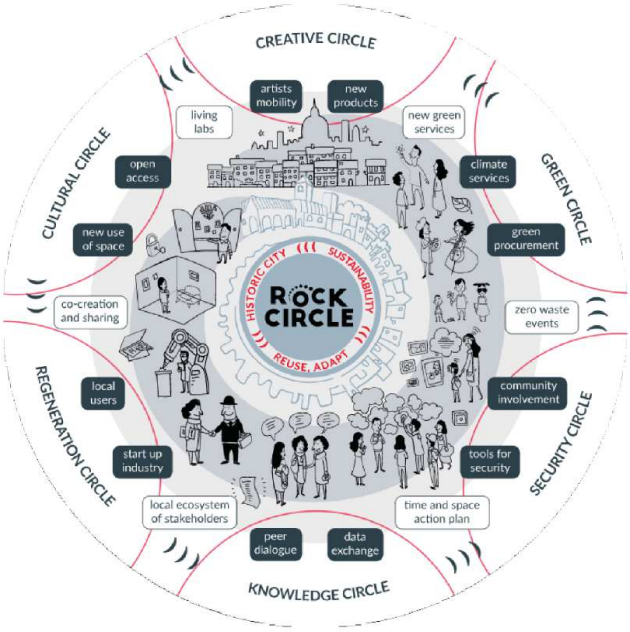

Fig. 1 ROCK Circle

2.2.2 Addressability of knowledge gaps in the policy field of CH-led regeneration through ROCK

ROCK project adopts a vision towards urban transformation of city's heritage areas into Creative and Sustainable Districts through actions such as adaptive reuse, temporary structures and events, aimed at changing public space and buildings with high heritage values. Extending ROCK project's assumption, the present paper addresses two main knowledge gaps: 1) policy field: the demand for more evidence based policy about the impact generated by heritage led-regeneration and urban transformation actions (both permanent and temporary actions); and 2) operational field: the urgent need for adopting new technologies to create novel ways of mapping and measuring the impact provoked by the urban regeneration process and physical transformation actions in the context of heritage areas.

Throughout this paper, we direct our focus on ROCK tools and technologies aimed at improving CH accessibility and public safety perception, namely the large-crowd monitoring tool developed by DFRC.[2] The large-crowd monitoring tools is contextualised in two of ROCK Role Model Cities: Cluj-Napoca (Romania) and Turin (Italy), in order to understand the impact of transformative actions in heritage districts. The tool is used to study users' flows generated by urban transformation actions, on two different circumstances: one related to regular activities and ordinary uses of public space in the monitored areas, while the other one shaped by temporary public installations, structures and happenings related to specific cultural events/ large crowd events. The end goal of testing the large-crowd monitoring tool in the two cities is to collect missing, but essential data for optimizing safety conditions and tailoring urban policies.

The large-crowd monitoring tool is based on the LBASense system, which relies upon a network of sensors placed in both indoor and outdoor areas of the city, later called monitored areas. The sensors provide accurate analysis on spatial-temporal behaviour, based on collected data over time and real-time insights on mobility patterns within and between the monitored areas. The collected data allows the system to perform a comprehensive reading of the crowd's nature, enabling end-users to access demographic figures and mobility patterns during ordinary (during conventional/ average week days) and extraordinary conditions (i.e. cultural-based festivals and events) for the selected locations. The main objective is to determine the footfall in real-time, as well as the change rate in crowd's size, dwell time and data concerning revisits and nationality information for visitors. Additionally, the system provides explicit visualisation for flow patterns and distribution in the monitored areas.

[2] Data Fusion Research Centre (DFRC), a Swiss SME founded in 2006, World leader in WiFi analytics. DFRC is specialised in geospatial data fusion and analysis, delivering powerful end-to-end solutions based on meaningful information about location, movement and flow of people and objects through unique monitoring tools such as its patented LBASense mobile phone detecting sensors, software and platforms. (http://www.dfrc.ch/)

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3 METHODOLOGICAL APPROACH

3.1 Paper objective

The main objective of this paper is to perform a trend analysis within city-flows by investigating data provided through the LBASense and constructing situation awareness pictures in specific heritage areas from two of ROCK Role Model Cities: Cluj-Napoca (Romania) and Turin (Italy). Both cities are currently under the testing phase of the LBAsensors in real urban environments, with the aim of measuring the impact of large-scale events and urban transformations in the city heritage areas. The major contribution of this paper covers two main outcomes: 1) a visual analysis approach to highlight the impact of urban transformation actions, generated from location-based data concerning people movement flows and 2) identification of frequent versus exceptional movement flows and rhythms to highlight changes occured during ordinary (in the sense of conventional/ average days) and extraordinary times (i.e. during particular large-scale events).

3.2 Methodology

The methodology used for investigating the impact of urban transformation actions in city's heritage areas is based on a systematic analysis on data generated from the LBASense (through the locally-deployed WiFi sensors in the two selected cities), collected over three selected moments, as follows: one, covering an ordinary week period with no exceptional event/ particular happening (data gathered over seven consecutive days) and the other two, concerning two different extraordinary/ large-scale events that generate temporary changes in the normal behaviour (data gathered over the entire event period). Therefore, the paper explores real-time data provided by the LBAsense system (raw data transposed into charts) for a limited period of time (chosen moments according to data availability), in order to identify mobility patterns within the monitored areas, which are consequently translated into visual representations (charts and mobility maps).

The performed analysis highlights the accessibility dimension to specific contextual data on crowd flows (during ordinary days and extraordinary/ exceptionally events) in different CH locations in the city, related to both traditional heritage spots and unconventional spaces, outlining urban hotspots and preffered locations.

3.3 Case studies selection

The reasoning behind the selection of the two cities for performing the analysis was the similarity of the conceptual approach towards heritage-led regeneration (both cities have undergone through a transition phase, building a new culture and knowledge-led identity), differentiated through diverse implementation methods and tools, which served to the definition of the city's model framed in ROCK project:

- Cluj-Napoca displays a model of Community-based Design, based on the process of reinventing Cluj-Napoca historical centre and redevelopment of the city's backbone to create a sustainable and equitable solution to address the community's needs, by enabling citizens to become active participants in the life of their own community;
- Turin showcases a model of sustainable re-use of the spaces and Public-Private synergies, based on the reuse of the heritage in the central districts combined with physical regeneration, great international events (e.g. 2006 Winter Olympics) and the development of a strong, long-term publicly-led cultural policy, contributed to boost an overall and wider redevelopment process.

Consequently, the options considered by cities for selecting the areas to be monitored through ROCK project were quite different from two main reasons: on the one hand, due to the particularity of the locations influenced by the large-scale events organised in the city heritage areas, while, on the other hand, considering the specificity of the spatial approaches included in the city's overall regeneration or development strategy. For instance, Turin's city strategy proposes the dispersal of the major urban (cultural) regeneration projects in both the historic core of the city as well as in more peripheral areas surrounding the city centre (like for example San Salvario, Barriera di Milano (Urban Recovery Programme Turin[3]), Porta Palazzo (Colantonio, 2011), etc. Contrarily, the city of Cluj-Napoca concentrates the cultural happenings nearby the central area of the city, with a focus on the old town and the west part of the city center (near Simon Bărnuțiu Park and Someș Riverbanks). Despite the different spatial approaches towards the regeneration process, crowd flow analysis is still dependent on the fact that in a highly dynamic urban

[3] Urban Recovery Programme Turin, available at: http://www.comune.torino.it/rigenerazioneurbana/en/

environment, people's flow remain the only constant, expressing the lively dimension of changes in the urban fabric (M. Castells, 2000). Therefore, identifying crowd flow patterns in the two cities allows us to draw some conclusions regarding the use intensity of certain locations in correlation with particular events (especially in respect to extraordinary events), as well as to determine average mobility flows during ordinary days and diviation trends during extraordinary periods, in order to formulate a set of adequate policy recommendations.

3.4 Criteria for periods selection to conduct the analysis

In the present research, the urban transformation actions are understood as temporary/ extraordinary events that produce variations in the people flows among different city locations, according to the reasoning behind the usage of particular spots, intensity of usage, etc. This analysis allows for the identification of hot-spots inside the urban tissue which could be subject of tailor-made policy interventions or specific measures regarding mobility issues (such as accessibility means, public transportation timetable, etc). The impact of urban transformation actions is measured in three different moments, selected individually for each city, but following the same guidelines, in order to allow for a comparison between mobility patterns between the monitored areas inside the city. The time slots/ periods were selected according to the following criteria:

- First moment: during a large-scale[4] event, following a period of at least three consecutive days, during which large crowd flows differ (between days and between monitored spots);
- Second moment: during a smaller-scale event, but which accommodates temporary installations/ structures in the monitored area, following a period of at least five consecutive days, during which large crowd flows differ (between days and between monitored spots);
- Third moment: during an ordinary week, including the entire weekdays and weekends, from Monday to Sunday, when no particular event is organised within the monitored area.

3.5 Evidence-based results of crowd flow impact during urban transformation actions

In the context of this paper, possible impacts of urban transformation actions in city's heritage areas were grouped in different sub-domains, falling under the three main pillars of ROCK vision: accessibility, sustainability and collaboration (ROCK Deliverable 2.2). Each of these three areas corresponds to specific scenarios and measures considered in the regeneration processes, all impacting the way urban transformation actions bring visible changes in the urban environment. In ROCK acceptance, accessibility is understood both in terms of physical aspects (mobility issues, as well as the access of people with different disabilities) and non-physical/ immaterial accessibility (on the basis of economic accessibility, social equity and digitalisation level). Sustainability (climate/ environmental) and resilience is expressed through the capacity of urban systems and cultural heritage to be sustainable in terms of mitigation and adaptation to climate change (i.e. actions for mitigating and adapting to climate change, greening actions, etc). Lastly, collaboration (for new productions) is used to boost the process of creating new ways of collaboration among stakeholders and users with the aim to transform them into prosumers/ active producers of new values (i.e. new typologies of unconventional collaborations for adaptive reuse, temporary uses, etc). One limitation of the present study refers to the lack of data availability on certain aspects concerning these pillars in the two analysed cities. Hence, starting from ROCK pillars, for measuring the impact of urban transformation actions in city's heritage areas generated by crowd flows, the study has defined a limited number of impact areas, as shown in the table below.

The process of data collection and interpretation aims at identifying people flows related to chosen periods of time in order to correlate the effect they produce over these identified impact areas. This corelation allows us to make evidence-based reccomendations for improving the policy framework in different domains, all affected more or less by spatial-temporal behaviour connected to specific extraordinary events/ happenings. In this respect, the differentiation of the selected times for analysing data reflects important changes in the mobility patterns produced by fleeting large crowd flows between city's heritage areas and hotspots.

[4] Large-scale event has been interpreted as an event whose people flow exceeds 90k visitors per day, while the smaller-scale event has been interpreted as an event whose people flow exceeds 25 visitors per day. The number of days for each type of event varies.

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ROCK Pillar	Sub-domains/ Themes	Impact area	Policy domains
Accessibility	Physical accessibility	Public transportation means/ timetable Routes management and signage Physical access for people with different disabilities (sight, hearing, movement)	Mobility (including services for disabled people) Urban design/ signage
	Non-physical accessibility	Awareness/ communication of action Price for use/ consumption of the event	Communication and advertising
	Safety	Police and security Health/ First aid Perception/ Lighting system	Security Health Urban Lighting
Sustainability	Environmental aspects	Traffic and air pollution Waste management Energy efficiency	Environmental protection
	Physical environment	Noise and vibrations Physical degradation of built heritage	Heritage protection
	Socio-economic environment	Short-term housing price speculation Social conflicts over the use of space	Site management
Collaboration	Services and facilities (commercial, cultural, leisure and entertainment)	Adaptive reuse of buildings Temporary use of urban space	Space provision and use
	Events/ festivals organisation	Partnerships for event organisation Incentives for event organisation	Public-private partnership

Table 1: Impact areas and related policy domains grouped under the three key ROCK pillars

4 TECHNOLOGY ENABLERS FOR DATA-DRIVEN URBAN TRANSFORMATION ACTIONS

Cultural heritage-led regeneration represents a sectoral part of the city's urban regeneration strategy, which is typically a spatial component of a wider policy program addressing social deprivation in inner-city areas (McCarthy, 2007), but also a means to improve physical fabric of urban areas to stimulate economic growth (De Magalhães, 2015). No matter what the tackled policy goal is, urban regeneration remains, even nowadays, an important tool for dealing with the urban transformation process. In this context, ROCK project assumes a regeneration process oriented to go beyond the physical transformation by assuming the city as a common heritage, with the end goal to ensure social equity and community cohesion.

One of the most frecquent policy challenges cities are facing in relation to cultural heritage regeneration lies in finding the right balance between conservation and modernisation/ valorisation measures. The regeneration measures are considered at two main levels in respect to the urban transformation intervention actions: 1) permanent physical transformations (projects concerning physical operations such as rehabilitation/ conservation of heritage buildings, public spaces, etc) and 2) organisation of temporary events for cultural purposes. In either case, the outcomes lead frequently to the intensification of mass tourism, over crowdedness, leading, eventually, to spatial overuse and environmental degradation. The rationale behind the pressing need for acquiring evidence-based policies in the heritage regeneration processes comes, alongside urban management questions, also for bridging the existing gaps in the policy framework in relation to the identified challenges (i.e. management plan based on spatial-temporal analysis; diversification of culture-connected services and facilities offer in the area; spatial redistribution of uses and flows, etc). Therefore, ROCK envisions regeneration measures as being part of a process managed through a complex regulatory framework with complementary governance and policy instruments, in order to avoid touristification and

gentrification phenomena, without constraining the enjoyment and accessibility of heritage areas and sites (ROCK Deliverable 6.4).

In this context, technology plays a fundamental role in providing evidence-based analysis related to the aforementioned pillars of cultural heritage-led regeneration processes. However, technology integration into the heritage environment and the urban regeneration process of heritage areas is not an easy task. Throughout ROCK project, the involved cities adopt a data-driven approach for progressive transformation of CH in creative and knowledge cities, collecting data generated by iterative transformation actions, analysing and interpreting it, and assimilating the feedback into the regeneration process through corrective or adjusted actions or specific measures. Within this paper, we are examining a particular typology of data (concerning Cultural Heritage and Safety issues), resulted from the deployment of the LBASense system in the two selected cities (Cluj-Napoca and Turin), which provides real-time insights on activity and mobility patterns within the monitored areas.

4.1 Technology integration into heritage areas

Technology integration into heritage areas is one of the biggest provocation of the project so far, since the authorisation processes for the deployment of particular sensors is more complicated and requires a longer approval period. However, the LBA sensors come in different forms (short-range and long-range sensors), in order to make their usage possible both indoor and outdoor, but none of them generates any interferences with the heritage, being non-invasive for heritage building's structure and image. For this reason, ROCK project paid special attention to acquire an optimal integration between new technologies and the historical centre, with no disruption or disturb for people, historic buildings and areas, the LBAsensors being carefully placed in areas which do not affect in any way the historical buildings or other components of heritage areas. As such, the deployment of the Large-Crowd Monitoring Tool did not raise unexpected issues for the cities experimenting with this specific technology.

4.2 Technicalities and functionalities of the LBAsense: expected outcomes

The Large-Crowd Monitoring Tool used for generating the necessary data to carry out the impact measurement of urban transformation actions in city's heritage areas is represented by the LBASense system, which performs location-based analytics through a comprehensive reading of the crowd's nature, enabling end-users to access demographics figures and mobility patterns on a wider scale, in ordinary and extraordinary conditions (i.e. festivals and events). The LBAsense system comprises a network of mobile devices scanning sensors, which converts human traffic data into powerful and versatile analytical and profiling services through innovative algorithms. The sensors determine footfall in real-time and change rate in the crowd size, besides dwell time, revisit and flow patterns and distribution, as well as any abnormality, in the overall area under monitoring, with an additional focus on selected key-locations[5] (DFRC reports).

The networked system of the LBASense is composed of two complementary sensors types: 1) long-range sensors, providing full coverage of the monitoring area on a citywide scale, but generating low accuracy mobility patterns and 2) sensors located at specific points of interest within the coverage of the wider system, providing high accuracy location specific data for those locations. The mixture between the sensors supports high accuracy measurements of footfall and mobility patterns within the entire monitored area. Specifically, the LBASense mobile phone sensors are capable to monitor, using both cellular and Wi-Fi signals, crowd dimension for monitored spots and people flows between the monitored spots (the area where the sensor is placed, with a radius of approximately 100 m radius around the sensor location). The compiled data is delivered through the LBA Dashboard, which allows end-users to retrieve various analytics on request under the form of raw numbers and aggregated graphics. The LBASystem installation comes with a set of requirements from the city side for the selected areas to be monitored, including the definition of concrete installation points, supply of power/ connection to the grid, access to the Internet/ local server, min/ max temperature threshold.

5

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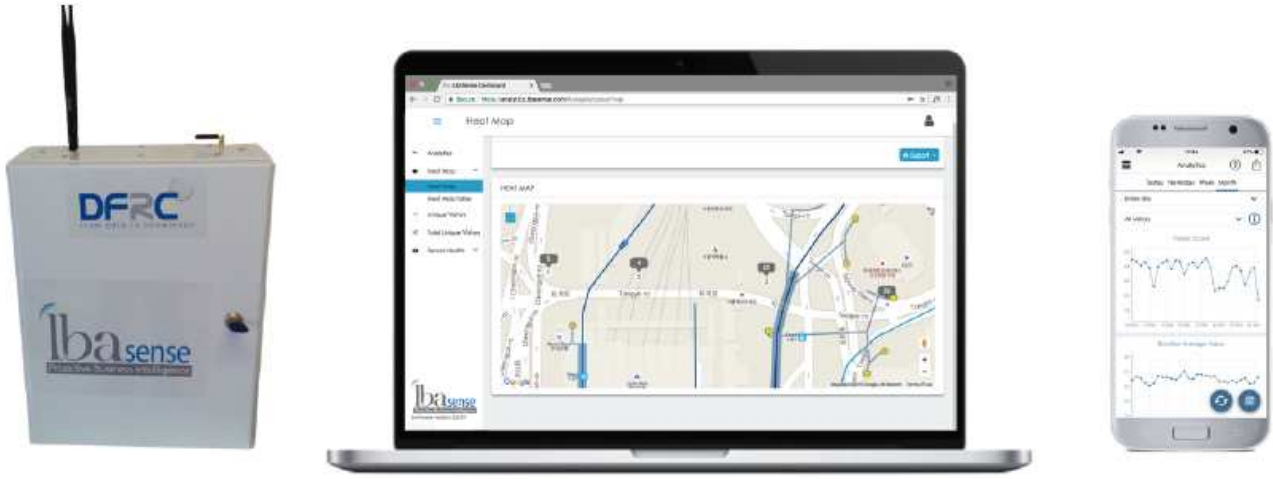

Fig. 2 Crowd Analytics Monitoring Tools: Outdoor Box, LBASense Web Dashboard and Mobile App6

4.3 Data description and processing

The LBASense system generates Big Data, which is analysed through the Analytics Builder Service and translated into visitor movement track through the Track Builder. Specifically, the data employed in the present analysis falls under visitor track data, which is periodically read from database, processed into visits analytics (including site, flow, mobility, link, behavioural analytics) and stored back into the same database. The data collected comprises the following information: a) visitors count per hour/ day, b) duration of the visit, c) mobility of visitors among city areas (measured through in/ out flows for specific target spots where the sensors are placed), d) new visitors versus returning visitors.

4.4 Criteria for periods selection for the analysis

In the present research, the urban transformation actions are understood as temporary/ extraordinary events that produce variations in the people flows among different city locations, according to the reasoning behind the functional usage of particular spots, intensity of usage, etc. This analysis allows for the identification of hot-spots inside the urban tissue which could be subject of tailor-made policy interventions or specific measures regarding mobility issues (such as accessibility means, public transportation timetable, etc).

The impact of urban transformation actions is measured in three different moments, selected individually for each city, but following the same guidelines, in order to allow for a comparison between mobility patterns between the monitored areas inside the city. Therefore, the time slots/ periods were selected according to the following criteria:

- during a mega-event[6] (Valentino P., 2011), following a period of at least three consecutive days, during which large crowd flows differ (between days and between preferred spots) – two different events selected for each city;
- during an ordinary week, including the entire weekdays and weekends, when no particular event is organised within the monitored area – senven consecutive days from Monday to Sunday for each city.

The selected events for each city varies on many levels, starting from the length (measured in number of days), frequency (annually), location (measured in number of venues, sites activated), attendance level (measured in number of visitors). Nevertheless, temporary impacts caused by these events are often associated with negative externalities, among which we mention the displacement of people and short-term gentrification phenomenon, the commercialisation of public space or environmental deterioration.

[6] Mega-event is defined as "a large-scale special event that is high in status or prestige and attracts a large crowd and wide media attention" (Jago L.K, Shaw R. N. (1998), p. 30). Hence, a mega-event in the present articles has been interpreted as a large-scale event whose people flow exceeds 25k visitors per day. Unlike the commonly accepted understanding of mega-event, large-scale events referred in this paper do not produce long-lasting transformative impacts on the urban fabric.

5 CROWD FLOW ANALYSIS IN THE TWO CITIES: CLUJ-NAPOCA AND TURIN

In order to perform the analysis on the flows generated by people movement between hot spots of the city in different moments/ periods of time, a short background on the city profile is required for understanding the particularities that lay behind distinct spatial patterns and, particularly, the reasoning behind the sensors' setting within the urban tissue. A short descriptive contextualisation of the city's background and cultural profile eases the understanding of the expected

5.1 Cluj-Napoca (Romania)

5.1.1 City profile and contextualisation

Cluj-Napoca is the second largest city in terms of population, located in the heart of Transylvania. The city is labelled as one of the most important university centres in Romania and a knowledge node of EU significance (ESPON 1.1.1). Among the main strengths of Transylvania's capital, Cluj-Napoca benefits from an advantageous geographical position near the western borders of the country and it is recognised as an emergent economic centre, developing economies with a diversified structure and proving a high clustering potential in many domains. In terms of demographics, the city has a significant increase of young population, being one of the few cities in Romania with a positive natural growth and population growth at a steady pace (SIDU, 2017).

Over the past ten years, the internationally renowned university environment favoured a transition towards a knowledge-based economy, with a strong orientation to innovation and ICT sector. In consequence, the city witnessed a flourishing cultural dynamic and registered the highest urban vitality index after Bucharest, the capital city, considering the following indicators: cultural sector infrastructure, specialised human resources, budget spent on cultural-related activities/ services, participation in cultural activities, creative economy, NGO sector, medium income, number of students and investment per capita (World Bank, 2017).

Since creative industries and the university sector are among Cluj-Napoca's growth engines, the city currently focuses on developing its innovative character, increasing the culture of entrepreneurship and providing good training of young workforce in competitive fields such as IT and creative industries. After adopting a more cultural-oriented approach, the transition has been visible especially in the increasing number of cultural events, with over 100 annual festivals offering theatre, literature, dancing, musical experiences. Cluj has a specific cultural vitality defined by a wide range of events throughout the year. It has also been the Youth Capital of Romania in 2015 and shortlisted for Cultural Capital of Europe 2021 title (European Capital of Culture Candidate City, 2016).

One of the major festivals is called Untold, the largest electronic music festival held in Romania yearly, reaching its 5th edition in 2019, is organised in the very centre of the city (Cluj Area location), but highly impacts the surrounding areas (Central Park, Unirii Square, etc). Together with Untold Festival, Transylvania International Film Festival (TIFF) attracts a significant number of visitors at both national and international level, contributing to the enhancement of the tourism sector as a key pillar in the economic, spatial and cultural development of the city. In the past 5 years, Cluj has been appointed European Youth Capital in 2015 and shortlisted for Cultural Capital of Europe 2021 title, which also strengthens the city's cultural and vibrant profile. All of the fast changes occured in Cluj dynamics in terms of demography, economic development and specialisation are inevitably speeding the urban transformation processes as they are generating changes both in terms of new spatial configurations (secondary centres for diffusing the cultural interest within the city, new interest spots, etc), flows and mobility patterns within the city.

Considering the city's background, the option for using the crowd analytics instrument for monitoring large-crowd events was without any doubt, the best choice for measuring the impact produced by temporary installations and events in the heritage areas in the city, specifically the historic city centre. The crowd analytics instrument has been placed in strategic areas and spots in the Unirii Square surrounding areas (Unirii Square (1), Central Park (1), Cultural institutions: Casino Building Rooftop (1), Magyar Opera House (1), Polyvalent Hall (2), Cluj Arena (1)) for a period of 2 years (August 2018 - June 2020). By using this instrument, the city of Cluj-Napoca aims at examining people's flow among various locations, based on information collected about the visitors' habits, period of usage of the space, visitors' returning rate during large cultural events, such as Transylvania International Book Festival, Transilvania International Film Festival, Cluj Days, Cluj Never Sleeps, etc.

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5.1.2 Data interpretation and results

In the following lines we will briefly describe the main results of the data analysed for each particular event and will link the conclusions to the impact areas listed above.

For Cluj-Napoca, the graphic representing the number of visitors by daily footfall shows an increase of almost 200% of total visitors during the large-scale event (UNTOLD), with a total number of new visitors almost 2.5 times bigger than the number of new visitors at TIFF, and 5 times bigger than the number of new visitors in an ordinary day of the year. In what concerns the most crowded periods, the peak hour during the UNTOLD festival was 10pm, gathering a maximum number of around 25k visitors, followed by the interval from 12 to 6 am with around 20k visitors. These big figures have a big impact on the physical accessibility of the surroundings of the festival's area, as crowd flows put a lot of pressure on both pedestrian routes and roads, thus bringing the necessity for a good traffic management and a well-organized public transport system, especially during the peak moments of the event. The big amount of people also impacts the natural environment, which is of particular importance in Cluj's case as UNTOLD area includes the biggest park in the city, and, on the other hand, the main venues are very close to Someș River. Another domain which is affected is the area's safety during a large-scale event, which need to be assured through a set of clear measures. On the other hand, in what concerns users preferences for different locations, we have noticed two different types of locations: the ones that keep a moderate number of persons in the same place for a long period of time (from 20 minutes to one hour) and the ones that attract mainly transitory flows (1-5 minutes). The socio-economic environment is also a challenge especially during large-scale events, as it leads to housing speculation and social conflicts regarding the use of space between residents and visitors, considering the fact that public spaces such as Simon Bărnuțiu park, the single big park in Cluj, cannot be accessed by residents during the event.

During both analysed events in Cluj-Napoca (UNTOLD and TIFF), we have noticed that transitory flows are linked to locations such as Simon Bărnuțiu Park, Cluj Arena and Polyvalent Hall, while Unirii Square, Magyar Opera House and the Casino are keeping the visitors at the location for a longer period. Thus, the statistics showcase several differences between different paces that each location imposes on the users and also reflects how the activities carried out in each location shape their behavior. In what concerns the mobility patterns, we have noticed that users preferences differed from an event to another, thus each event had 2 routes which were more populated - for UNTOLD, the path between Polyvalent Hall and Cluj Arena, and also from the park to the Casino, while during TIFF people moved from Unirii Square to Cluj Arena and Polyvalent Hall, but also from the Hall to the Arena. People movement impacts the non-physical accessibility of the area, bringing the need for particular on-site soft interventions for a better orientation, and also for raising the attractivity of less popular locations. Furthermore, they bring the need for certain services and activities provided by the area, all of these impacting also the natural and the built environment, which need to be protected from noise, pollution and harmful vibrations.

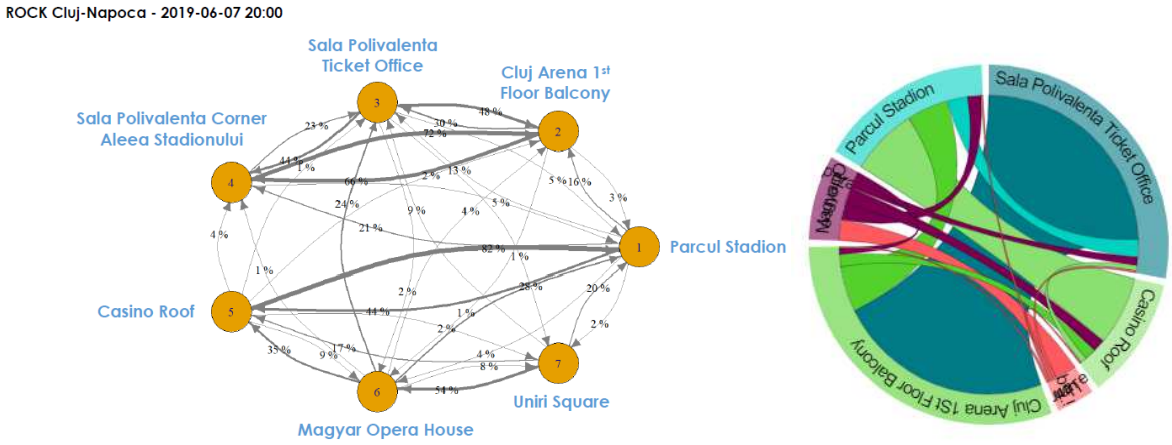

Fig. 3 – Mobility patterns map. Preffered locations/flows distribution in Cluj-Napoca during TIFF festival

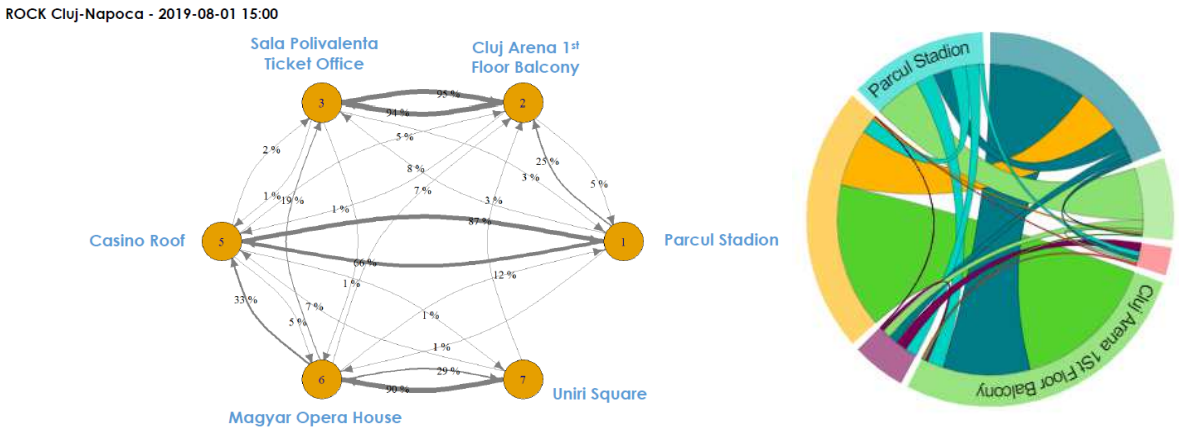

Fig. 4 – Mobility patterns map. Preffered locations/flows distribution in Cluj-Napoca during UNTOLD

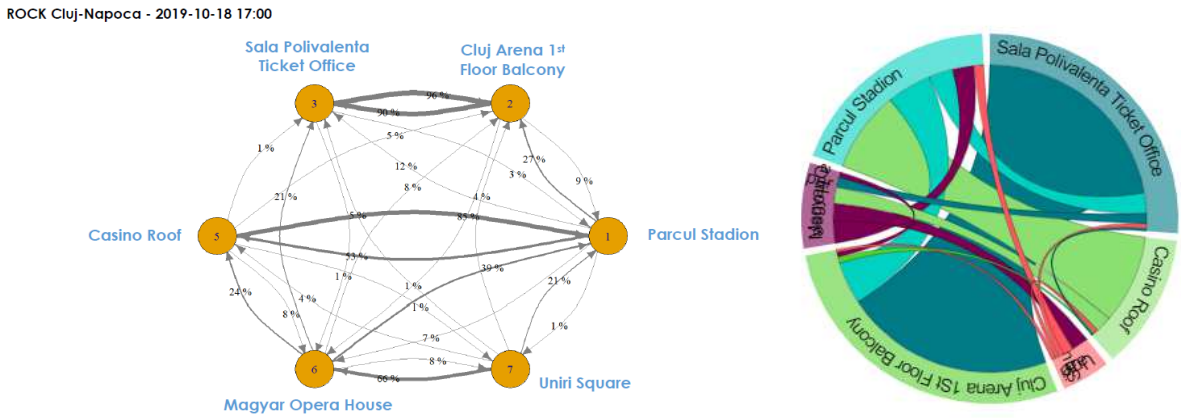

Fig. 5 – Mobility patterns map. Preffered locations/flows distribution in Cluj-Napoca during ordinary week

5.2 Turin (Italy)

5.2.1 City profile and contextualisation

Turin is an important economic pole located in the northern part of Italy, in the Piedmont Region. Ranked as the third richest Italian city, after Rome and Milan and it used to be one of the main industrial centers of Italy, being part of the so-called “industrial triangle” together with Milan and Genoa (Carter, 2016). The industrial past has brought the city a significant challenge in repositioning in the national and global economy, but also a valuable legacy of former industrial buildings that have been partly reconverted with new functions, partly being still vacant. Therefore, the cultural heritage of the city is characterised by different historical layers, developed from the Roman times to the post-industrial years. However, the consequences of the de-industrialization process were heavy both economically and socially, questioning the identity of a whole city. As a major university centre, with 7 prestigious universities (among which Polytechnic of Turin and University of Turin being particularly focused on developing technical and creative competencies), Turin embraced this strength and overcame the post-industrial crisis by leveraging on the social capital.

Pressured to reinvent itself, the city of Turin made tremendous efforts to orient its industrial reputation towards business and creative sectors, by leveraging on its rich culture and history, as well as on the well-prepared workforce, whose primary asset lies in the extensive knowledge of design and production processes due to their industrial background. Currently, according to UNESCO, around 9.1% of the active bodies and companies are represented by creative and cultural industries, counting around 100.000 employees (UNESCO Creative Cities Network, 2014).

In this context, the city administration channeled its efforts not only onto the reconversion of post-industrial areas into new service areas, but also on urban and cultural regeneration, with a particular focus on cultural heritage areas within the city. Beside physical infrastructure projects, the city also embraced and encouraged the implementation of several major cultural events such as Contemporary Art Week, Turin International Book Forum and others, which bring annually hundreds of thousands of visitors to the city.

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Considering Turin's background, the use of LBAsense system under the ROCK project framework tackled two main issues. On the one side, the city needs to better understand the connection between the permanent heritage (museums, UNESCO locations, historic city centre) and temporary events attracting large amount of visitors, which, in many cases, are organised in areas outside the city's centre, areas under development or in transition, therefore the potential in terms of attractiveness of neighborhoods in the process of regeneration needs to be better investigated and understood. The second need is related to the negative side effects of the fruition of CH and cultural events such as the management of large crowds in terms of security, noise, mobility and waste. As such, the strategy for choosing the areas under sensors' monitoring follows a two-fold approach: permanent locations for tracking large crowd flows (Museo Arte Orientale, Galleria Arte Moderna, Borgo Medievale, Palazzo Madama, Museo del Risorgimento Italiano, Palazzo Reale, Giardini Reali, Courtyard Palazzo Carignano and Appartamenti dei Principi) and temporary locations, which follow the most popular locations during the large-scale events (Salone del Libro Pad 2, Salone del Libro Pad 3, Salone del Libro Pad OVal, Da Lisa Via Baretti 2, Palazzo Carignano - Cortile (x2), Office Test 1, Office Test 2). One of Turin's intents is to enable wider knowledge about existing cultural heritage in the city, beyond the conventional and institutionalised heritage assets, its condition and usability perspectives, to which the crowd flow analysis during certain temporary events can input with relevant quantitative data sets.

5.2.2 Data interpretation and results

In Turin, the conclusions resulted from analysing the figures during extraordinary events are the following: there are 3 times more visitors in the peak day of Turin International Book Fair (90k people on 11.05.2019) in comparison with the Contemporary Art Week (37k people on 2.11.2019). Compared with an ordinary week, TIBF figures are 11 times higher, while CAW figures are 4 times higher than during an ordinary day. (90k, respectively 37k versus 8k). Considering the very big differences occurring between extraordinary events and ordinary days regarding crowd flows, the highest impact in the city is probably related to the physical accessibility of the area and its safety. Even if it does not imply a natural area (as in Cluj-Napoca's case), the environmental impact is another matter of concern during particular events, as issues such as waste management and traffic must be very well organized.

The mobility issues are another tensioned point during extraordinary events, but in this case the figures resulted from hourly footfall and also the schemes on mobility patterns can lead to a good management. For Turin, both events are showcasing the same popular periods, as there are two main peak time intervals preferred by visitors: from 10am to 4 pm (9-10 May 2019, around 5k visitors) and from 12pm to 4 pm in the following days. An interesting fact about people patterns during CAW is the curve showing visitors flows, which is very similar from one day to another. It shows every day the same two peak moments (12pm and 16pm), with Palazzo Reale and Giardini Reali being the most preferred locations. On the other hand, both events are bringing a big number of new visitors in all festivals days, with TIBF bringing the highest percentage (70%) during the second day of the event, on a Friday (10.05.2019), while also showing a gradually decrease until the last day of the event (10% new visitors). On the other hand, the Contemporary Art Week, even if it brings a smaller total number of visitors in comparison with TIBF, brings a higher percentage of new visitors during the whole period of the festival. These figures describe a huge need for a good public transportation system, and also require special attention given to assuring physical access and safety measures for vulnerable social categories (disabled, elderly and children). In what concerns the mobility patterns, there are big differences between user preferences during each event, showing major flows between book salons organized in the central area during TIBF, while during CAW the most popular paths are Museo Dei Risorgimento – Palazzo Carignano – Cortille and Palazzo Reale – Giardini Reali. This results can impact the urban transformation processes related to the temporary use of urban space (temporary installations), public awareness and indications related to a certain action/event and also measures related to noise and vibrations.

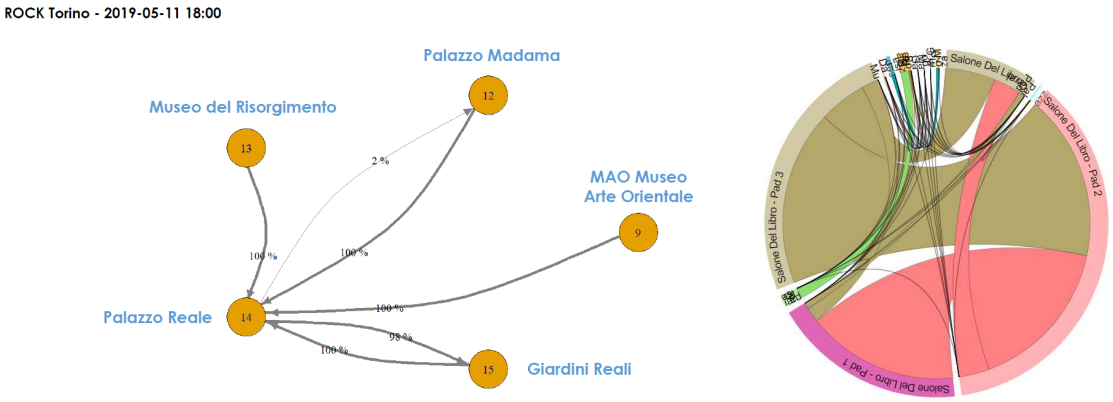

Fig. 6 – Mobility patterns map. Preffered locations/flows distribution in Turin during International Book fest

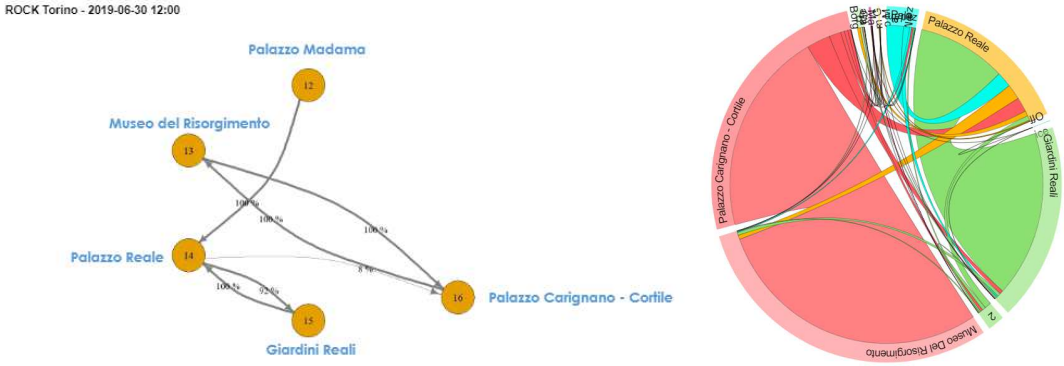

Fig. 7 – Mobility patterns map. Preffered locations/flows distribution in Turin during ordinary week

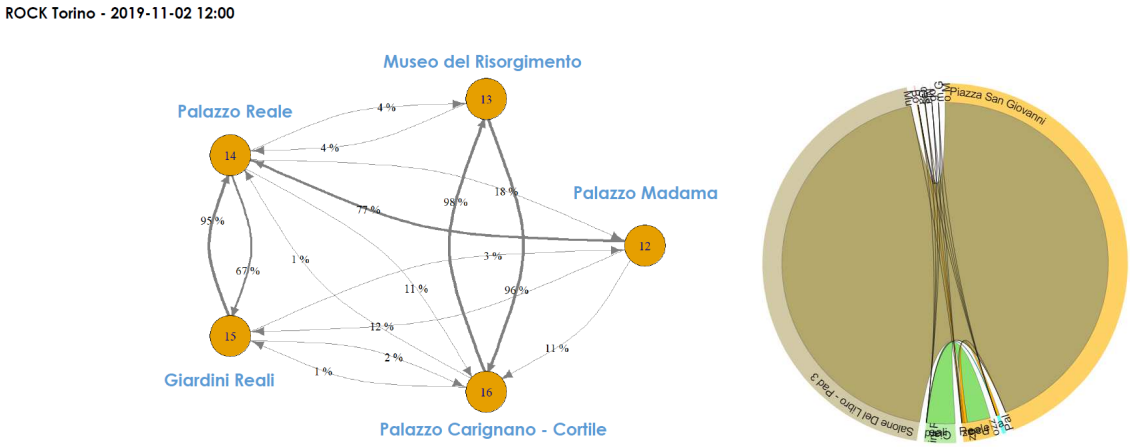

Fig. 8 – Mobility patterns map. Preffered locations/flows distribution in Turin during Contemporary Art Weekend

6 EVIDENCE-BASED POLICY RECOMMENDATIONS

To conclude, the sensors deployment strategies in Cluj-Napoca and Turin are quite similar, being mainly oriented towards collecting data on people's flow among various locations among the city and identifying movement patterns related to cultural assets and events for a period of approximately 2 years (from August/ October 2018 to June 2020). Nonetheless, the spatial approach (location of sensors) and partially the expected outcomes vary to some extent. The data analysis carried out in Cluj-Napoca and Turin within the three selected moments of 2019 (two large-scale event and an ordinary week of seven consecutive days), resulted in a set of relevant conclusions regarding different types of impact that crowd flows dynamics has on both studied cities.

As an overall consideration, the monitored areas of the two cities outline a similarity in terms of accentuated "festivalization" phenomenon of culture, as well as a concentration of events in the same spots of the city, which eventually leads to short cultural experience duration. Besides, this tendancy creates an unbalanced distribution of people flows between different spots in the city, leading to high polarisation and attractiveness

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of certain spots, the so-called hotspots. However, one limitation of the present study has to be considered here – conclusions have been drawn based on the monitored area in each city, determined by the places where the sensors have been located. Therefore, we are reffering to specific parts of the city which have fallen under the monitoring process. While the city of Turin struggles to distribute the cultural happenings and events outside the concentrated city centre, the city of Cluj-Napoca is still lagging behind in terms of the cultural offer, which is still reduced outside the city center.

Taking into consideration also other study constraints (such as the availability of qualitative data regarding the selected events – perceptions, emotional mapping, as well as the lack of preliminary policy framework analysis), a set of policy recommendations has been formulated in respect to the three main ROCK pillars (accessibility, sustainability and collaboration), considering the identified subdomains in relation to urban transformation actions on which crowd flows impact. The table below summarises the policy recommendation on the ROCK pillars:

ROCK Pillars	Policy recommendations	
	Explicit (directly resulted from raw data analysis)	Intuitive (requiring further analysis of compementary data)
ACCESSIBILITY **Subdomains:** Physical accessibility Non-physical accessibility Safety	• Limitation of number of people visiting certain areas • Develop thematic routes in order to help different types of users to orientate in crowded areas (vulnerable social categories, visitors, etc) • Increased safety services (police, first aid) during extraordinary events, especially during peak hours/periods in certain locations	• Diversification of offer in regards to economic and leisure activities, in relation with the events/ Encompassing different parts of the city to minimize the pressure on existing hotspots • Strenghten and widen urban connections/ paths in different points, especially from events area to key points such as airport, railway station
SUSTAINABILITY **Subdomains:** Environmental aspects Physical environment Socio-economic environment	• Develop specific measures and regulations regarding to car access and parking during the extraordinary events • Integration of another valuable elements (natural/built) in the festivals circuit, through temporary uses, art installations, etc	• Assure a well developed waste management infrastructure, especially in the proximity of natural areas such as parks, lakes • Find methods for softening the social conflicts regarding the use of public space during the events
COLLABORATION **Subdomains:** Services and facilities Cultural production Events/ festival organisation	• Polarization/ distribution of smaller events/ facilities in other areas to lower the impact on a certain location • Highlight and improve less popular CH locations through developing cultural, leisure and entertainment offers	• Adaptive reuse of buildings, Temporary use of urban space (easy permits for temporary installations) • Provide incentives for event organisation in order to help the local economy • Strenghten the PPPs regarding the festivals organization, accommodation during the festival and other goods and services provision during the events

Table 2 – Impact areas grouped under the main three ROCK pillars

7 CONCLUSION

A specialised institutional setup is highly required for identifying and addressing properly the policy challenges through regulatory framework and measures for creating a balance between conservation issues and modernisation/ valorisation ones (i.e. overcoming the touristification phenomenon without constraining the enjoyment of heritage areas value). Therefore, according to ROCK vision, data evidence is mandatory for ensuring appropriate impact assessment in cultural heritage valorisation projects, assumption which stands as a key cross-policy recommendation in the course of the implementation of cultural heritage valorisation project (ROCK Deliverable 6.4). In this sense, the rationale for performing a crowd-flow analysis stays at the

basis of measuring the impact of urban transformation actions in city's heritage areas, through a clear evidence on movement patterns between and within monitored areas, allowing the comparison between people flow distribution at different momentums.

The results of data analysis and interpretation were correlated with qualitative information regarding the nature of the urban transformation action (temporary character of the transformation actions studied in the present paper, in the context of large-crowd events and ordinary week days). Based on the outcomes, a set of recommendations have been proposed, with the final goal of tailoring the local policies to respond to dynamic changes in the flow distribution and usage of space in the city's heritage areas. The proposed recommendations have been structured based on the same format and logics as the established impact areas, grouped under ROCK pillars.

We would like to express our gratitude for the support and contribution received from the teams involved in ROCK project, representing the two Role Model cities Cluj-Napoca and Turin, as well as DFRC.

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UNESCO Universal Declaration on Cultural Diversity

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Data and Algorithm – the Fast Lane for Carless Mobility

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1 ABSTRACT

Die Wahl für ein Verkehrsmittel fällt primär durch Bequemlichkeit und Reisedauer und somit auf den motorisierten Individualverkehr (MIV). Insbesondere der Fuß- und Radverkehr wird dem MIV bereits in der Planung untergeordnet. Ineffiziente Wegenetze die der Fußgängerpsychologie und der Fahrradfahrphysik widersprechen entstehen. Dieses hemmt die Bequemlichkeit und Reisedauer des Fuß- und Radverkehrs und somit per Mobilitätskette die des öffentlichen Personennahverkehrs (ÖPNV).

In einem Vorhaben wird untersucht, ob durch den Einsatz von künstlicher Inteligenz (KI) effiziente Wegenetze, die der Fußgängerpsychologie und der Fahrradfahrphysik entsprechen, entwickelt werden können. Es wird untersucht, mit welchen verfügbaren Daten der Fuß- und Radverkehr so beschleunigt werden kann, dass er zusammen mit dem ÖPNV zur Konkurenz für den MIV wird.

Keywords: ÖPNV, Radverkehr, Fußverkehr, Algorithmen, Daten

2 FRAMEWORK

2.1 Infrastruktur heute

Die historisch gewachsenen Wegenetze des Fuß- und Radverkehrs weisen Lücken und mangelnde Barrierefreiheit auf. Es fehlt an Brücken, Tunneln, Rampen, Durchstichen und Lückenschlüssen. Radwegradien entsprechen nicht den Schleppkurven eines Fahrrades. Radverkehrabbiegetaschen und Fußgängerforten sind fehldimensioniert und fehlplatziert. Unwegsame bzw. unsichere Oberflächen, Wurzelwerkaufrisse und Stehwasser beeinflussen ebenfalls die Wegroute. Mangelnde und mangelhafte Infrastruktur motiviert die Verkehrsteilnehmer zum Finden eines eigenen Weges (verkehswidrig sowie „Desired Path Phänomen“) oder hält sie von der Teilnahme am Fuß- und Radverkehr und am ÖPNV ab.

2.2 Stand der Forschung

Ca. 70 Prozent aller Wege unter zwei Kilometern werden zu Fuß oder per Fahrrad zurückgelegt [1]. Die Empfehlungen zur Wegstrecke für Infrastruktureinrichtungen liegen unter zwei Kilometern [2]. Diese Wege werden jedoch nur per Fahrrad oder zu Fuß zurückgelegt, wenn dieses über die produktivste Wegstrecke (schnell und kurz) möglich ist [3]. Bestehende Algorithmen (z.B. Dijkstra) zur Berechnung der kürzesten Route arbeiten auf der Basis von (realen Verkehrs-) Knotennetzen. Aktive Mobilität orientiert sich jedoch nicht an Knotennetzen, sondern folgt primär den Grundsätzen der Physik und Psychologie des Menschen. Seit den 1960ern ist bekannt, dass sog. Trampelpfade („desired path“ ->: „gewünschter Weg“) nach wissenschaftlichen Regeln entstehen [4].

Erhebungen belegen die Notwendigkeit, dass Trampelpfade bereits in der Planung berücksichtigt werden müssen – zwei Beispiele: 2015 ergab in der Stadt Kopenhagen eine Untersuchung des Fahrverhaltens der Radfahrer an einem großflächigen, stark frequentierten und verzweigten Knotenpunkt, dass mehr als 50% des Radverkehrs nicht auf dem Radweg stattfand [5]. 2017 untersuchte ein Planungsbüro in der Stadt Herrsching (Kloster) die Fußverkehrstraßenquerungen vom S-Bahnhof zum Klosterwanderweg mit dem Ergebnis, dass 95% des Fußverkehrs hier nicht an der LSA querten [6]. Beide Untersuchungen wurden rein empirisch, nicht durch den Einsatz von Software, durchgeführt. Auf der Ebene der mikroskopischen Verkehrsplanung gibt es erste Softwarelösungen, die auf der Basis der Fußgängerpsychologie eine Verkehrs-Wirkungs-Analyse in der Flächennavigation zur Erstellung von Evakuierungsplänen und ÖPNV-Konnektivität simulieren [7].Die Forschung zeigt, dass Wissen und Sensibilität für effiziente Wege vorhanden sindund diese für punktuelle Anforderungen angewendet werden. Was jedoch fehlt, ist die Verbindung zwischen mikroskopischen Modellen und der ganzheitlichen Tür-zu-Tür-Route (Haupteinfluss in der „desired path“-Thematik), die erheblich durch das Gesamtinfrastrukturangebot und die damit erzeugte Netzwirkung beeinflusst wird. Vorliegende Studien zur Fußgängerpsychologie und Fahrradfahrphysik zeigen Stellschrauben zur Verbesserung der Infrastruktur auf.

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2.3 Quantisierung der Mobilitätsmodi

Im Rahmen eines urbanen Radverkehrprojektes (2016) analysierte der Autor die Quantisierung der Mobilitätsmodis Verkehrsmittel Fuß, Fahrrad, Auto und ÖPNV für Strecken unterhalb fünf Kilometer in deutschen Großstädten [8]. Die Grafik zeigt, dass insbesondere die Weganbindung an die ÖPNV-Haltestelle einen Aufwandtreiber darstellt.

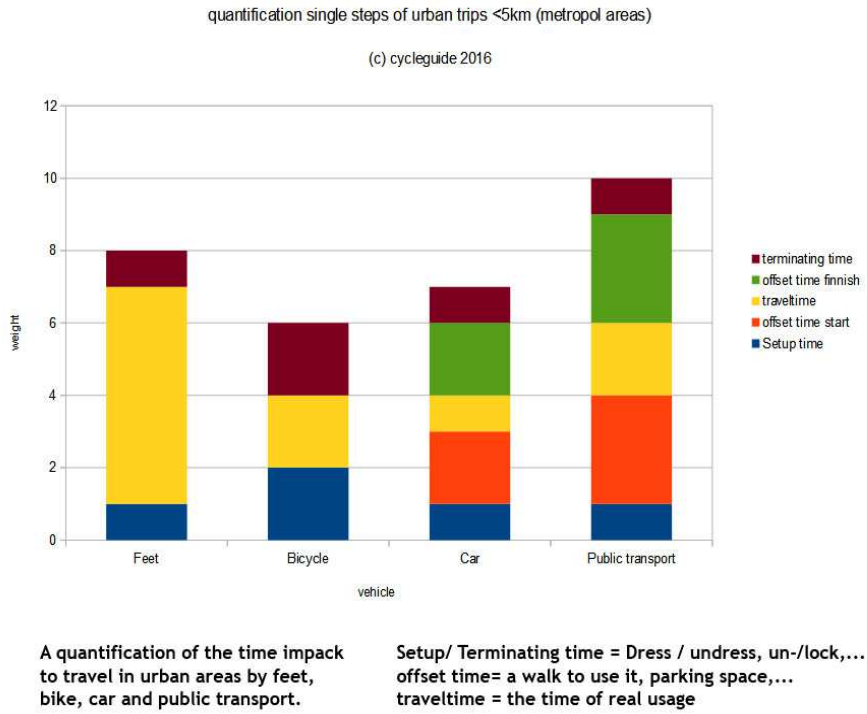

Fig. 1: Quantisierung der Mobilitätsmodi [8]

3 PROPOSITION

3.1 Wissenschaftlicher Ansatz des Vorhabens

Verfügbare offene Daten und Behördendaten (z.B. Infrastruktur- und Wetterdaten) werfen die Frage auf, inwiefern diese miteinander verknüpft werden können, um mittels eines Algorithmus automatisiert Vorschläge zur effizienten und barrierefreien Verdichtung des Wegenetzes der aktiven Mobilität zu gestalten.

Zur Beantwortung dieser Fragestellung zielt dieses Vorhaben auf die methodische Konstruktion der Verdichtung eines Wegenetzes. Hierfür werden verfügbare offene Daten und Behördendaten sowie einzelwissenschaftliche Erkenntnisse über das Mobilitätsverhalten von Fußgängern und Fahrradfahrer herangezogen. Es wird untersucht, welchen Einfluss Qualität und Quantität der Quelldaten auf die Attribution der Empfehlungen der Infrastrukturmaßnahmen haben und ob fehlende Daten durch andere Daten interpoliert werden können, um das Risiko eines Datenqualitätsmangels möglichst gering zu halten. Hierbei soll die Belastbarkeit der vom Algorithmus generierten Empfehlungen für Infrastrukturmaßnahmen abhängig von der Verfügbarkeit der Daten innerhalb der zu analysierenden Fläche bewertet werden. Das Vorhaben zeigt dabei auf, welche Daten für die Vorplanung der Wegenetzoptimierung unabdingbar sind und wie einzelwissenschaftliche Erkenntnisse über das Mobilitätsverhalten sich auf die Optimierung des Wegenetzes auswirken. Kern des Vorhabens ist die Generierung von Positionsvorschlägen zur Wegenetzverdichtung im Sinne der Ergonomie, Sicherheit und Länge, die in ihrem Mehrwert für die aktive Mobilität für jedermann nachvollziehbar und verständlich sind.

3.2 Digitale Innovation im Bereich der Mobilität

Die digitale Innovation für die Mobilität besteht im Einsatz eines Algorithmus (KI) zur Generierung von datengetriebenen Wegenetzverdichtungsmaßnahmen, die der Physik und Psychologie der aktiven Mobilität entsprechen. Als Datenquelle wird der „BigData“- Ansatz verfolgt. Herangezogene Daten sind z.B.:

Wegenetze, Kreuzungsskizzen, Lichtsignalanlagen, Wohndaten, Katasterdaten (z.B. Bebauung, Bäume, Stromtrassen), Fahrstühle, Bodendenkmäler, Tunnel- und Brückenbauwerke, Wohndaten, DGM, Luftbilder, Wetterdaten, Quellverkehre (z.B. Touristische POI, ÖPNV-Stationen), Ziele/POIs (z.B. medizinische Versorgung), ÖPNV-Fahrpläne, Katastrophenmanagement, Gesundheitsdaten, Luft- und Lärmemissionsdaten, Verkehrsstärken und Wegeoberflächendaten.

Ziel ist es, je zu analysierender Fläche maximal viele dieser Datenlayer zu überlagern, die einzelnen Aspekte zu parametrisieren und in einem Algorithmus zu verbinden. Funktion des Algorithmus wird sein, Empfehlungen für Wegenetzverdichtungsmaßnahmen mit den Attributen Position, Relevanz und Realisierungspotential zu generieren. Die Attribution wird durch die Parametrisierung der Quelldaten beeinflusst. Damit liegt das technologische Risiko in der Verfügbarkeit und Qualität der zu akquirierenden Daten. Dieses kann die Qualität und die Quantität der Ergebnisse beeinflussen. Das wissenschaftliche Risiko in den Ergebnissen wird dabei in Feldtests (Begehung, Inaugenscheinnahme, Vermessung) vor Ort analysiert und deren Erkenntnisse zum Lernen der KI verwendet, um per KI das Gesamtrisiko zu minimieren.

4 BEISPIELE

4.1 Beispiel für eine durch KI generierte Brücke für die aktive Mobilität

Für dieses Beispiel [vereinfacht] wird die Fläche der Stadt Hamburg in Betrachtung gezogen und angenommen, dass folgende Daten für das Gebiet verfügbar sind: Hochschulen, ÖPNV-Netz, OSM-Daten, Bebauungspläne, Baum-Kataster, Bevölkerungsdichte, Luftaufnahmen, Verkehrsstärken, Umweltdaten und DWD-Daten. Hieraus könnte der Algorithmus in folgenden Schritten ein Ergebnis generieren:

1) Erhebung des Einzugsbereiches der umliegenden Schnellbahnstrecken verknüpft mit den Studentenzahlen

2) Erhebung möglicher Wege zwischen Schnellbahn-Haltestellen und Hochschulen

3) Heranziehen der Wetterdaten für mögliche Witterungsfaktoren

4) Aus diesen Daten sondiert der Algorithmus z.B. die Hochschule für angewandte Wissenschaft (HAW) in Hamburg-Uhlenhorst und die U-Bahn Station „Wartenau“ der Linie U1, die zur Anbindung der Menschen entlang der Nordost-Magistrale Hamburgs der HAW am nächsten ist.

a) Der Algorithmus findet den kürzesten Weg mittels Dijkstra-Algorithmus die Wegerelation Hochschule - U-Bahnstation „Wartenau“ (ca. 900m).

b) Der Algorithmus findet im Radius zwischen HAW und U-Bahnstation „Wartenau“ den Auenstieg in OSM und die unbebaute Lücke über den Eilbekkanal zur HAW per Bebauungspläne, Luftaufnahme und Baum-Kataster als potenzielle Abkürzung (ca. 450m).

c) Der Algorithmus vergleicht die Verkehrsstärken und die Luft- und Lärmdaten zwischen heutiger Route und potentieller Route. Die deutlich besseren Umweltdaten (bedingt durch Wohngebiet, Baumbestand und Wasser statt Hauptverkehrsstraße) entlang der potentiellen Route gewichten diese zusätzlich.

c) Die Halbierung der Wegstrecke, die deutliche Reduzierung der Umweltbelastung für den Menschen, die hohen Einwohnerzahlen entlang der Nordost-Magistrale U1, die hohe Anzahl an Studenten und das unbeständige Wetter in Hamburg (Wunsch nach kurzen Fußwegdistanzen) führen zum Ergebnis: „Brücke über den Eilbekkanal“.

5) Prüfung, ob die Brücke regelwerkskonform nach ERA und EFA und den Erkenntnissen der Physik und Psychologie der aktiven Mobilität möglich wäre.

6) Feldtest: Durch Inaugenscheinnahme vor Ort wird überprüft, ob das vom Algorithmus vorgeschlagene Netzelement „Brücke“ realistisch ist. Mögliche Hinderungsgründe werden dokumentiert.

7) Die Erkenntnisse aus dem Feldtest werden in die Projektdatenbank hinterlegt und trainieren die KI von so für zukünftige Ergebnisse.

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Fig. 2: Beispiel für eine durch KI generierte Brücke für die aktive Mobilität

4.2 Beispiel für eine Negativentscheidung: „keine Brücke“

Für dieses Beispiel [vereinfacht] wird die Fläche der Stadt Hamburg in Betrachtung gezogen und angenommen, dass folgende Daten für das Gebiet verfügbar sind: LSA-Daten, ÖPNV-Netz, OSM-Daten, Bebauungspläne, Baum-Kataster, Bevölkerungsdichte, Luftaufnahmen, Verkehrsstärken, Umweltdaten. Hieraus könnte der Algorithmus in folgenden Schritten ein Ergebnis generieren:

1) Erhebung des Einzugsbereiches der umliegenden Haltestellen

2) Erhebung möglicher Fußwege zu den Haltestellen

3) Erhebung übergeordneter Fahrradroutenströmungen

4) Aus diesen Daten sondiert der Algorithmus den ÖPNV-Netzknoten „Barmbek“ und dessen Einzugsbereich südlich des Osterbekkanals sowie die Fahrrad-Pendlermagistrale „Bramfelder Straße“.

a) Der Algorithmus findet den kürzesten Fußweg mittels Dijkstra-Algorithmus die Wegerelation Wohngebiet - Netzknoten Barmbek (ca. 450m).

b) Der Algorithmus findet den kürzesten Radroutenweg mittels Dijkstra-Algorithmus die Wegerelation entlang der „Bramfelder Straße“ LSA Süd - LSA Nord (ca. 550m).

c) Der Algorithmus findet im Radius zwischen Wohngebiet, Netzknoten, LSA Nord und LSA Süd in OSM die unbebaute Lücke über den Osterbekkanal innerhalb der Maurienstraße per Bebauungspläne, Luftaufnahme und Baum-Kataster für eine gleichlange Strecke (4a) ca. 450m | 4b) ca. 550m) .

d) Der Algorithmus vergleicht die Verkehrsstärken und die Luft- und Lärmdaten zwischen heutiger Route und potentieller Route. Die Umweltdaten der potentiellen Route sind jedoch nur marginal besser.

e) Der Algorithmus vergleicht die Reisezeiten für den übergeordneter Fahrradroutenströmung per Streckenlänge und LSA-Querungen. Die zusätzlichen LSA-Querungen stadtauswärts verschlechtern die Reisezeit erheblich.

c) Die Kosten für die Brücke, die gleiche Weglänge sowie die längere Reisezeit in einem Szenario stehen in keinem Verhältnis zur geringen Verbesserung der Umweltdaten und führen zum Ergebnis: „KeineBrücke über den Osterbekkanal“.

5) Negative Ergebnisse werden auf Grund ihrer Unwirtschaftlichkeit nicht per Feldtest validiert.

Fig. 3: Beispiel für eine Negativentscheidung: „keine Brücke“

5 CONCLUSION

Eine unbehagliche Wegführung steht einer aktiven Mobilität entgegen. Durch die mittels dieses Projektes generierten Positionsvorschläge können Wegführungen, die der Psyche und Physik der aktiven Mobilität entsprechen, geschaffen werden. Wege werden barrierefrei, sicherer, kürzer und ergonomischer. Dieses Vorhaben ist somit ein unmittelbares Werkzeug zur Förderung der aktiven Mobilität und steigert damit die Lebensqualität innerhalb des urbanen Raumes. Ein barrierefreies verdichtetes Wegenetz ist ein wesentlicher Baustein zur Reduzierung von Lärm- und Luftemissionen, da Fuß- und Radverkehr auf der Kurzstrecke gegenüber zum motorisierten Verkehr zur attraktiven Alternative werden. Zu Fuß gehen oder Fahrradfahren haben zudem direkten positiven Einfluss auf die individuelle Gesundheit, es wirkt z.B. Übergewicht und Depressionen entgegen. Durch die Erhöhung der Sicherheit mittels zusätzlicher Netzelemente und kürzerer Reisezeit ist erfolgt ein Beitrag zur Vision Zero. Attraktive, aktive Mobilität stärkt das Quartier: Die medizinische Versorgung wird durch kürzere Wege verdichtet, lokale Geschäfte und Gastronomie in guter Fuß- und Fahrradreichweite werden verstärkt genutzt. Der Einzugsradius von ÖPNV-Haltestellen wird erweitert, die Leistungsfähigkeit der ÖPNVs erhöht, Straßen werden entlastet, der Modal Split verschiebt sich zu Gunsten des Umweltverbund. Die autolose Mobilität wird beschleunigt.

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Developing Public Rental Housing on Rural Collective Construction Land in Shanghai Suburbs: A Case of Cao'an Village in Jiading Industrial District

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1 ABSTRACT

Since the 1990s, it is an obvious feature of Shanghai suburbs that the spatial urbanization lags behind the industrialization, with thriving demands for housing from domestic immigrant workers. By contrast, the villages surrounding the industrial area undergo an aging process continuously, with the youth moving out of the village and many rural houses left vacant, expecting new developing opportunities and vitality urgently. If the demands from both sides can not be coordinated or guided, the indigenous villagers would likely construct or enlarge the owner-occupied houses illegally arbitrarily and rent them to the immigrants, resulting in the deterioration of the living environment and social conflicts in the village.

In 2017, the national policy "Pilot Scheme for Building Rental Houses on the Collective construction land" was released, in which Shanghai was selected as a pilot city. In this background, this paper aims to examine the necessity and feasibility of building public rental houses (abbr. PRH) on the rural collective construction land[1] (abbr. CCL) in Shanghai suburbs and propose appropriate strategies for it. The paper first summarizes relevant experience from villages in Dongguan and Beijing via documentation. Then combined with the author's practice of Master-planning in Jiading Industrial Zone in Shanghai, with a local village named Cao'an as the case, this paper evaluates the necessity and feasibility of constructing public rental houses in Cao'an village respectively from the village's status quo of development and the opportunities offered by its special location. Finally, drawing on the experience of Dongguan and Beijing, corresponding strategies regarding the construction of housing-supply-system and subsequent development are proposed. This paper aims to discuss whether it's possible to, and how to use rural land reasonably to resolve the supply-demand contradiction of housing in the context of rapid industrialization of suburbs in developing countries, guide the orderly construction of suburbs, and prevent villages from becoming informal settlements.

Keywords: Suburb, Public Rental Housing, Rural Collective Constructing Land, Shanghai, Rural Development

2 BACKGROUND

2.1 Leading Industrialization vs. Lagging Urbanization in Suburbs

After the 1990s, the scale of Shanghai's cities expanded rapidly, and the suburbs gradually showed an obvious characteristic that the urbanization lagged behind the industrialization, with numerous small- or middle-scaled factories located in villages and towns. By 2005, the average proportion of the secondary industry in Shanghai suburbs had reached 61.2%, and some towns have even reached 80% (Luo, 2007).

The large-scale conversion of agricultural land to industrial land has promoted the rapid growth of construction and the number of residents, and brought about a change in the employment mode: By 2007, although the registered urban population[2] in Jiading District accounted for only 30.2% of the total population, the actual employment rate in non-agricultural sectors has exceeded 90%; Even in suburbs at the edge of the city, the employment rate in the agricultural sector is still less than 1/3 (Luo, 2007). This change in employment has brought some benefits to rural residents, but also put pressure on rural communities: Limited public resources need to be shared with a large number of new-coming residents, and the shortage of housing is particularly prominent.

[1] Rural collective construction land refers to the land held and managed by the village collective and can be used for non-agricultural activities, namely construction. It mainly includes homesteads, land for infrastructures, and land for business. Its counterpart is farmland.

[2] Chinese statistic population used to be mainly divided to urban registered residents and rural registered residents, according to where they were born. It is thought as a significant factor for Chinese rapid development that a great deal of rural registered population came to cities for non-agricultural jobs.

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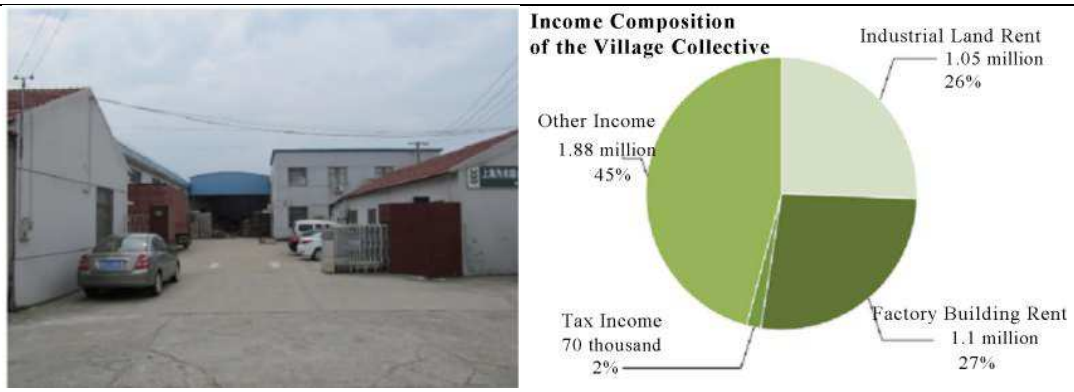

Fig. 1: Industrial Enterprises in the Village and the Income Composition of the Cao'an Village Collective (Source: Author)

2.2 Misalignment of the Strong Housing Demand and the Vacant Rural Houses

On the one hand, the number of industrial employees in the suburb (especially young technicians and migrant workers from other cities) has risen sharply, while the number of dormitories that employers can provide is limited, and, therefore, regional demand for rental houses is particularly strong. On the other hand, the youth in the villages surrounding the industrial area is relocating, and the rural area shows a serious trend of "hollowing out" and aging. Many rural houses remain vacant, and new opportunities and vitality for development need to be triggered and brought in. There exists a clear misalignment between these two aspects.

If the needs of these two aspects cannot be well-coordinated, guided and fulfilled, the in-situ industrialized areas[3] are prone to see a "chaotic phenomenon" where indigenous villagers spontaneously build new or expand existing private houses on the collective land, and rent them to the new-coming residents. A typical case is Shipai Village in Guangzhou. When commercial housing was not developed on a large scale in the early 1990s, cheap rural houses in the suburb became the primary accommodation for many migrant workers who came to Guangzhou, one of the first opening-up cities in China. Driven by economic benefits, the villagers quickly demolished the original one- or two-story brick-concrete houses and converted them into a six- or seven-story buildings of reinforced concrete, the interior space of which was divided into several small rooms for rent to migrant workers. More than 3,500 buildings crowded on just 0.7 square kilometers of land. The 170 small alleys that were only 3 meters wide and narrow enough to allow only one person to walk were sunk in the dim shadow of buildings, with merely "a skin line of the sky" above. The village has become a "scar" of the city, with tough public security and a harsh environment.

2.3 Policy Support for Development of Public Rental Housing in Rural Collective Construction Land

In September 2011, the Chinese General Office of the State Council issued the document of "Guiding Opinions on the Construction and Management of Affordable Housing", which highlighted the development of public rental housing. After that, the Chinese Ministry of Land and Resources approved Shanghai and Beijing as the first batch of pilot cities for developing public rental housing on the collective construction land. On August 21, 2017, the Chinese Ministry of Land and Resources and the Ministry of Housing and Urban-Rural Development issued the "Implementation Scheme for the Construction of Rental Houses Using Collective Construction Land" and identified 13 pilot cities including Beijing and Shanghai. In September 2018, Shanghai issued the "Announcement on the Transfer of the Use-Right of Rural Collective Construction Land in Shanghai", approving the sale of the use-right of a plot in Songjiang District for rental housing construction, which symbolized the historic leap towards the development of rental housing on rural collective construction land.

Against this background, it is of great significance to discuss whether it's possible to, and how to use rural collective construction land reasonably to resolve the contradiction between the supply and demand of rental houses in the context of suburban industrial development, guide the orderly construction of village houses, and prevent villages from becoming informal settlements. It is also the core content this paper examines.

[3] In-situ industrialized area means a rural area transforms to an industrial area with the local villagers employed either in factories or in related service industries. It was a typical phenomenon in China in the 1980s and 1990s and thought to account for the rapid industrialization or even urbanization in villages and small towns.

3 VALUABLE EXPERIENCE AND REFERENCES

The development and governance of rural settlements in the area with a high proportion of immigrants are always one of the focuses in Chinese urban and rural development. Some villages in urban margin areas took the initiative to take the housing of migrant employees in the city into account in planning, making the construction of rental houses in villages reasonable, legal, and institutionalized and gained some successful experiences. The development of informal rental houses in Dongguan and the development of public rental houses in Beijing's Haiqing Niaoluo Village are two examples that can be used for reference.

3.1 Institutionalization of Rural Informal Rental Houses in Dongguan: Mutual Benefits for the Government, Industry and Rental Housing Market

Dongguan is one of the pioneers in China for industrialization, urbanization, and the use of foreign capital to develop an export-oriented economy. It enjoys a rather relaxed policy environment given by the state. The rental housing in Dongguan villages started earlier and its development was more mature than other Chinese cities.

3.1.1 Origin of the housing problem in Dongguan: insufficient supply of the bottom-up housing institutions

Dongguan's housing problem is related to two characteristics of its external-labor-relied and export-oriented industrial model: a) An active utilization of migrant labor. With the increase of local workers' wages, factories gradually tend to use cheaper migrant labor in the later stage of industrial development. b) The local government withdrew from the industrial capital raising process and concentrate more on the land development, property management, and infrastructure support, and the local rural residents withdrew from the labor market, both consciously or unconsciously, in the competition with the migrant workers and switched engaging themselves to house renting business.

The influx of migrant workers brought housing pressure: From 1986 to 2007, the migrant labor force in the industrial sector increased from 87,000 to 4.481 million, a 50-fold increase; In the commercial sector, it has increased by 183 times. The 1990 Provisional Measures for the Administration of Foreign-Invested and Operated Lands legally established the right to build dormitories for foreign-owned enterprises. However, collective dormitories also have their limitations: a) Cannot cover a large number of highly mobile and scattered immigrants engaged in business services. b) Unable to solve the housing problem after the employees start a family. c) The scale of the needed workers in some factories often changes significantly, while the size of the dormitories is difficult to increase or decrease accordingly.

The housing problem also lies in the insufficient supply of institutions: The existing domestic land- and housing- supply system cannot cope with the rapid bottom-up development of industrialization; The housing problem in Dongguan requires informal houses and, moreover, a corresponding supply mechanism.

3.1.2 Rise of informal rental houses in the villages and small towns: the mutually beneficial symbiosis between factories and villagers

Driven by the realistic needs and economic benefits, the migrant workers in the suburbs seek to meet their housing needs in the informal rental housing market in villages and towns. And because the village collective[4] can obtain additional compensation from the higher government by integrating small rural collective land, the villagers' behavior of building houses for rent also received acquiescence. This opened a cycle of benefits: low rents of rural houses reduced the cost of living for immigrants and thus the cost of labor for factories, strengthened, therefore, the willingness of external capital to join in, and positively fed back the collective economy of the village, which is dominated by operating industrial real estate. And once again, more immigrants would be attracted to flow in, and the supply of informal rental houses would further expand.

The supply of informal rental houses in villages and small towns has increasingly taken a proactive role in responding to the residential needs, from the site selection and the land-use planning to the design of

[4] The village collective, also called as rural collective economic organization, consists of all the villagers in the same village. It is the only organization that is allowed to own the property of rural land. Its functions and responsibilities are similar to a local government, but their nature are different.

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buildings and living units types. However, there also emerged chaos, such as the complex housing sources, the layout that exploits every tiny space, coarse designs, and uneven qualities of living facilities. Therefore, standardized management and supply mechanisms need to be established.

3.1.3 Institutionalization of informal rental houses in villages: Introduction of management regulations and indirect recognition of property rights

In 2004, the Dongguan government terminated the traditional practice that allows the rural resident to build self-occupied houses and promoted collective apartments for rural residents to support the expanding urban construction via a more intensive use of rural construction land. Under the dual pressure of gradual "local labor shortage" and "land shortage", the extensive growth of informal rental houses in the village can not sustain. Village rental housing needs to optimize quality and achieve institutionalization and standardized management before it can continue to develop.

In December 2003, Dongguan promulgated the "Interim Provisions on the Management of Rental Housing and the Personnel in Dongguan", which identified the management agencies for village rental housing, their functions, the content of the lease management, and the responsibilities of the lessor and the lessee. Since then, the departments of housing management, family planning, and fire protection have also formulated detailed rules to implement this lease management. Disputes over the legality of property rights have been shelved in management practice, which has promoted the standardization of the village rental housing supply.

Dongguan referred to the Housing Rental Licence System for the management of villages' informal rental houses, and the collection of house lease tax symbolized the recognition of the property rights of informal rental houses. In particular, the implementation rules stipulate that "if there is no land-use licence or legal certificate of the real estate's property rights, but there is no dispute about the ownership of the real estate, a provisional valid certificate of property rights can be issued by the local village committee, and after the property rights are legalized in the future, the house-leasing licence can be re-registered and issued." Recognizing property rights and levying rental taxes can help achieve a win-win situation between local governments and the rental housing market.

3.1.4 Marketization of informal rental houses in the villages and small towns: further division of labor in development and management

After the rental housing system in the villages and small towns was established, the market further improved the quality of rental houses from the supply side and gradually formed a stable housing supply.

One of the manifestations is the deepening of the division of labor in the housing development. In terms of the way of selling the use-right of construction land, the villagers in the same village would usually compete for internal bids. The relationship between the village collective and its members (villagers) is closer to the relationship between the government and the developers: the village collective is responsible for the planning and operation of the land, the construction of supporting facilities, while the villagers are responsible for the development, construction, and management of the rental houses; the village collective is mainly involved in the field of large industrial, commercial, and formal residential real estate, while the villagers in the field of small-scale rental real estate.

Another manifestation is the deepening of the division of labor in the leasing operation, that is, the emergence of the professional "sublessor", who is responsible for the security, fire protection, cleaning and other duties of the contracted houses, and cooperates with managers from the government to register or write off the leased personnel, which improves the efficiency of the lease work and marks the improvement of the degree of professionalism in the industry.

At this point, a complete villages' housing supply system has been formed: the village collective undertakes the land-planning, infrastructure construction and land transfer for rental housing; the villagers carry out the design, construction and contracting of the rental housing; the sublessor is responsible for the operation of the rental housing, and the local government is responsible for the standardization and management of rental housing.

3.2 Constructing Formal Public Rental Housing on Collective Construction Land in Haiqing Niaoluo Village, Changping District, Beijing

3.2.1 Background: housing demand brought by the establishment of the industrial zone

The reasons for developing public rental housing in Beijing's Haiqing Niaoluo Village are related to the long-term idleness of collective construction land in the village, the large demand for rental housing brought by the establishment of the Zhongguancun industrial zone in the surrounding, and the urgent requirement of villagers to obtain long-term and stable income.

1) The collective construction land was left idle for a long time. In addition to arable land and homesteads, in 2010, there were still available collective construction land of about 133 ha in the village. Most of them were not well managed and had only low economic benefits. By contrast, the village possesses a strategical location in the core area for the R&D and high-tech industries in the north of Zhongguancun, a famous national industrial zone. The village's surrounding area was developing rapidly.

2) Large-scale demand for rental housing was formed in the surrounding area. The town where the village belongs to had about 50,000 indigenous residents, while the migrant population had reached 270,000. After 2010, the first batch of 15 central enterprise projects settled in the Future Science and Technology City and started their construction, attracting at least 20,000 more researchers and related personnel to move in, creating further demand for high-quality rental housing in the region.

3) Villagers' requirements for long-term and stable income sources. After two large-scale land-acquisitions in the village conducted by the higher government, a large number of landless farmers were generated. Although the villagers got one-time compensation for the land acquisition, however, if there is no good investment channel and guidance, the money is likely to be squandered.

3.2.2 Development mode of the public rental housing: villagers held shares and dividends

In 2010, the Villagers' Congress decided to use collective construction land to develop public rental housing. After the public rental houses were completed, it became a collective asset of the whole village, which is only used for rental and not for sale. Part of the funds for the real estate development was raised from the villagers' investment, and the other part came from the compensation of the land acquisition and the accumulated assets of the village collective. Most of the income of public rental housing is distributed to villagers every year in the form of share dividends.

3.2.3 Benefits of the public rental housing development: a win-win for the villagers, village collective and industrial zone

After the completion of the public rental housing project in Hailuo Niaoluo Village, the villagers, village collective and industrial zone will benefit from:

1) Villagers have stable jobs, industries, and income sources. The daily operation of public rental housing projects requires personnel for property management, such as managers, accountants, and marketing persons. The maintenance of the community infrastructure also requires decorators, gardeners, and cleaners, which meets the needs of the employment of villagers of different ages and educational levels. At the same time, as a large number of young technical staff moved in, the development of the village's laundry, catering, Internet and other service industries has also been promoted. Also, because the shares of public rental houses allocated to the villagers can be inherited, transferred, and gifted, even if the villagers move outside the village and become urban registered residents, they can be free from the worry of losing their assets.

2) The village collective's income from the land and property has increased significantly. Compared with the former compensation for the land-acquisition, the village collective's income from developing public rental housing has increased by 73.6 times; the investment of public rental houses is expected to recover the cost in 16 years. Correspondingly, the per capita income of villagers has also increased rapidly, and the annual per capita income has increased by 22,000 yuan (2900 Euro).

3) Broadened the housing-supply-channels and eased the pressure of housing in the industrial zone. Within the first two or three years of the completion of the Zhongguancun industrial zone, there were only 8,000 public rental houses planned to be put into use in Changping District, with a large gap between the supply and demand. However, after the completion of the second-phase public rental houses in Haiqing Niaoluo

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Village, about 4,000 public rental houses will be added, alleviating the pressure of houses for young technicians.

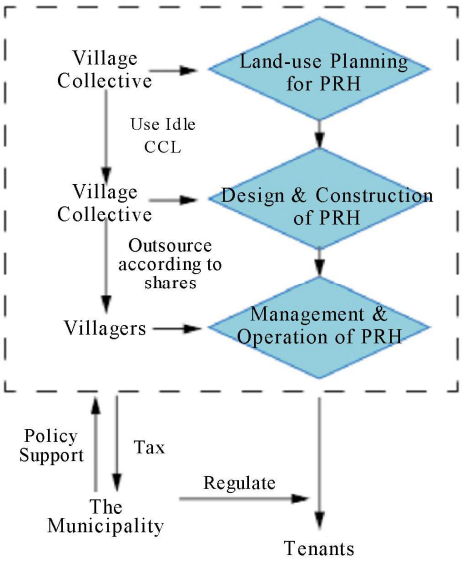

Fig. 2: Supply Mechanism of Public Rental Housing in Haiqing Niaoluo Village (Source:Author)

4 DISCUSSION ON THE STRATEGY OF DEVELOPING PUBLIC RENTAL HOUSING IN CAO'AN VILLAGE, JIADING INDUSTRIAL ZONE, SHANGHAI

Cao'an Village is located north of Loutang Old Town, Jiading Industrial Zone, Shanghai, and close to the northern core of Jiading Industrial Zone. By 2015, the permanent registered population of Cao'an Village (namely villagers) was 950, and the number of permanent residents (including immigrants that stay in the village for more than six months) was 2,230. In addition, more than 1,200 registered villagers moved out of the village and settled in Jiading City and Shanghai Central City. Among all the residents, the immigrant residents are mainly employed in the nearby industrial enterprises, while the remained indigenous villagers are mainly elderly people. By 2015, most of the existing houses in Cao'an Village were self-built by the villagers, with relatively scattered distribution and no centralized planned and constructed settlements.

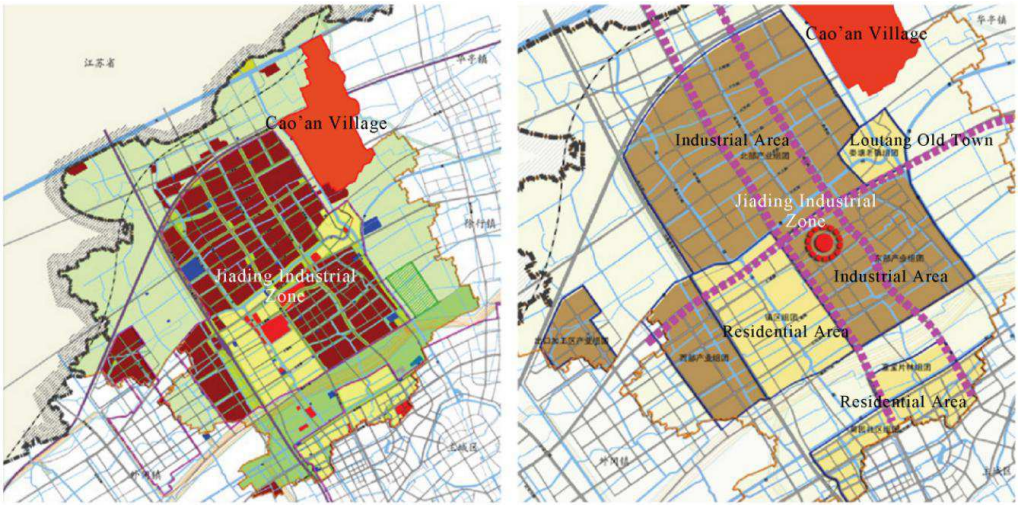

Fig. 3: Location of Cao'an Village (Source:the Government of Jiading District)

4.1 Problems and Difficulties in the Development of Cao'an Village

From July to August 2015, the author participated in a symposium with 6 main enterprises in Jiading District, and inquired the development status and needs of the enterprises; through field researches, the symposium with the village collective, interviews with villagers and questionnaire surveys, the author investigated the development status of Cao'an Village.The research found several problems and difficulties in the development of Cao'an Village, including:

1) Villagers' income is low; the employment is difficult, and the village is “aging”. The villagers' main fixed income comes from the land-use transfer fee from the enterprises settled in the village of about 1,300 yuan (about 170 Euro) per month and the annual land-rent-dividends from the factories settled in the village. The source is relatively single and the income level is low. To obtain a higher level of income, many middle-aged and young people in the village choose to work outside the village, and the problems of "hollowing out" of local rural families and "aging" of rural society are serious. For the left-behind elder villagers, the lack of industries and a stable source of income is a major problem; while for the villagers working outside, although they have generally expressed a strong willingness to return to their hometown, it is still a big obstacle that there are no suitable jobs.

2) The village has a backward infrastructure condition. The specific problems are as follows: the only road in the village is less than six meters wide, the cement pavement is poorly maintained, and the traffic capacity is limited; the density of the road network in the village is low, and in the east-west direction, the village lacks roads connecting with the outside; there is no public transportation in the village, which is inconvenient for traveling; there are no street lights installed in the village, and there are certain hidden safety hazards when traveling at night; villagers' houses are aging and need repair; public service facilities in the village such as elderly-care-centers and places for sports are insufficient. The village needs to consider how to promote the construction of infrastructure and public service facilities, and, hereto, the introduction of market mechanisms should be given special attention.

3) The industrial structure needs to be adjusted and upgraded urgently. By 2014, manufacturing was the most dependent industry in Cao’an Village: In 2014, the village collective's income was 4.1 million yuan (about 0.54 million Euro), including 1.05 million yuan (about 0.14 million Euro) for industrial land-rent and 1.1 million yuan (about 0.15 million Euro) for plant-building-rent, which together accounted for 52.4% of the village collective's total income. However, the manufacturing factories established in the village are generally small in scale and low in production-efficiency, and their negative effects such as environmental pollution exceed their economic benefits. The relocation of factories is inevitable in the future for more efficient development. After the manufacturing industry moved out, what kind of resources and industries the village can rely on for sustainable development is a question worth pondering.

4.2 Necessity and Feasibility of Developing Public Rental Housing on Collective Construction Land of Cao'an Village

4.2.1 Necessity at the regional level: introduction of technical talents vs. the shortage of public rental housing

According to the urban plan, after the completion of the Jiading Industrial Zone, a large number of technical personnel engaged in advanced manufacturing industries will settle in, and a considerable part of them will be introduced in the technical, R&D, and management departments for the needs of industrial upgrading. However, the current projected population size of the Jiading Industrial Zone is far more than what the regional available houses can support: According to related plans, the three residential areas planned by the Jiading Industrial Zone can accommodate 99,000 residents; By contrast, after the completion of the two major industrial areas, the population size in the industrial zone is expected to reach 136,000, and there is a certain gap in the housing supply.

For the introduction of technical talents in the region, the development of public rental housing is a good strategy. The reason is that on the one hand, young technical talents often lack the accumulation of asset and thus it is difficult to realize the purchase of commercial houses in the short term; on the other hand, in the survey of enterprises in the Jiading Industrial Zone in 2015, it was found that the salaries of young technicians and managers are often not low. After working for several years, the annual salary of many university graduates can reach 120,000 yuan (about 15.7 thousand Euro). According to the relevant policies of affordable housing, it exceeds the maximum-wage-threshold for purchasing affordable housing, and it is therefore unlikely for the young technicians to apply for affordable housing guaranteed by the state.

However, public rental housing resources are still insufficient in the industrial zone. Although in recent years, the New City Center area of the industrial zone has concentrated on building multi-story apartments, they are mainly low-cost affordable housing for purchase not for rent. The old town of Loutang, which is adjacent to the northern industrial zone and Cao'an Village, is a historic protected area. In terms of the

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available land and the difficulty of development, it is also difficult to realize the intensive construction of public rental housing in the old town in the future, so the residential needs cannot be met in the old town as well.

Also, the old town of Loutang, which is close to Cao'an Village, is facing the pressure of immigrants. Compared with the newly developed New City Center area in the Jiading District, the old town of Loutang has a dense and convenient road network, prosperous commerce along the street, and relatively sound living supporting facilities after a long period of development. It is well connected with several main roads in the northern industrial zone. With convenient transportation, it is regarded as one of the first choices of residence for many new employees in the enterprise. If this pressure on housing demand cannot be released on time, driven by the economic interests, it may be possible that the residents renovate and expand the existing dwellings for lease in the Loutang old town and surrounding villages (including Cao'an Village). Building low-quality, disorderly houses is not conducive to the construction of a safe and good living environment, but instead would bring a burden of management and may breed a series of social problems. Cao'an Village will be the first to bear the brunt because of its location, so it is reasonable to proactively prevent such a situation through appropriate rural planning.

4.2.2 Feasibility of developing public rental housing on the village level

Cao'an Village has the conditions and feasibility to develop public rental houses and low-rent houses. In terms of the location, Cao'an Village is very close to the high-tech industrial area to the north, where the main migrant groups are young technicians and have a large demand for rental houses in the future. Besides, Cao'an Village is also closely connected with Loutang old town and thus has good accessibility to the relatively sound social and cultural infrastructures.

Besides, Cao'an Village has a total of 162 hectares of collective construction land, of which 80.8 hectares are homesteads, 13.4 hectares are industrial land, 0.1 hectares are public service facilities land, with about 68 hectares left for further development and utilization.

In terms of villagers' willingness, interviews and questionnaire survey results show that villagers generally want to build a "New Countryside" and look forward to the long-term, stable employment; some villagers have expressed the hope that the settling of the youth would improve the current situation of aging and increase the vitality of the village. Besides, the "Pilot Plan for the Construction of Rental Houses Using Collective Construction Land" released in 2017 and the "Announcement on the Transfer of Use-Rights of Village-Collective-Operated Construction Land in Shanghai" issued in 2018 offered also strong policy support for the construction of public rental housing in Cao'an Village.

Experience of domestic cases indicates that after the completion of public rental houses, the rural collective, villagers and Jiading Industrial Zone would achieve a win-win situation: a) The income of the village collective and villagers will increase by times. For example, in Beijing's Haiqing Niaoluo Village, compared with the former compensation for land acquisition, the income of the collective land-use has increased by 73.6 times, and the per capita annual income has increased by 22,000 yuan. b) Villagers can achieve the goal of having jobs, establishing industries, and accumulating capital by providing services such as property management, laundry, and catering to the community. c) Villagers working outside the village can find suitable local jobs now and return to their hometowns for employment. These benefits, which are in line with the expectations of the villagers, will greatly promote the villagers' initiative to construct and manage public rental housing.

4.3 Strategies for Developing Public Rental Housing in Cao'an Village

At present, there are two main approaches to develop public rental housing on collective construction land: a) The zone of public rental houses can be designated either specially or together with the construction of houses for the resettlement after the land acquisition, and the villagers can either apply to manage the public rental houses according to their family-conditions or rent out their idle houses of resettlement on their initiative. b) Public rental houses can also be constructed on the idle collective construction land or the site of the vacated industrial land. Since the remaining amount of collective construction land in the Cao'an village is still sufficient, it is more suitable to adopt the second approach.

Cao'an Village can learn from the experience of Haiqing Niaoluo Village, Changping District, Beijing. For one thing, the village collective can lease the houses for the resettlement from the villagers in the long term and integrate these properties in the official public rental housing system, which could be used exclusively for the provisional and transitional residence (normally 3-5 years) of employees of key enterprises in Jiading Industrial Zone. Besides, villagers can also be allowed to rent their idle resettlement houses for their own accord. At the same time, the village collective can set up companies for the real estate development and property management to deliver daily services in the communities, and create different posts such as security, cleaning, and housing agencies, meeting the needs of the employment of the villagers and increase their economic income.

In terms of spatial layout, the experience of the informal rental housing in Dongguan villages shows that rental houses are usually attached to other functional blocks, including industrial areas, residential areas in the newly developed districts, markets, and commercial areas. Most of these rental houses are arranged along roads, thus attracting tenants with good accessibility. As far as Cao'an Village is concerned, the south of the village is connected to the Loutang old town by Zhaojing Road (6 meters)-Jiatang Road (12 meters), which is rather tortuous and distant; while the west of the village is directly adjacent to the northern industrial area, and the Loulu Highway (20 meters), which is parallel to the village boundary, leads directly to the Loutang old town and the deep part of the northern industrial area. Therefore, more consideration should be given to strengthening the transportation links between the public rental housing communities and the Loulu Highway in the west. In terms of specific measures, it is planned to extend the existing east-west Xingqing Road in the northern industrial area and Zhao'an Road to connect with the village's core area of public services directly. The planned rental housing blocks will be centered on the core area of public services in Cao'an Village and will be arranged along the Xingqing Road and Zhaojing Road to obtain good traffic accessibility to the northern industrial area. Besides, commerce and daily services will be established on the ground floor of the buildings to form continuous commercial streets that stretch from the Loutang old town. On the micro-level, various apartment-types with different living standards can be provided based on the needs of different groups of people, such as single, double and triple rooms for single tenants, and standard apartments for families.

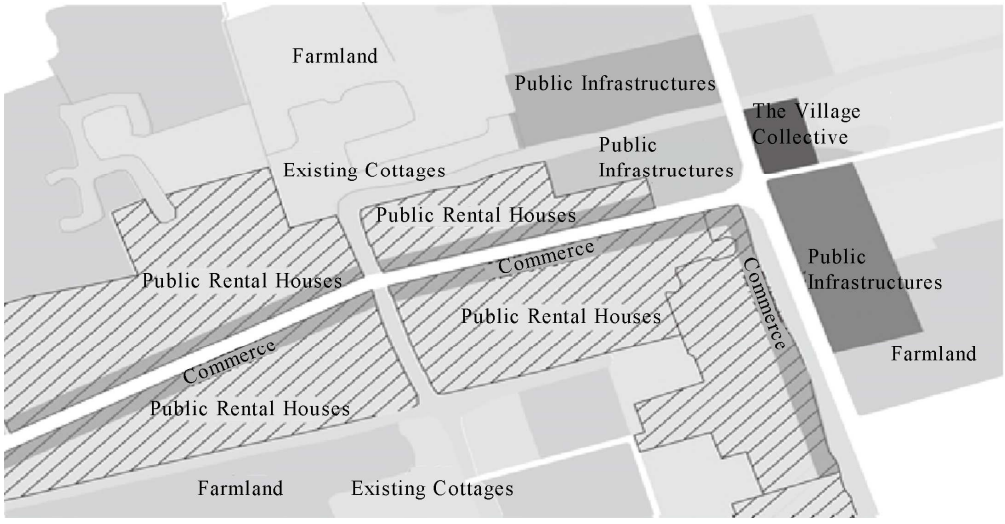

Fig. 4: Spatial Layout of Public Rental Housing Development in Cao'an Village (Source: Author)

5 CONCLUSION

Since the 1990s, it is a feature of suburbs in Shanghai that the urbanization lags behind the industrialization. A large number of new domestic immigrants in the suburbs occupy only a few urban public resources, and the shortage of housing for migrant workers is particularly prominent. If the housing demands in the industrial district in suburbs are not met for a long time, the indigenous villagers would likely construct or enlarge the owner-occupied houses illegally arbitrarily and rent them to the immigrants, resulting in the deterioration of the living environment and social conflicts in the village.

With the national policy support, villages in Dongguan and Beijing adopted the strategy of developing rural rental housing, which combined the processes of both "top-down" and "bottom-up" and realized the mutual

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benefits and win-win result among the village collective, villagers and the industrial enterprises. The key to its success lies in the cooperation of the village collective, villagers and local governments with the policies' support, which facilitated the normalization and marketization of the informal rural rental houses, formed a series of complete supplying mechanism, guaranteed the sustainable development and the enhancement of the living environment of the rural community.

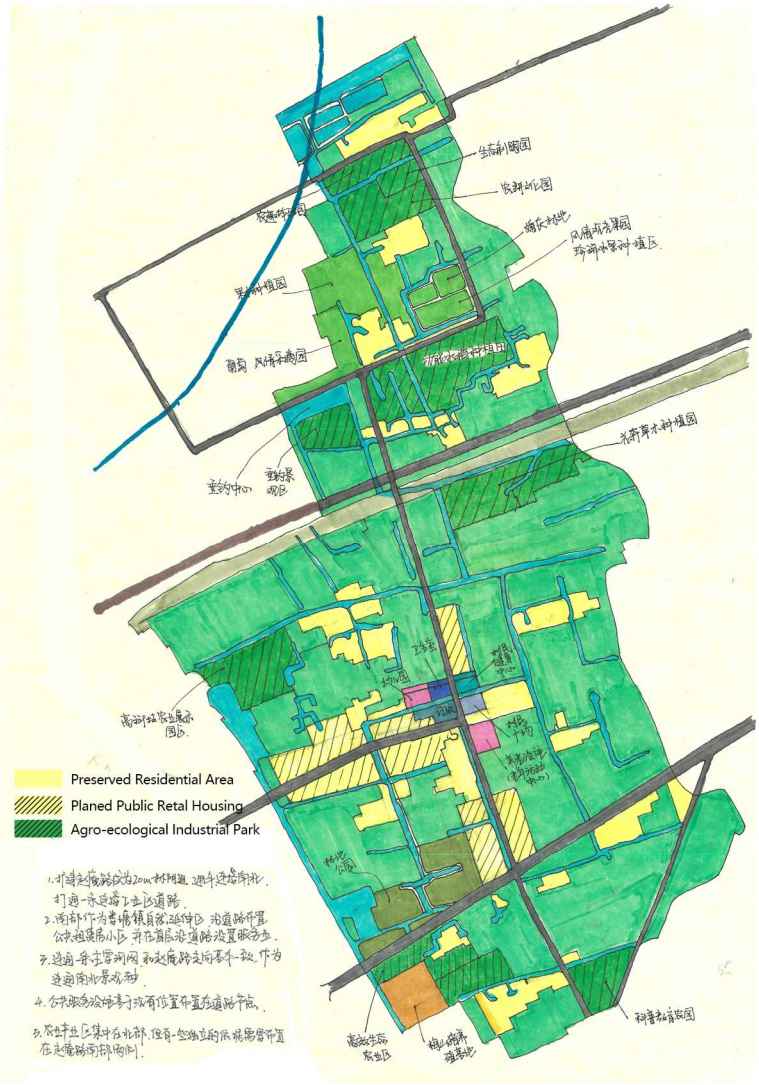

Fig. 5: Proposal of Development Plan of Cao'an Village (Source: Author)

Cao'an village in the Jiading Industrial Zone in Shanghai, by contrast, is facing the developing dilemma of the villagers' low income and low employment rate, the poor basic infrastructure, and the urgent needs to optimize the industrial structure. However, the village also has the potential and opportunity to utilize the collective construction land to develop public housing: From the regional level, with the introduction of technicians in the industrial district, the regional demand of public rental houses will increase substantially, and it is, therefore, necessary for Cao'an village to develop it; From the village level, there is still stock of collective construction land available in Cao'an village currently, and the villagers generally expressed their expectation for a long-term, stable employing condition. There is, therefore, endogenous dynamics and the feasibility for the village to develop public rental houses.

Based on the references and analysis, this paper suggests strategies for the development of Cao'an village. First, the government could rent the houses for the resettlement from the villagers collectively and integrate them into the public housing system. Second, villagers should also be allowed to rent their unused houses for the resettlement independently, so that a resilient housing supplying system can be established. Besides, the village collective can set up property-managing companies to offer high-quality daily services to the tenants, as well as to create stable, long-term jobs for the villagers, achieving, in the end, the win-win results among the regional industries, the village collective, and the villagers.

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Do we Need Urban Shrinkage to Become Smarter Planners? The Masterplan for Novoshakhtinsk

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1 ABSTRACT

The urban planning transition in Russia has been following the way from the so-called command-administrative system to a new one which should be more democratic, market-oriented, more adequate and corresponding better to the current needs of the cities and regions. However, since the planning system is an element of the political system and is characterized by the same disadvantages such as lack of the local independency and resources, weak capacities of local authorities, absence of opportunity to implement the specific planning addressing local issues that are not into the national planning agenda. A silent but wide-spread process of urban shrinkage affects most of the Russian cities that are deprived of a possibility to develop new approaches to planning that could help them to confront this challenge and very few cases of the appropriate policy development appeared in the country. The present paper explores an example of a planning experiment in a former mining city Novoshakhtinsk in southern Russia that is developing a master-plan aiming at addressing challenges provoked by urban shrinkage.

Keywords: shrinking city, mining city, depopulation, urban planning, masterplan, Russia

2 INTRODUCTION

A shrinking city in any country faces not only issues related to its spatial, social or economic development but also must confront great resistance of the existing political institutions, planning culture and state ideology while planning for shrinkage since they hardly accept the new reality of urban shrinkage. In Russia, most regions and cities are currently depopulating and are facing the new unknown challenges accompanying the urban shrinkage process. However, they are limited by the paradoxical situation in which the national policy, becoming more and more centralized and leaving fewer opportunities for self-governance and local policies formulation, at the same time totally ignores spreading all over the country urban shrinkage issue and provides place-unspecific growth-oriented solutions (BATUNOVA&GUNKO, 2018). Notwithstanding, in some cities, the emerged issues related to urban shrinkage become so extremely influential that the municipalities start searching for innovative solutions even in this unfavorable for any innovations political environment. It is not that different from the rest of the world, in which neoliberal ideology does not favor acceptance of urban shrinkage as a possible future and where the systematic changes happen when a city's attempt to return to population growth fail and shrinkage consequences become a notable issue (PALLAGST, FLESCHURZ&SAID, 2017).

The paper explores the case study of the master plan development for a shrinking city Novoshakhtinsk in the Rostov region of Russia that represents a rare for Russia case of the municipality that is moving towards the application of a 'decline-oriented' approach – planning with the assumption of the future population decline. The process is innovative in Russian planning due to two factors. First, acceptance of urban shrinkage as a natural inevitable process and planning for shrinkage is still a 'taboo' in the Russian political discourse. Second, this kind of tool as a 'master plan' (in contrary to 'general plan') does not exist in contemporary Russian law and its development is an experiment born in collaboration with the local authorities and planners that enrich the experience of both sides.

3 URBAN PLANNING IN TRANSITION

Russian planning system as a part of the state socio-economic and political formation has been experiencing dramatic transformations. The strict hierarchical socialist system of economic and spatial planning, in which the goals for existence and development of any city were defined and implemented by the state, collapsed. After a long 'no planning' period caused by a kind of allergy to planning after the USSR dissolution and strong beliefs that market is able to solve all the development issues, the planning system was introduced again in 2004 together with the approval of the new Urban Planning Code. From its beginning, the new planning law was subordinated to land legislation developed much earlier. Both actually had to support a

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privatization process, which is still ongoing and is far from being complete. Since its approval, the Urban Planning Code had numerous amendments: in the last decade, when the state has been following a path of re-centralization of governance (GELMAN, 2018), the meaning of a general plan as a tool for setting the goals of long-term spatial development vanished from the law. Nowadays, a general plan is just an instrument for the spatial localization of sectoral plans of federal and regional ministries or local departments and also a calculation for the necessary land provision for housing and infrastructure construction. If during the socialist period the general plans' development based on the goals set by the national government, now the possibility to define goals and objectives is absent in the modern spatial planning at the municipal level. Planners continue to design comprehensive plans of the desired cities, operating in growth paradigm (BATUNOVA & GUNKO, 2018). Continuing in Russia after the USSR dissolution for many years construction boom and lack of housing and commercial buildings, especially in the larger cities, path-dependent growth-oriented planning and false statistics created blinkers before planner' and policymakers' eyes. Moreover, the collapsed Soviet planning system in the 90s and following years of no-planning vanished many experts from the profession and interrupted continuity in the profession's evolution that is resulted nowadays in the lack of professionalism in planning. Entering today into the profession, planners dragged to light the old methods used in the Soviet times while the state itself introduced planning law and regulations borrowed from the other planning cultures and is not operating as intended. Cheap mass housing construction in a form of well-known micro districts and targeted goals measured in millions square meters of housing set by the national government continue to be the main drivers for urban development in major cities. Simultaneously silent but wide-spread process of urban shrinkage corrodes most part of the country's urban system and poses problems previously unknown to cities. However, the relevant for most Russian cities problems in the current model of urban planning are ignored and, accordingly, the feasibility of general plans tends to zero.

4 MASTER-PLANNING AS A NON-REGULATED ALTERNATIVE

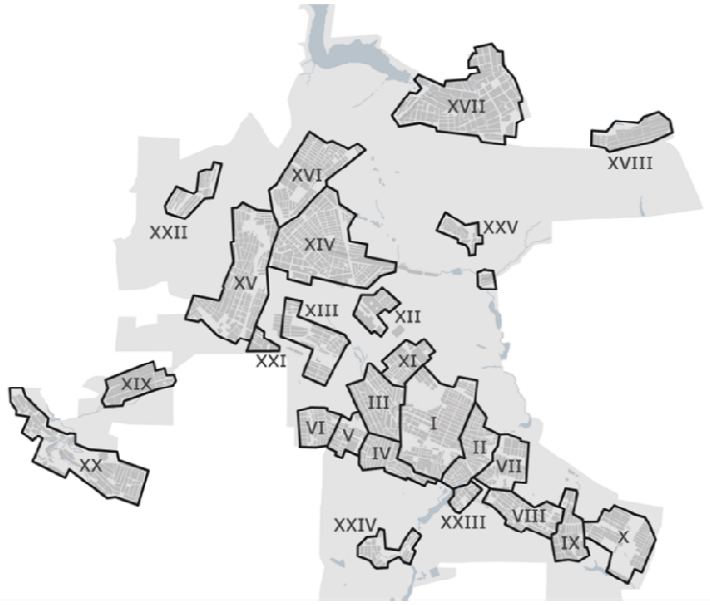
The current Russian legislation defines two basic documents for long-term urban planning: a strategy for socio-economic development and a general plan. These documents have different objectives, but the separation of socio-economic and territorial planning makes it difficult to form a comprehensive strategic vision of the future city. The strategy of socio-economic development determines the resources and sources of financing, sets target indicators for the development of the socio-economic situation in the city, but pays little attention to the spatial development and territorial localization of the proposed measures. The general plan focuses on land use, construction, technical infrastructure, but practically ignores the socio-economic rationale for engineering and technical solutions. The national law clearly defines the relationship between long-term planning documents at the municipal level: the Urban Planning Code declares that 'the development of territorial planning documents is carried out on the basis of strategies (programs) for the development of individual sectors of the economy, priority national projects, interstate programs, programs for the socio-economic development of the constituent entities of the Russian Federation, plans and programs for the integrated socio-economic development of municipalities (if any)' that means subordinate position of territorial planning in relation to socio-economic planning. Paradoxically, strategic planning is optional for municipalities according to the Russian law and in most cases, a general plan remains the only long-term planning document.

A master plan is a relatively new term that appeared in the Russian professional planning discourse and there are two main areas of professional activity in which the term 'master-plan' is used: a strategy of a city's spatial development and an urban design concept (BELOUSOVA, 2019). A master-plan does not have any legal status and exists informally not supported by methodology or requirements to the document. There is no common agreement among planners and policy-makers on what is a master-plan. All mentioned aspects cause difficulties in a master-plans implementation – there are no legal tools for it. Strategic master-planning in the contemporary conditions in Russia remains an area of risky investments also due to the instability of local authorities and the absence of continuity in political decisions. At the same time, more and more master-plans emerge because they serve as the missing component that could link socio-economic and territorial planning. However, their main function is an experiment, an attempt to create different 'what if' scenarios' which are not possible within the existing legal framework.

5 THE NOVOSHAKHTINSK CASE

Novoshakhtinsk is a former mining town in southern Russia having a population of 107,539 people (2019). Its foundation in 1939 was due to the growing coal mining production in the Eastern Donbas which started in the second half of the 19th century: several small mining towns grew rapidly and, after the construction of the railway, were united administratively and got city status. At the moment of foundation, the city had a population of 48 thousand people. By 1962 the Novoshakhtinsk's population reached its maximum of 108 thousand people and in the following years, the population number had been fluctuating at the level of 100-107 thousand people until 1994. Since 1994 the population of Novoshakhtinsk had been constantly declining. It reached its minimum of 100.6 thousand people in 2004 (ROSSTAT, 2020) and in 2005 the city administration decided to include three rural settlements bordering the city to maintain its population number over 100,000 people. Despite this, the Novosjhakhtinsk's population continued to decline from 116.2 thousand people in 2005 to 107.5 thousand people in 2019 (ROSSTAT, 2020). Both job-related out-migration and natural population decline cause Novoshakhtinsk's depopulation. The coal-mining industry's decline started in the area at the end of the socialist period and after the USSR dissolution, this sector plunged into crisis. The last mine was closed in Novoshakhtinsk in 2003 due to the national restructuring of the coal-mining industry and after the tragic accident at the mine 'Zapadnaya-Kapital'naya'. Since the end of the socialist period, Novoshakhtinsk had been experiencing out-migration but it managed to reverse the negative trend in 1999. From 1999 to 2019 the net migration balance was positive in the city due to the impact of different process: the attraction of migrants from the northern and far-eastern parts of the country during the first decade after the USSR dissolution, active diversification of local economy and attraction of new workers from the nearest rural areas and the other Russian region, relocation of the Ukrainian migrants caused by the armed conflict in Eastern Ukraine. However, the mortality in Novoshakhtinsk steadily exceeds the birth rate at least twice and a positive migration net is not able to compensate for significant natural population decline. Due to migration, the city gained about 6.3 thousand people in the period 1998-2017 but it lost 18.8 thousand people due to the excess of deaths' number over the number of births in the same years (ROSSTAT, 2020).

During the socialist period, the state planning for Novoshakhtinsk had been growth-oriented and provided by the state. The first Novoshakhtinsk's general plan developed in 1939 by architect I.Dedkov planned a city that had to reach a population of 85,000 people by 1942 (PILIPENKO, 2009). The following documents always planned a city for a bigger population. The socialist general plans also tried to tie the Novoshakhtinsk's fragmented planning structure that was the main characteristic of a city founded through the unification of settlements, founded in the closeness to the mines. Planners introduced new residential areas and public centres within voids between former mining settlements, however, Novoshakhtinsk did not manage to overcome this disadvantage of its planning structure (BATUNOVA, E. & TRUKHACHEV, 2019).



I	Center
II	Gorlovka
III	Antipovka
IV	Petrovskiy
V	Gor'kogo
VI	Belysheva
VII	Tel mana
VIII	Yuzhnyy
IX	Krasnyy Shakhter
X	Kirova
XI	Gorodskaya
XII	Mikrorayon
XIII	Mikhailo-Leontievsky
XIV	Zapadnyy
XV	Nesvetayevskiy
XVI	Novaya Sokolovka
XVII	Sokolovo-Kundryuchenskii
XVIII	Yubileynyy
XIX	Krasnyy
XX	Sambek
XXI	Radio
XXII	Vtoroye otdeleniye ZAO Prigorodnoye
XXIII	Proletarskiy
XXIV	Bugultai
XXV	Pervoe otdeleniye ZAO Prigorodnoye

Fig. 1: Novoshakhtinsk's planning structure composed by former mining settlements.

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After the USSR collapsed when economic and population decline became the main trends in Novoshakhtinsk, the city's fragmentation increased due to the degradation of the never complete settlements' peripheries and vacancies or abandonment that spread all over the city. The successful attraction of the state investments and implementation of the new housing projects, on the one hand, improved people's living conditions but, on the other hand, accelerated erosion of urban morphology due to the relocation of the residents into the new residential areas.

Fig. 2: A dilapidated apartment building. whose residents were relocated according to the housing program. Photo: M. Bolotov, 2020

Currently, there are more than 2,000 unused buildings in the municipal register which is not complete yet. Management of these properties is a challenging task: 94.5% of residential buildings are privately owned but the legal mechanisms that could help municipalities to confront this issue are immature and lead the city into a cul-de-sac.

6 MASTER-PLAN FOR A SHRINKING CITY

The critical situation called for searching specific solutions to address the emerging issues. Novoshakhtinsk's municipality started forming a comprehensive vision of the city's future from the beginning of the 2000s. In 2000, the municipality created its first program of socio-economic development but the most innovative transformations of the local planning started with the arrival of the new Mayor Igor Sorokin in 2008 who was re-elected for a second term in 2014 until 2019 when he left his position. It worth noting that the political situation in the city had been quite stable and positive during the 10-year stay of Mayor Sorokin in power. Thanks to him and his team in 2009 Novoshakhtinsk's municipality developed the new general plan started implementing the 'compact city' concept (even if it was not labeled in this way) through the reinforcement of the city center and preventing urban sprawl. In 2010, the local administration developed the strategy of socio-economic development until 2020 – not obligatory for the municipalities document. Both documents were regularly updated to find the working tools to address the emerged issues. Obviously, the main goals in those strategies were the city's economic diversification since the collapse of the mining industry Novoshakhtinsk lost its economic basis. Housing construction and development of the social and technical infrastructure were as well in the focus of the local policy but the process of urban shrinkage was not addressed until it was widely spread and evident in the cityscape. However, it was not ignored either: the municipality started monitoring vacancy and abandonment since 2006-2007. Depopulation and urban shrinkage became drivers for the appearance of the new approach to strategic planning in Novoshakhtinsk.

The idea of the master-plan development emerged as a result of a long-term collaboration between the city's administration and the private planning bureau Southern Urban Planning Center. Proposed by the planning bureau volunteer experiment was supported by the local authorities and in February 2019 the work began. If a master plan itself is a novelty for the Russian planning culture, then a master-plan for a shrinking city that accepts future population decline is 'terra incognita'. In Russia, very few examples of realized planning for

decline exist and all of them have been implementing in totally different conditions compared to Novoshakhtinsk. For example, the famous policy of the 'controlled shrinkage' that the Arctic city Vorkuta implements has been realizing in the conditions when the bigger share of housing is presented by the apartment residential buildings and is owned by the municipality (POLYAKOV, 2019). In Novoshakhtinsk applying similar tools is impossible due to the high share of private property and single-family houses with a garden as the prevalent typology: such conditions conduce emerging of numerous erosions in different parts of the city that hardly can be controlled.

Fig. 3: A series of participatory workshops organised for different groups: children, students and representatives of the municipality. Photos: E.Batunova, E.Khityova, 2019

The master-planning process based on the participation principle and the first efforts targeted the involvement of different stakeholders' groups into the city's problems' discussion. The first step of the participation process included a series of deep semi-structured interviews conducted with the local professionals: local experts, representatives of the local authorities, heads of the companies providing technical services, cultural and educational organizations. This kind of 'participation' is the most natural and familiar in the urban planning process in Russia. However, in this case, interviews were not directed by the concrete purposes of the general planning defined by the Urban Planning Code but were more free discussions on the city's' main challenges, opportunities, and possible strategies. The next step aimed at involving the different groups of the residents and the external participants in the discussion of the city's future. Thus, several workshops were organized starting from the children workshop with the youngest students of the Novoshakhtinsk's art school and finishing with the students of several universities of Rostov-on-Don. The aim of those events was in generating different strategies to address urban shrinkage issues. In parallel, numerous field trips and observations were made together with the desk research that included a literature review, statistical analysis, mapping of the critical issues in the city's spatial development (such as abandonment, vacancy, non-registered in the cadastre land and others, see fig.4).

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Fig. 4: A fragment of the Zapadny settlement' territory with the mapped demolished and planned for demolishing buildings. The map was developed on the basis of the municipal monitoring register with the following actualisation through the field trips observations.

During this long process the main principles for a master-plan were developed, which are defined as the most important for its successful implementation: 1) True assessment – impartial evaluation of available resources and existing issues; 2) Continuous harmonized planning; 3) Realism and efficiency – setting achievable goals and identifying resources, careful and efficient use of available resources and the generation of new resources; and 4) Involvement.

Based on the planning principles and active participation, the strategic vision for Novoshakhtinsk was formed:

Novoshakhtinsk is a laboratory of opportunities that unites developed, clean, green and safe urban areas (towns) with equal access to services and strong identity.

The implementation of the strategic vision includes 4-RE strategic directions:

(1) RE-SOURCE CITY: Rethinking the available resources of the city. Transforming the negative aspects of urban development into resources. Residents of the city as the main resource for transformation. Problems as a resource for innovation.

(2) RE-CONFIGURATION: Optimization of the spatial structure of the city for a decreasing population. Reengineering Urban Infrastructures and Services

(3) RE-HABILITATION: Search for mechanisms to improve the quality of the urban environment with a focus on everyday comfort and safety. Short-term and long-term solutions, temporary measures for rapid qualitative changes and the creation of conditions for gradual systemic transformations.

(4) RE-CONTEXTUALIZATION: Formation of monitoring systems and databases containing information on the state of the urban environment and key elements of the urban economy. Constant updating of information about the city at different levels. Involving a wide range of participants in monitoring. The formation of horizontal ties.

The very important part of the work was to find a way of the masterplan's measures legalization. The proposed model for the formation of planning documents in the municipality involves the first development of a strategy for socio-economic development, then the master plan of the city with the sequential or parallel development of a general plan (in the case of Novoshakhtinsk, updating the general plan based on the results of strategic planning). The city administration decided to approve at the end of the process a new 'Strategy of socioeconomic and spatial development' that will include harmonized measures of the strategy of socio-economic development and of the master plan.

Thereby, the master-planning process for a Russian shrinking city called for evolving new approaches and became an experiment for both planners and policy-makers leading to the formulation of new tools and solutions within the institutional framework that is not conducive for implementing of policy for the decline.

7 CONCLUSION

Novoshakhtinsk is a medium-sized former mining city experiencing 30-years long population decline during which a city lost about 13% of its population. The city is facing unknown challenges of widespread urban fabric erosion that the local authority is not able to address properly due to the gaps in the national legislation, lack of finances and difficulty to provide an alternative vision within the growth-oriented planning system. Being dependent on the upper levels of government in their financial and authority capacity, lacking high-skilled specialists, municipalities are strictly limited in their possibilities to respond to the new challenges. There are no successful cases in the country that could be adopted, no law or instructions that cities could follow, but, at the same time, the state requirements to housing construction and provision are equal for growing and shrinking cities that put the latter even in a more complicated situation. Nonetheless, worsening situation provokes in some cases transformation of the local visions and perceptions and transforms shrinking cities into laboratories experimenting with smarter and more specified approaches to planning and policymaking. In Novoshakhtinsk, a combination of many factors, such as professionality of the local municipality's team, its long and successful experience in planning and policy-making, the gravity of the shrinkage issue and readiness to percept the phenomenon realistically, led to the appearance of the innovative approach to the strategic and spatial planning for the city. 'There is nothing to be afraid of, shrinkage is just new conditions' – these words of a former City Mayor Igor Soroking formed the city administration's perception of urban shrinkage and its willingness to 'plan for decline'. The understanding of the complex urban shrinkage causes, lying at different scales and not manageable by the local authorities, provoked an emergence of comprehensive local planning and policy, oriented to cope with the challenge. A collaboration between planners and policy-makers, having a similar perception of urban shrinkage, made possible emerging of an innovative planning experiment that is a novelty in the Russian contemporary political context. Its final implementation is still uncertain, however, the process of planning for shrinkage itself became a driver for evolving of new for Novoshakhtinsk methods of participation, collaboration and decision-making that undoubtedly will impact the city's future development.

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Exploring the Applicability of Sustainable Development Goals in Fringe Areas of Fast Growing Metropolises

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1 ABSTRACT

The social sustainability of the north-east Asia has been threatened by the rising population and poverty. The unplanned metropolitan and suburban growth endangers the existing systems of social, economic and environmental balance and creates hindrances towards sustainable development. Existing urban infrastructure has become unable to cater services to all citizens resulting poor quality of life. The government is also struggling to pay for new and expanded services. Most of the existing metropolitan cities in the south-east Asia were not planned how to face these kinds of problems when it arise. Contemporary policy problems are to be found in the rural areas of this region which act as hindrances of the city expansion. In most of the cases the existing metropolitan cities expand without any proper guidelines where the cities hardly breathe. The people living in urban fringe areas are contributing to the economy; they are more susceptible to social, economic and environmental shocks generated within the region. The Fringe area Development may be a solution to these growing problems in this region. Urban Fringe is an area that situates between urban and rural system. Fringe is defined as a relation to the city and exists in agriculture hinterland (area around or beyond a major town) where land use is changing .It is the most sensitive, dynamic and swiftly changing area during the urbanization process. However to minimize the growing development pressure of the metropolis emergence of fringe area development has become popular to decentralize the population in this region. But at the same time the development without proper guidelines results poor services in the fringe areas which has become a common phenomenon in the region and it gradually attempts to destroy the overall infrastructure and environment of the metropolis.

In 2015 the UNDP has formed certain global goals known as “Sustainable Development Goals”. The motto of the SDGs is “To provide a better future for everyone of the society”. However it is noticeable that in most of the cases the fringe area development in this region is basically focused to cope up with the present scenario; either focuses on social or economic or environmental benefit. But to achieve the SDG it should be focused on these three perspectives equally. In Indian context the fringe area development is focused to decrease and decentralize the pressure of the mother city. Thus it is hardly seen to achieve the SDG in Indian scenario. In the contrast in the developed countries the fringe area development hardly neglects any of the three perspectives of the sustainability as the cities are already developed in every aspect that the fringe area development does not require to decrease and decentralize the pressure of the mother city. So the fringe area development in developed countries is more likely policy oriented whereas in south-east Asian context it is more likely depends on the nature and characteristics of the mother city. . This paper aims how far is it applicable to induce the SDGs in the fringe areas in Indian scenario so that it may draw sustainability in these metropolitan cities as well as in the fringe area.

Keywords: Fringe Area, Development, Sustainable Development Goals, India, Metropolis

2 INTRODUCTION

Now-a- days with the growing development pressure of the metropolis, emergence of fringe area development has come up as one of the solutions for decentralization. Again at the same time, unplanned haphazard growth in the fringe areas has become a common phenomenon, which consequently attempts to impose a negative change in the overall quality of life in the metropolis.

Factors responsible for the said phenomenon can be explained through the following-

New urban developments usually take place on virgin areas predominantly with rural settlementnearer to an existing metropolis. After completion of the project it goes under a separate urban statutory body where in general case the areas in close proximity of those new urban developments remain under panchayet control. Therefore, a contrast in operation of urban and rural local bodies become prominent creating differences in physical attributes in both regions.

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Again the activity zone of the urbanized areas attracts a large number of people, especially people engaged in the informal sector, but it is unable to provide sufficient space for their living. As a consequence, these people tend to clog in the fringe areas. The high price value of the residential plots and apartments of the newly developed areas make it out of reach for a number of people in the society. So these people usually search for cheaper accommodation in the fringe areas. These factors increase the development pressure at the fringe areas where the land value is comparatively less. So the people start gathering at the periphery to get the facilities of the newly developed areas. Again there are no such strict building-by-laws to restrict the growth pattern because these areas remain under the panchayet judiciary in Indian scenario. In this way the population of the peripheral areas goes on increasing. This situation gradually creates pressure on the infrastructure of the mother city as there used to be no planning at the panchayet level to resist the haphazard growth. As a result the situation tends toward formation of slums and unauthorized colonies at the fringe areas, which can be seen in many cases. This hampers the overall environment of the area.

There are several examples of haphazard growth in the fringe areas of developed towns especially in India. In many cases lack of proper infrastructure, services and guidelines the adjacent fringe areas of the newly developed areas gradually converted into slums. The fringe areas of New Delhi and Indore are good examples of this kind of consequences.

3 A CASE STUDY OF INDORE

Indore, the commercial capital of Madhya Pradesh, is home to hundreds of small-scale and large-scale manufacturing and industrial units in areas of automobiles, pharmaceuticals and textiles. It is the 10th fastest growing city in India and the world's 32nd fastest growing urban centre. Being a major trading hub, it also has a rapidly growing presence in software, retail and real estate sectors.

The Bypass road around the Indore City is one of the major development nodes around the city and all the new development is takes place in that area. The growth direction of city is towards south-east periphery of Indore City. Criteria for selecting the fringe area for the study:

- Proximity (Map), within a radius of 5 km
- Population Size
- Growth rate
- Density
- % of Non-Agriculture Worker

3.1 Urbanity index and scale of urbanity

Urban index of the fringe area is calculated by index values of the town, village and fringe unit for which it is to calculate.

For Factors which Decreases as we go close to the town the index value will decrease from town, fringe to the village. So the urban index will be:

- UI = (F-V)/ (T-V) ×100

For Factors which increases as we go close to the town the index value will increase from town, fringe to the village. So the urban index will be:

- UI = (V-F)/ (T-V) ×100, where

T, V & F are Index Value of Factor for sample Towns, Villages and Fringe respectively and is the weighted sum of the sub variables of that variable.

Scale of Urbanity (SU): $\sum$ UI.

3.2 Factors that influenced fringe area development

Low cost & easy availability of land in Indore favors the development of industrial and educational institutions. Huge reservoir of competent skilled manpower readily available in the area favors the good economical growth of the area. Again good communication, Well connectivity with the rest of the states, availability of market facilities etc work as icing on the cake for the fringe area development in Indore.

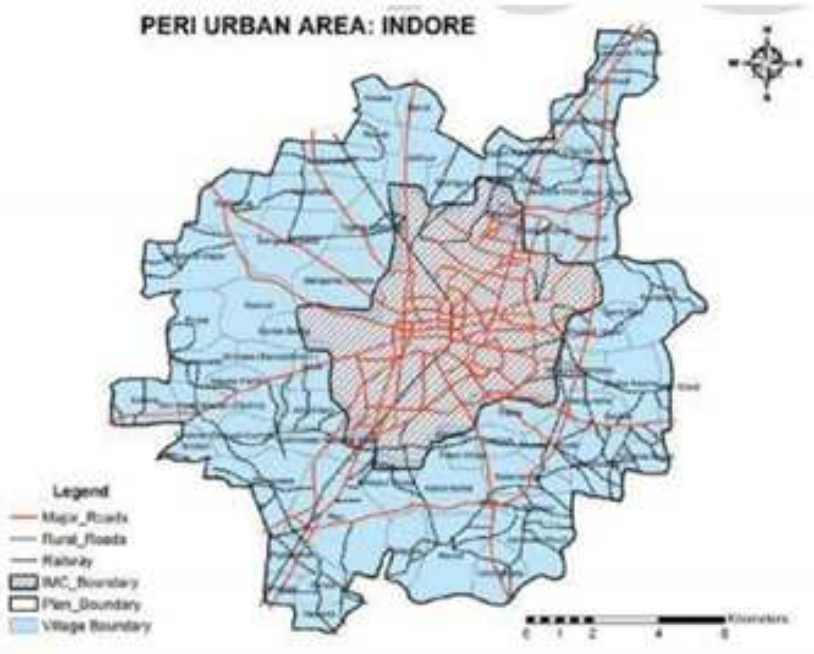

Fig. 1: Proximity map of peri-urban area within 5km radius of Indore Municipality

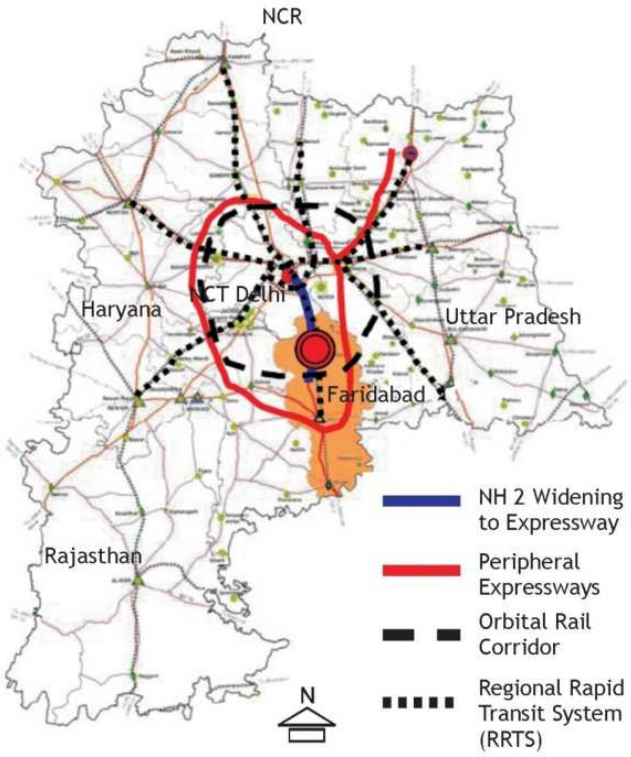

Fig. 2: Ribbon development in the fringe areas of Faridabad

4 A CASE STUDY OF FARIDABAD CITY

It is a leading industrial centre and situated in the National Capital Region bordering the Indian capital New Delhi. Migration is taking place because of adequate infrastructure facilities and proper connectivity to nearby growth centers like Delhi, Gurgaon, and Noida. The people because of higher taxes and livelihood expenses in the core of Delhi prefer to move to suburban areas of the city. So due to all these factors Faridabad is growing at higher rate in last ten years which has resulted in city expansion and given rise to fringe area development with various projects and land use transformations. There are several key points that work in favor of the fringe area development in Faridabad. They are as follows-

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- The city has a clearly defined linear shape due to its evolution along linear and parallel transit corridors.
- The city is basically growing on one side towards Agra along NH-2.
- There are large industrial plots lined up along both sides of these corridors.

4.1 Factors that influenced fringe area development

Faridabad has strong linkages with Delhi through railways, metro and road and it has well-developed infrastructure. It has good accessibility with the presence of industrial growth centre. Though 3 national highways pass through the city but the land value is comparatively less than the capital, Delhi. Unplanned Fringe Area is demarcated under the Faridabad control area boundary, so it is facing mixed land use growth including land use transformations from agricultural to commercial land use.

5 INFERENCES DRAWN FROM THE INDIAN FRINGE AREA DEVELOPMENT CONTEXT

- The growth of the fringe area is initiated by the growth of the mother city and depends on the push and pull factor of the mother city.
- Sometimes the growth is natural, sometime it is pre-planned.
- If properly planned the fringe area has the potential to be transformed into a core sub center to balance the population pressure of the mother city.

6 SUSTAINABLE DEVELOPMENT CHALLENGES IN INDIA

6.1 Gap in India

In most of the cases cities expands through the rural areas nearer to any metropolis to decentralize some of its activities and its rural fringe areas experience tremendous development pressure towards urbanism in a rapid way. This leads to urban growth in a haphazard way, as there are no strict planning rules and regulations at panchayat level (73rd Constitution Amendment Act).

6.2 Hindrances towards sustainability

- Lack of financial resources to carry out and plan sustainable development
- Sustainable development is often not possible in war-torn countries like as there are other priorities on hand
- Natural and man-made occurrences may pose a threat to sustainability as they can shift the flow of development and destroy certain elements of infrastructure.
- The governmental conflict between immediate profit and investment towards sustainable technologies
- Corruption
- Lack of efforts at municipal level

Four areas have been identified as areas of concern for India in Achieving SDGs.

- Defining the indicators of SDGs.
- Financing the SDGs.
- Monitoring and Ownership.
- Measuring progress.

7 SCHEMES IN INDIA

India is the 5thlargest economy by nominal GDP in the world. Its economy is booming in all sectors especially in the service sector. But India ranks 119th by GDP(PPP), which means there is so much economic contrast in the society, which indicates that it will be very challenging for a developing country like India to achieve all of the SDGs within 2030. Recently World Bank and Government of India Sign $250 million Agreement to Boost sustainable development in India

However Indian government has specifically focused on the inclusive development to ensure adequate, safe and affordable housing with for all and providing basic services for the poor and upgrade slums through various centrally funded schemes such as PMAY(Pradhan Mantri Awas Yojna) and state funded schemes such as VAMBAY(Valmiki Ambedkar Aawas Yojna in Surat). For the economic betterment of the individuals as well as of the society and to reduce the number of people affected due to global gross domestic product caused by disasters, various schemes have been initiated in India such as PMJDY(Pradhan Mantri Jan Dhan Yojna), SSY(Sukanya Samridhhi Yojna) etc. To decrease the death including water-related disasters, with a focus on protecting the poor and people in vulnerable situations Indian Government has set up new ministries.

8 CONCLUSION

To support the positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening the national and regional development planning, Development Authorities (DA) have been formed and these DA are strictly following the guidelines for the development in any sectors of the development whether it is related to socio-economic or physical improvement. To increase the number of sustainable cities and human settlements by adopting and implementing integrated policies and plans towards inclusion, Fringe Area Development has become an effective and emerging way to mitigate the socio-economic contrast in the developing Countries like India.

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Finding a Midpoint between Civil and Military Use. The Case of Villaputzu (Sardinia, Italy)

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1 ABSTRACT

The paper addresses the issue of the concurrent use of areas for military and civil activities. In particular, the paper analyzes the effect of planning tools on the valorization of a territorial enclave, namely a military training area located in the coastal area of the municipality of Villaputzu (South Sardinia, Italy), that is, moreover, a Site of Community Importance. In this area, thanks to an institutional agreements between the Municipal Administration of Villaputzu and the Ministry of Defense, has been possible define the coexisting ways where is an important coastal military easement. and the use of the coast for recreational tourism purposes through a specific planning tool. In this specific case, the Local Coastline Plan (LCP) has been identified as the planning tool, which better addresses the co-existence of apparently opposite land uses and interests, as those expressed by the local municipality and those expressed by the military hierarchy. The assessment method is based on the capacity of the Local Coastline Plan (LCP) and the Site of Community Interest Management Plan (SCIMP) to create ecosystem services in the military enclave. The evaluation of the LCP and SCIMP shows how their combined action favors the environmental enhancement of territory, contributing to the formation of ecosystem services, The area, initially subject to different constraint (military easements and SIC rules) evolve, by that way, from 'anticommons' to 'semicommons', guaranteeing sustainable renewal of economic development of the area and looking to become 'commons' through planning of ecosystem services.

Keywords: Protected areas and spatial planning, strategic environmental assessment, landscape connectivity, semi commons, Sardinia - Italy

2 INTRODUCTION

State property includes a various set of assets They consist of the 'necessary state property' (which includes the maritime state property, the water state property and military property) and from the "accidental state property" (which includes roads, railways, aeronautics, aerodromes, aqueducts and cultural properties). Furthermore it consists of other assets, equally subject to the regime proper to the public domain, belonging to other administrative bodies as regions, metropolitan cities, provinces, or municipalities. Public use is exercised on state property (Angiolini, 2018), i.e., the community can enjoy its benefits directly, as in the case of beaches or museums (Imperiale, 2018), or indirectly, in the case of ports or airports. The main characteristic of these goods is their inalienability. Among the assets owned by the public, those relating to military uses also take on particular importance in relation to the fact that military defense is configured, in strictly economic terms, as a pure public good—non rival and non-excludable—and therefore, as an asset, the benefits of which fall indistinctly on the totality of the population, a fact that partly explains the huge amount of financial resources that the various states allocate (Caruso, 2018). After a descending phase in the 1990s, starting from 2000, military spending has in fact been continuously growing.

As shown in Figure 1, in 2018, the United States of America was the leading country in military spending of the sector, with 649 billion dollars - worth 36% of the world military spending and 3.2% of its Gross Domestic Product (GDP), followed by China with 250 billion dollars—14% of the world military spending and 1.9% of its GDP. In this ranking, Italy occupies 11th place, with 27.8 billion dollars (equal to 1.5% of the World spending and 1.3% of its GDP). The state properties, on the one hand, can be traced back to the so-called 'enclaves', which are closed areas defined by administrative or cultural characteristics different from the surrounding territory and on the other hand, they have characteristics typical of the so-called

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'anticommons', first introduced by Michelman[1] (1982), in contrast to that well-known common (Hardin, 1968; Marciano et al., 2019).

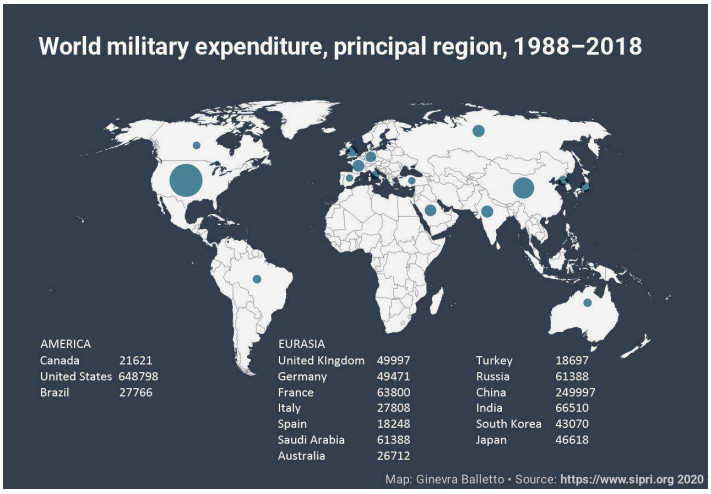

Figure 1: World military expenditure, by region, 1988–2018. Author: G Balletto

This concept was then widely developed (Heller, 1998; Heller and Eisenberg, 1998) through the theory concerning the under-use of a resource caused by the right of ownership, and therefore of exclusion, legitimately attributed to a multitude of subjects. Since it is sufficient for only one of the subjects to exercise their rights, it is clear that it is very probable, due to the high transaction times and costs necessary to reach a satisfactory agreement for all, that the fruition of that will lead to a blocking situation in which 'no one has the actual privilege of use' (Heller and Heisenberg, 1998). This is what happens in a by now recurrent form, in the occasion of the dismissal of the state property, both in the urban areas and in extra-urban ones (Gastaldi and Camerin, 2017). Activities carried out span from training of national and foreign units to testing missile prototypes and targets, from quality tests in cooperation with industries and organizations in the aerospace electronics sector and activities related to scientific research, etc. Their impact (Odoni, 2018; Esu and Maddanu, 2018) is significatively negative on the territory directly concerned and also for local communities, also under form of constraints expressed through the form of easements. In particular, military easements involve limitations or prohibitions that can be imposed both on private and public assets located near military installations, as, for example, to limit the buildings height. On the one hand, it is true—as evidenced by several studies (Hreško et al., 2015; Špulerová, 2013; Zentelis, R and Indenmayer, 2015; Silva Arimoro, 2017; Ellwanger et al. 2016; Reinhardt et al., 2019) that military goods and easements perform a substantial function of indirect landscape protection. On the other hand, the intensity and concentration military tests and training use of fuels and propellants, have a significant impact on the environment and biodiversity (Jenni et al., 2012), whose possible redevelopment may require expensive and difficult land reclamation works, even if the alleged correlation between military activities and the anomalous appearance of damage to health is still not completely defined. Finally, it should be noted, from the economical point of view, that in territories used for military training the potential sources of economic development, as agriculture fishing and tourism are damaged. In particular, the failure to take off the tourist industry, is both due to the unavailability of the sites, and to the interference that military activities have with the normal process of tourist settlement. It is also true, however, that this 'cumbersome' presence is connected to a related economic activity, mainly service activities but also industrial, in order to satisfy the needs of the military staff (Payolo et al., 2010). . The current orientation of several European countries is aimed at the rebalancing of military easements and the closing down of settlements (Camerin and Gastaldi, 2018). In Italy these procedures have often turned out to be cumbersome and slow due to the frequent change in the regulatory framework. Anyway, overcoming the exclusively military destination of certain areas often require guarantees of naturalistic protection (Ellwanger and Reiter, 2019). In such a framework, the concept of semicommon (Smith, 2000) is well suited to be used for a new interpretation of those areas that present a mixture of civil and military uses in time and space. This concept, in fact, interposed between that of

[1] "[A anticommon is] a type of property in which everyone always has rights respecting the objects in the regime, and no one, consequently, is ever privileged to use any of them except as particularly authorized by others." (Michelmann, F, 1982, p.6)

commons and anticommons, establishes an interaction between public and private property (Angiolini, 2018), and 'allows the right holders to benefit from the joint use of the resource' (Bertacchini et al., 2009). The semicommons incorporate all private collective rights, but at the same time attribute a series of public rights to other subjects, such as those arising from military easements generating positive effects (figure 2).

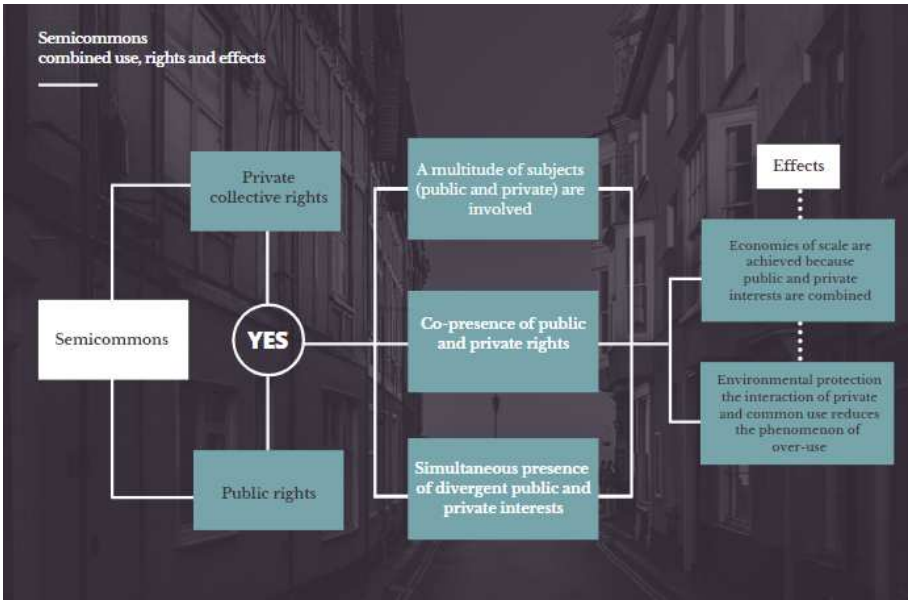

Figure 2: Semicommons combined use, rights and effects (Authors: G. Balletto and G. Borruso)

3 THE SARDINIAN MILITARY ENCLAVE

In Italy, military easements date back to the 1950s and derive from international agreements signed by Italy as a defeated country, at the end of World War II, in particular by the bilateral agreement 'Mutua Sicurezza' (Reciprocal Security) (1952) under which the United States imposed military bases in Italian territory. These agreements provide for the limitation of the right of ownership in the areas adjacent to installations of military interest. In 1976, the first law governing all matters of military easements was issued (L. December 24, 1976, No. 898 'New Regulation of military easements), which provided for the establishment, in each region, of a joint commission with the task of assessing the compatibility of military programs with territorial development plans. With the National Law 104/1990, the regions most affected by military easements was identified to provide for a compensation. In particular, the Autonomous Region of Sardinia (ARS) is one of the regions where the presence of military bases and training areas is higher with a total area of approximately 234 km2 (figure 3): Capo Frasca, Teulada, and Salto di Quirra (Military Proving Ground of Salto di Quirra, MPGSQ).

The MPGs together with the military easements (Perelli, 2017) account for about 1.5% of the total surface area of Sardinia which, in addition to the block of the air spaces during the trainings, determine that in some periods of the year a great part of the island is concerned in different ways by military activities (Figure 3).

Even if the great presence of military settlements confirm the strategic role of Sardinia in the context of the political–military system of the North Atlantic alliance related to control in the Mediterranean, it requires a complex system of easements, consisting in the permanent and/or temporary prohibition of use of internal and coastal areas, and of flight in particular air spaces.

During the last 20 years to change this situation the ARS started a dialogue, formalized in several agreements with the Italian State (namely the Ministry of Defence) defining demilitarization and economic compensation (Balletto et al., 2020). In figure 4 is shown the list of the main agreements and memorandum of the Ministry of Defense and ARS, inherent the refunds to Municipality and the military activity disposal.

The agreements, however, has not generally had the desired effects, as the ARS pushes for the non-onerous transfer of state property, while municipal administrations push for ownership to activate the territorial development (Colavitti et al., 2016).

The novelty has been the memorandum between the Ministry of Defense and the ARS dated 18 December 2017, that stated the suspension of the training within the MTASQ from 1 June to 30 September in order to

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guarantee the exploitation and use of the coast, in line with the Natura 2000 network and the regional landscape plan (PPR).

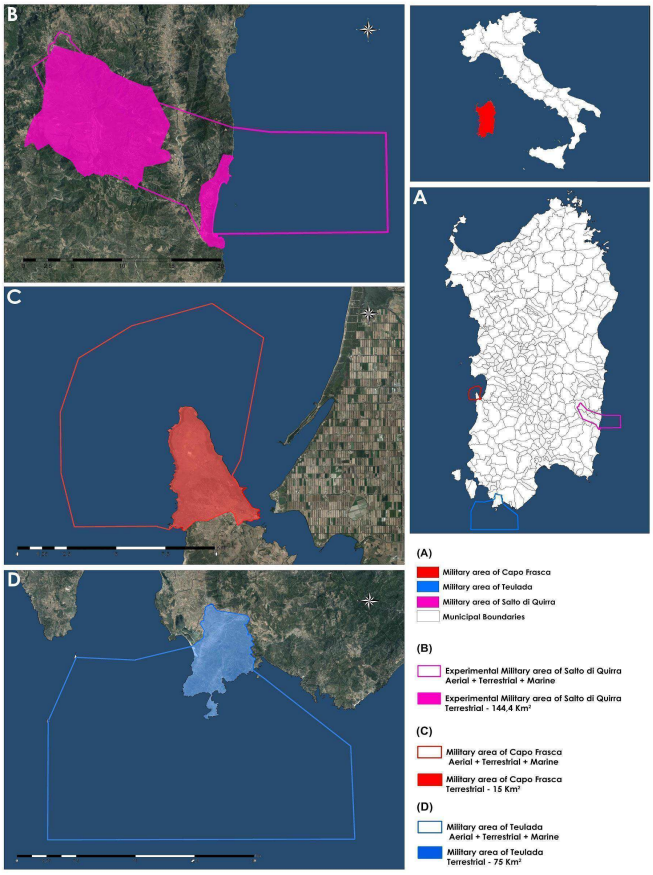

Figure 3. Maps of military areas in Sardinia - Italy (Author: A. Milesi in G Balletto et al Military Training Areas as Semicommons: The Territorial Valorization of Quirra (Sardinia) from Easements to Ecosystem Services. Sustainability, 2020, 12.2: 622)

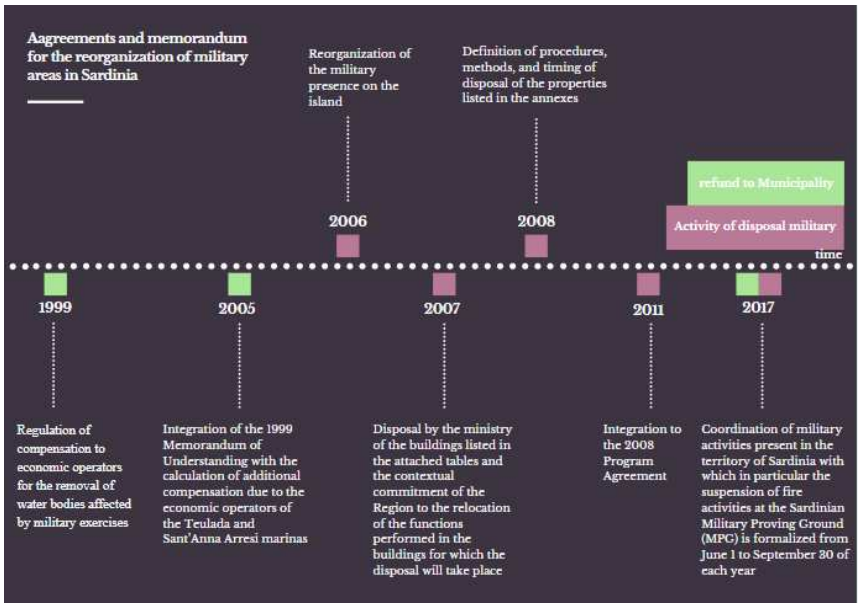

Figure 4. Main agreements and memorandum for the reorganization of military areas in Sardinia. (Author: G Balletto)

Recently, an agreement between the Ministry of Defense and the municipality of Villaputzu allowed the tourist use on the beach of Murtas. In 2017, it was included in the regional list of bathing beaches, thus allowing the municipality of Villaputzu to include this beach within its Local Coastline Plan (LCP).[2]

[2] It's a municipal plan that define the structure of the coastlines through an integrated and systemic management and aims to guarantee the preservation and enhancement of the territory which guidelines are defined by ARS.

4 THE LCP OF VILLAPUTZU AND THE MILITARY PROVING GROUND

The MPGSQ (Codonesu, 2013) is located in the southeastern part of Sardinia with 144.4 km2 of easements that accounts for 62% of all military easements in Sardinia. The municipality of Villaputzu covers about 181.25 km2 and is the most affected by the MPGSQ, with about 41% of the land area occupied by military easements. The peculiarity of the area is given by the presence of a site of community interest (SCI)[3] identified with code ITB040017 and name Stagni di Murtas e S'Acqua Durci.

Even if the divergent strategic objectives - environmental and military - could converge, for a long time was not possible to find a midpoint to counterbalance the different needs transforming the area into an anticommon. The possibility of making the coastline accessible to users was reached only with the recent state–region agreements (2014–2017), which allowed the use of the coast for tourism purposes in a limited period of the year (June 1–September 30), thus allowing the municipal administration of Villaputzu to equip itself with a LCP.

The planning and management of the coastal environment requires careful assessment of both coastal evolutionary trends, such as marine and hydrodynamic weather phenomena, and the phenomena of increasing anthropic pressure connected to tourist use in order to integrate the planning and management of the coastal environment between risk mitigation and conscious use (Marx and Liebenberg, 2019; Seidel et al., 2019). The LCP and the SCI Management Plan (SCIMP) (Leone and Zoppi, 2019) were identified as the main instruments for planning, particularly to allow coastal municipalities to regulate the use of maritime state-owned areas.

The regulatory system where the LCP is inserted concerns the reorganization of maritime state property concessions. Regional law foresees that the municipalities are obliged to draw up the LCP as an integral and substantial part of the municipal urban plan. In particular, the LCP regulates the use of the coasts and of contiguous territories for recreational tourism functions, dividing the coast in relation to the specific environmental characteristics, establishing the use and the related support services.

The LCPs in Sardinia often act within the territories of the Natura 2000 Network. Such a network represents the main instrument of the European Union policy regarding the conservation of biodiversity—established pursuant to Directive 92/43/CEE 'Habitat' and subsequent national transpositions—to guarantee the long-term maintenance of natural habitats and threatened flora and fauna species, divided into Sites of Community Interest (SCI), Special Protection Areas (SPAs), and Special Areas of Conservation (SAC). According to the recent literature, these areas are recognized as central for the creation of ecosystem services (Santolini et al., 2015).

4.1 Local Coastline Plan (LCP) And Management Plan Of The Site Of Community Interest (Sci) Of Murtas Beach - Villaputzu Sardinia, Italy.

The Villaputzu LCP developed in this framework in addition to the state-owned maritime areas, also governs the contiguous areas, regulating road and pedestrian access to the areas in order to create an integration between the coast and the areas not immediately close to the coasts, thus also directing tourist flows towards less privileged areas.

In particular, the Murtas beach LCP proposes the following strategic objectives:

- guarantee the conservation and protection of local coastal ecosystems, with reference to habitats - Directive 21 May 1992, 92/43 / EEC and subsequent amendments;
- harmonizing local actions to ensure sustainable development, promoting measures to reduce degradation and soil consumption processes;
- encourage environmental requalification through renaturalization projects;
- promote innovation and diversification of the tourist offer; and regulate the various activities for the purposes of integration and complementarity between them.

The Villaputzu LCP also affects the MPGSQ enclave. This constitutes the first case in Sardinia of coastal planning that intends to reconcile the military activities with the tourist ones, in compliance with the current

[3] Sites identified within the 'Habitat' directive 92/43/EEC, for the conservation of natural habitats and species of wild flora and fauna of community importance.

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legislation in terms of health and safety and in the framework of environmental monitoring conducted by the ARS.[4] In the same territorial context it is present the SCI called 'Ponds of Murtas and S'Acqua Durci' (code ITB040017) located in the coastal sector of the mouth of the Rio Quirra, in central-eastern Sardinia, that includes the portion of territory that from the promontory of Torre Murtas reaches Capo San Lorenzo and extending for an area of 7.4 km2. The management plan (SCIMP) regulates the SCI, which is consistent with the provisions of the art. 6 of the 'Habitat' Directive and of the art. 4 of Presidential Decree 120/2003, and has the objective of guaranteeing the conservation and protection of the habitats and species of fauna and flora, implementing protection and management strategies capable of allowing the maintenance of areas in optimal conditions, even in the presence of human activities, and thus favoring the maintenance of ecosystem services (Figure 5).

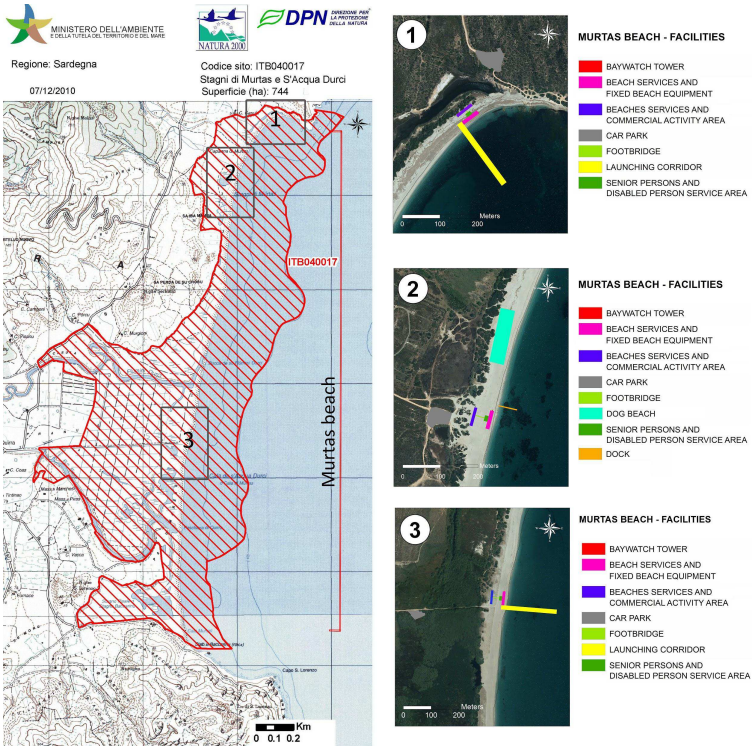

Figure 5. Sites of Community Interest (SCI) ITB040017 'Stagni di Murtas e S'Acqua Durci'. Murtas beach and the main areas of LCP (1,2 and 3). Author: A. Milesi.

4.2 The role of ecosystem Services in the transition from anticommons to semicommons

According to the definition given by the Millennium Ecosystem Assessment (2005), "the multiple benefits recorded by ecosystems for mankind" are expressed through four main categories: Life support, such as the nutrient cycle, soil formation, and primary production; procurement, such as the production of food, drinking water, and materials or fuel; regulation, such as climate and tide regulation, water purification, etc.; and cultural values, such as educational, recreational, etc. In this sense, the importance of including ecosystem services in planning processes is supported by a vast literature. In fact, the overcoming of the sectoral approaches (Geneletti, 2013; Blouin, 2013; Baker et al. 2013; Zoppi et al. 2018), oriented to the coherence between the economic and environmental dimension (Danley et al. 2016), build the prerequisites for the integration of ecosystem services within environmental planning. In particular, the transition from anticommons to semicommons is activated through the integrated environmental planning of ecosystem services. Therefore, to evaluate this integration referred to the case study, the methodology proposed by Mascarenhas et al. (2015) was applied to the management plan of the SCI and to the Local Coastline Plan (LCP) of Murtas beach by searching for the following keywords (figure 6).

[4] http://82.85.20.38/profili/stazione/profilo/id/665

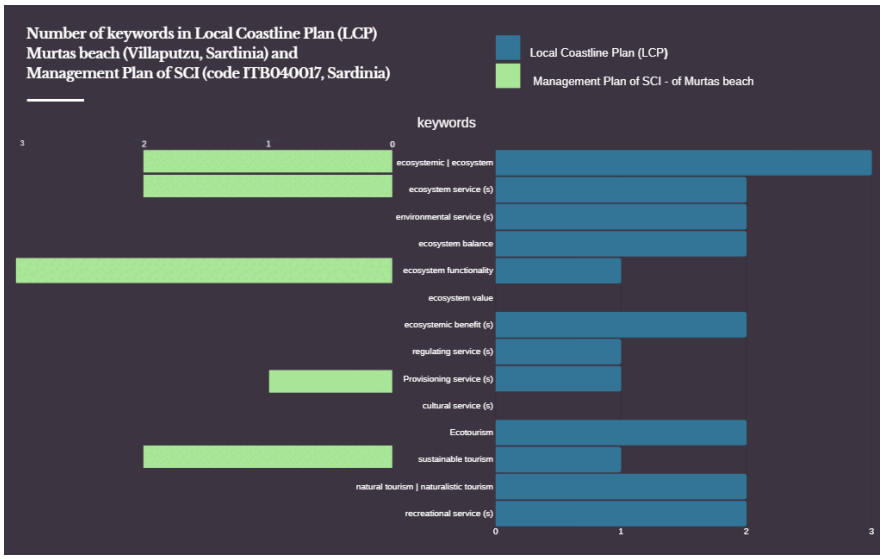

Figure 6. Number of keywords in Local Coastline Plan (LCP) Murtas beach (Villaputzu, Sardinia) and management plan of SCI (code ITB040017, Sardinia). Authors: G. Balletto

Figure 6 shows how the selection of the keywords related to the ecosystem services present in the LCP Murtas beach are highly representative in quantitative terms with respect to the management plan of SCI code ITB 040017. This confirms the role of the LCP strategy (Murtas beach) in the transition from anticommons to semicommons of the military proving ground of Villaputzu (MPGSQ). Such a concept seems nearly straightforward and obvious; nonetheless, it is not explicitly cited when considering this kind of mix use: military and tourist. In other words, through the LCP - Murtas beach- ecosystem services it is possible to activate the transition of anticommons towards semicommos.

5 CONCLUSIONS

The proposed approach highlights how an integrated environmental planning of ecosystem services can allow the transition from anticommons to semicommons, where multiple interests coexist. This transition is in fact a fundamental phase, often neglected in environmental planning, but which requires the utmost attention during changes in the use of the territory and in particular in the occasion of the disposal of public assets. In the study case of the Villaputzu municipality, Murtas beach this transition has been favored by the LCP, local coast planning, in coherence with the environmental protection policies (SCIMP) and the military regulations. In particular, the coexistence of multiple military, public, and private interests found a synthesis in the LCP. The transition from anticommon to common of the Villaputzu military enclave was in fact possible due to ecosystem services presence. In particular, the condition of semicommon good incorporates the private sector related to tourism and beach services. In the presence of this regime (semicommons) the following two effects arise, deriving from the combined use: 1. Economies of scale obtained thanks to the combination of public interests (military activities) and private (services seasonal tourist); 2. environmental protection: the interaction between private use (coastal use plan (LCP) and the common (management plan of the SCI of Villaputzu) reduces the phenomenon of overuse. In this sense, ecosystem services offered in the LCP, Murtas beach allow responsible use based on the dynamism of the natural context. In fact, the military enclave has led to an anticommons, but it is also true that it has preserved the coast, prohibiting the fruition. This prohibition allowed the natural beach to evolve without human interference in the Murtas beach. In this sense, the LCP is inserted and proposes tourist use compatible with conservation and valorization of the natural heritage. It should be noted, however, that the research carried out appears to be at an initial stage, and with little evidence of other cases in sensible areas around the world. To the authors' knowledge, no other cases have been widely tackled in the literature and in spatial planning actions. The authors in particular highlighted, in theory and practice, how a concurrent approach on planning can be adopted, allowing de facto multiple targets to be addressed: Military operations, environmental protection and management, and tourist recreational use.

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attributed to all the authors. This article is part of the work of drafting the Municipal Urban Plan (MUP) of Villaputzu and in the related Coastal Use Plan (LCP) and Strategic Environmental Assessment (SEA): Scientific coordinator Ginevra Balletto.

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Flexible, Digital and Integrated: Public Transport of the Future in Suburban and Rural Areas

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1 INTRODUCTION

Historically, urban transport networks were built for horses and pedestrians, resulting in the typical medieval structure of cities, which can still be found across Europe. A first transformation occurred during the period of industrialization, where public transport systems (tramways, railways) enabled the expansion of urban centers into the countryside and fostered the separation of residential areas and places of work. Then, boosted by the ideas of the Athens Charter 1933 (Le Corbusier, 1943) and a new reliance on motorized transportation, urban economic areas expanded into much larger metropolitan areas, by building low density suburbs that blurred into rural zones. In these areas, driving replaced more sustainable modes of transport and today suburban and rural environments experience severe mobility problems such as high levels of congestion, expansive parking lots, low accessibility for people who cannot or do not wish to drive and underserved sectors. Traditional public transport is less competitive in such low-density areas, service is often infrequent, concentrated during peak-hours and serving mainly city-commuters. The dispersion of origins and destinations makes it difficult to establish fixed high-performance routes and high car ownership means low patronage. Land use planning, including regulation to manage population and employment density, as well as walkability and cycleability policies, is the most efficient instrument for building more sustainable, public transportation friendly environments. In the meantime, however, shared mobility digital platforms and their customer-centric business models provide a new opportunity to improve mobility in suburban and rural areas.

Keywords: Digital, Integrated, Rural, Suburban, Flexible

1.1 A changing role for public transport operators

Much has been said about how shared mobility providers have contributed to declining public transport ridership or could become a threatening competitor for public transport operators (Ryerson CBI, 2019). Private transportation network companies (TNC), such as Uber, may increase driving, congestion, and even contribute to increasing car-ownership by helping their drivers acquire and pay-off their cars (APTA, 2018). This erodes public transport's user base, as well as deteriorates travel times. And while their services cost more, riders seem to be willing to pay a premium for the convenience of the service (City of Toronto, 2019). On the other hand, TNC's and other shared mobility platforms, have also greatly improved customers' travel experience, by providing real time, flexible and integrated transportation and by making the process of ordering and paying for the service seamless and easy. TNC's are asset light; they are nimble and can set up a service in a matter of weeks. They often operate small vans or minibuses that are better adapted to both congested urban centers and narrow residential streets.

These new shared modes are disruptive, and the public sector must adapt, and regulate if necessary, to ensure public transport remains the backbone of the urban transport system. Considering this, two complementary approaches are emerging (APTA, 2019, The Conference Board of Canada, 2019):

(1) Reinforcing rapid transit networks by increasing the efficiency of public transport along high capacity corridors and by making public transport the best option on those routes through improved reliability, higher frequency and higher speed (rail, light rail and subway networks and expansions, but also BRT's and even busways such as New York City's 14th street busway) (New York City, DOT, 2019).

(2) Providing flexible, digital and integrated solutions by leveraging new technologies and data, such as on-demand responsive systems (microtransit), as well as making improved station access a priority, through the integration of different transport modes both physically (e.g. mobility hubs, carsharing, bikesharing, micromobility solutions) and virtually (e.g. MaaS, integrated fares).

While the first approach is inherent to public transport planning, the second consists in a shift away from operators' traditional role and towards acting as mobility providers for regions, cities and citizens.

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2 DIFFERENT BUT SIMILAR: STADREGION+ AND MONTREAL METROPOLITAN AREA

While urban development has evolved differently in North America and Europe, suburban and rural areas are facing common challenges. In both cases, urban development since the 1950's has favoured car-centric sprawling suburbs. Car ownership has accelerated continuously in the last decades (CMM, 2020)[1], as has solo driving. Examples from OBB in the Stadtregion+ (Austria) and exo in the outer rings of the Montreal Metropolitain Area (Quebec, Canada) will be explored to illustrate how public transport agencies operating in different contexts but sharing common challenges are adapting their services.

2.1 Land use trends in the Stadtregion+

The Stadtregion+ comprises the city of Vienna (1,8 million inhabitants), the adjointing districs of Lower Austria and parts of northern Burgenland. It is the economic core of Austria with a total population of about 2,7 million people. Population density varies between 27,000 inhabitants/km² and 99 inhabitants per km² (PGO, 2015). Since 2000, all areas within a 50 km radius from the city of Vienna have seen a strong increase population (+5 to 10 %); the strongest increase being in the city of Vienna with more than 20 %. However, some suburbs have also seen a rapid population growth, such as the district of Tulln at the outskirts of Stadtregion+ (14,5 % between 2003 and 2018) with some communities growing even more than 54 % during this period (Statistik Austria, 2020). An increase that is, in the case of Tulln, strongly linked to the new Western Railway high-speed section.

2.2 Mobility trends in the Stadtregion+

The Stadtregion+ is crisscrossed with public transport services (mainly railway, tram and bus) and public transport ridership has been increasing since at least the 1990s. The city of Vienna has experienced a strong increase of public transport ridership; e.g. growth of annual season ticket holder: 2011 363,000; 2019: 852,000 (Wiener Linien, 2020). The parking policy of the city of Vienna has also contributed to strongly reduce commuting by car inside the city as well as from outside the city. Nevertheless, more than 180,000 (60,000 by rail; 120,000 people by car) are commuting every day to the city of Vienna (Arbeiterkammer, 2015). Interestingly, car ownership per capita has developed differently in major cities and rural areas: it has declined in Vienna, from 391 in 2008 to 374 in 2018, but has strongly increased in rural ares as well as areas of suburban areas such as the city of Tulln (441 to 641) (Statistik Austria, 2020).

2.3 Land use trends in the outer rings of Montreal Metropolitan Area

The Montreal Metropolitan Area (MMA) is constituted of 82 municipalities. 4,1 million inhabitants live in an area of 4,300 km2. The Agglomeration of Montreal (2 million inhabitants) is the economic core of the MMA, 21 % of all jobs are in the CBD. There is, however, a sharp contrast between land use, growth and mobility patterns between the center and the outer rings. The Northern ring (pop. 589,000) and Southern ring (pop. 508,000) are constituted of rural and suburban communities. Almost two-thirds of the territory is in agricultural use (CMM, Portraits Territoriaux, 2019). Average population density in the urbanized areas is between 1,500 and 1,700 persons per km2 (ARTM, 2019). Most households live in single-family homes (more than 60 %) (ARTM, 2019, CMM, Portraits Territoriaux, 2019, Statistic Canada, 2016). These suburban communities are thriving, creating most population and job growth in the region. 83 % of the region's population growth occurred off the island of Montreal between 2006-2016 (CanU, 2018) and although only 19 % of jobs are in the outer rings, 54 % of job growth and an increase of 12 % in work trips where registered in these areas since 2013 (ARTM, 2018).

2.4 Mobility trends in the outer rings of the Montreal Metropolitan Area

Mobility patterns in the outer rings of the MMA have evolved towards increasingly high levels of solo driving and a continuous decline in walking and cycling (CMM, Cahiers Métropolitains, 2019). Trip distances made by residents of these areas are typically 1,5 longer by car and twice as long by public transport as trip made in the rest of the region (Statistics Canada, 2016). Only 15 % of commute trips are destined to the city center, which is where most of the rapid public transport networks are oriented. Driving accounts for more than 80 % of trips. While 95 % of the population lives within a walking distance from a

[1] From 2013 to 2018, the number of passenger vehicles on the road rose from 1.84 million to 1.96 million, an increase of 6.8 %.

bus stop, only 6 % to 8 % use public transport on any given day (ARTM, 2018). For everyone else the service may be too infrequent, too slow or not go at all where they need to go.

2.5 Stadtregion+ and MMA: different trends, common challenges

Both regions show different trends in terms of population density and car ownership. Vienna's Stadtregion+ has managed to reduce car ownership and driving through a very comprehensive public transport network and strict parking policies, however the expansion of the rail network, while reducing car commuting to the city, comes with station access challenges in new developments. In the outer rings of the MMA, combined low density and a vast territory have favored driving and car ownership to the extent that 80 % of trips use an automobile. However, these communities are thriving and in need of more efficient mobility services. Common challenges include providing sustainable options for station access, beyond park and ride lots, serving dispersed low-density destinations efficiently and providing last mile solutions. Both ÖBB and exo have developed market-proven and innovative pilot solutions aiming to reinforce rapid transit networks and provide flexible, digital and integrated transportation services in these areas.

3 SOLUTIONS DEVELOPED FOR RURAL AND SUBURBAN REGIONS

3.1 Examples from ÖBB

As Austria´s largest mobility services provider, the ÖBB corporation moves 474 million passengers and 110 million tons of goods to their destinations in an environmentally friendly way every year. ÖBB operates 1,061 railway sations and railway stops and 20,648 ÖBB Postbus stops. Today ÖBB offers 47,000 Bike&Ride stations and 64,300 Park&Ride stations at railway stations all over Austria. Due to different geographical conditions and transport policies, more than half of ÖBB-Park&Ride can be found in Lower Austria: (34,000 plus 19,600 Bike&Ride). In other parts of Stadtregion +, such as Burgenland (2,700 and 1,300) and Vienna (1,100 and 1,300) the figures are much lower. The new Western Railway high-speed section in the western part of Stadtregion+ has strongly increased railway usage as well as attractiveness of suburban and rural areas. Similar urban developments are expected with ongoing and planned railway development projects. In these low-density areas, effective transport solutions to access high speed rapid transit lines are badly needed. Three different solutions (railway station services, ÖBB Postbus Shuttle, ÖBB Carsharing) ÖBB has developed to respond to these challenges are presented below.

3.1.1 MeinBahnhof: Railway station services

ÖBB has set up an internal programm "MeinBahnhof" ("My railway station") which is developing and testing solutions to increase services for railway stations including:

Purpose-centered access: as Park&Ride is also significantly used by non-rail commuters, technologies are developed to limit access to railway stations only to customers. These include, among others, parking meters, ticket validation systems, as well as boom barriers which verify tickets.

Carsharing: ÖBB-Rail&Drive, a carsharing service operated by ÖBB, is available in more than 28 cities in Austria.

Bike&Ride: considering the high costs for Park&Ride, ÖBB supports Bike&Ride solutions such as bikeparking boxes which are accessible only via a mobile application.

Bahnhofsgreißler: mini supermarkets ("Greißler") with longer business hours, designed for the needs of commuters, have been installed, most notably in and around Stadtregion+ (Hollabrunn, Mistelbach, Melk).

Parcels pick up boxes: ÖBB boxes, which allow to pick up parcels from railway stations, are available since autumn 2019 at more than 15 railway stations.

The example of Bahnhof Tullnerfeld: The railway station Tullnerfeld was opened simultaneously with the Western Railway high-speed section between Vienna and St. Pölten in 2012 and has since then much contributed to the attractiveness of the area, resulting in a remarkable increase in urban development. The station is 1,5 km away from nearby villages and, from the start, Park&Ride services were deemed insufficient; hence more than 1,600 Park&Ride spaces plus more than 250 Bike&Ride lots are available today. To further increase the level of service, ÖBB has also implemented its first grocery pick-up boxes: in partnership with a food store chain,where commuters can easily pick up their groceries. In addition, since

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January 2020, ÖBB carsharing is also available at Bahnhof Tullnerfeld. This is of interest, since this station is almost exclusively used by commuters. Other railway stations with carsharing are largely used by tourists or day visitors.

3.1.2 ÖBB carsharing

In 2012, ÖBB began offering its own fleet to its employees (e.g. service cars, company cars) for private use. Due to its success it was opened to the public in 2017. Currently ÖBB CarPool (ÖBB-internal Carsharing) has about 9,000 users and ÖBB Rail&Drive about 8,500 "external" customers. In total, 520 vehicles (including 24 electric vehicles) are available in 28 cities all over Austria; the service itself is based on fixed parking stations. The service is not limited to major railway stations but can be also found in touristic regions. Today, Rail&Drive is one of the largest carsharing systems available in Austria and has also helped to position ÖBB as an integrated mobility provider. Challenges, which need to be adressed in the upcoming years are carefully expanding the network, including solutions to increase usage per car, the number of e-cars as well as integrating the service with DeutscheBahn carsharing ("Flinkster") and further improving the application.

3.1.3 ÖBB Postbus Shuttle

The aim of ÖBB Postbus Shuttle, which began test-operating in the regions of Klopeiner See and Lustenau in 2018, is to offer public transport services in rural, low-density areas through easily accessible on-demand solutions. Postbus Shuttle complements existing rail and bus services and targets mainly the following user-groups: tourism, local companies and local population. Hence, it therewith contributes to reducing car-ownership. It uses vans, like taxis, and its service is limited to a specific rural region. Until now, the service has been operated in partnership with local taxi drivers. Thus, bringing together local taxi companies' knowledge with the technological expertise and brand value of ÖBB. Customers can choose between three different options to book a ride: via shuttle-app, shuttle-interface or telephone call. The IT-system, being a core element of the system, is easy, accessible, self-learning and integrates local destinations (e.g. doctors). It allows Door-2-Door mobility, virtual stops as well as fixed timetable routing. One of the main challenges remains funding. Until now, the system has been funded up to 30-40 % by the state, 40-50 % by the communities and 20 % via fares. As it is a new service offer, it also needs to be heavily promoted among local communities; this need also spurs from the changing role of ÖBB from a railway and bus operator towards a mobility integrator. ÖBB is now actively offering new mobility solutions to small communities.

3.2 Examples from exo

Exo is the second largest public transport operator in the MMA, operating all bus and most parapublic transport services in the Northern and Southern rings as well as all commuter rail in the MMA. Exo serves 45 million trips per year, operates 237 bus lines, 60 taxibus lines and 6 train lines. It was constituted in 2017 by joining a government agency operating the commuter rail and 13 municipal public transport agencies from the outer rings.

Some of exo's challenges are reinforcing rapid transit lines while minimizing capital investment and improving multimodal station access in order to increase ridership and reduce pressure on park and ride lots. Exo is conducting a network redesign and looking to develop solutions that are tailored to the community, especially through creating suburb to suburb connections, which often don't exist, as well as better serving local destinations. The increase of jobs and population in the suburbs has sparked the need to serve suburban destination and off-peak travel more. Exo works closely with municipalities to develop services are curated to the local context and consider the mobility needs of seniors, students or specific underserved areas.

3.2.1 Exo duo - integrated rail and bus lines

Commuter rail service in the MMA is mostly a weekday peak service, resulting in a lack of frequency and flexibility. The commuter rail network was expanded in the 2000's, growing from 2 rail lines in 1996 to 6 in 2012, and rail ridership went from 6,9 million to 19,2 million trips per year. Expanding the network or adding frequency is difficult since the rail infrastructure is owned by private rail companies. The REM, an LRT network (67 km, 26 stations), is currently being built by the CDPQ Infra (a subsidiary of Quebec's pension fund). This new LRT network, expected to open it's first branch in 2021, will replace one existing exo commuter rail line and add a rapid transit connection to several suburban neighbourhoods. Exo is

currently redesigning its bus network as bus services that now go directly to the CBD will be redirected to REM stations. This redesign is an opportunity to increase service on higher ridership routes. In order to reinforce its rapid transit network quickly, while limiting capital costs, exo has created combined rail and bus corridors. In one case, a bus line was redesigned to ride along the Mont Saint-Hilaire train line and serve the three furthest train stations from the CBD. Off-peak service was added and a single fare combining bus and train services is available. The combined service is advertised as one corridor and branded as exo duo. The schedule includes both buses and trains.

3.2.2 Improve local coverage networks – on demand or local shuttles

Exo runs 60 taxibus lines, these lines run on fixed route and about two-thirds must be reserved at least one hour ahead of time by phone. They are operated by local taxi companies and operate much like a regular taxi but cost a public transport fare. In 2018, exo worked with the city of Terrebonne, on the Northern ring, to set up a service to increase youths' mobility. Three new taxibus lines were created to serve students going to a regional college campus nearby, the trip required taking two bus and lasted about 50 minutes. The new service is more time competitive, taking about 24 minutes by taxibus. On-demand services by taxi are very promising to serve low density neighborhoods and they can eventually be scaled a larger vehicle once demand has been built up. Some challenges are the difficulty to advertise them and integrate them into trip planning apps. One looming challenge is the deregulation of the taxi industry, that will go into effect in October 2020 in Quebec. The new law will eliminate permits and quotas and allow surge princing. It is feared that this will impact the supply of drivers and vehicules, especially in low-demand areas and during peak hours.

Another notable initative is a new bus shuttle service mainly designed for seniors in the city of Mercier in the southern ring. Exo worked closely with the municipality to develop this service and improve mobility for residents. Residents were consulted in order to design and tweak the service and the approach is tailored to their needs. 73 trips a week are offered between key local destinations, such as grocery stores, medical clinics or hospitals using a minibus. The stops on the schedule are named after the destination they serve (rather than street names) and schedules are printed and mailed to residents. The service has been successful, and ridership has increased steadily. Plans to add new stops and frequency are underway. While this service is low-tech, the customer-centric approach that was used helped ensure its success and played a part in strenghtening exo's role as a mobility provider, as well its ties with the municipaity.

3.2.3 Improve station access – on- demand feeder services

Exo owns and operates over 30,000 parking spots in 65 park and ride lots. Historically, commuter rail ridership has largely followed the provision of parking spots. However, station parking quickly becomes a victim of its success, causing congestion, delays and general frustration among customers. To improve multimodal access to train stations and bus terminals, several cycling amenities have been built, such as 3,500 bike racks and 2 indoor bike-stations, with more currently under construction. Reserved paid parking and reserved spaces for ridesharing are also in effect, but their success is limited, except in some very crowded stations. Continuously increasing park and ride lots is not a sustainable option, furthermore municipalities are planning to develop greater residential densities near stations (transit-oriented developments) and wish to use the land nearby to this end.

In the spring of 2020, exo will be testing a new on-demand service to reduce the need for station parking as well as attract new customers to public transport. This app-based shuttle service using taxis will serve an area close to a train station and a bus station in two municipalities (one in the Northern Ring and one in the Southern ring) and drive customers to and from the station. The service is designed to be flexible, quick, and in real time. The wait time should be around 5 minutes and the travel time around 10 minutes, which is competitive with the car. Exo also hopes to build customers' confidence in shared modes which can increase their multimodality and eventually reduce car ownership and GHG emissions. This pilot project will run for one year, meanwhile exo is examining other options to improve station access, such as electric bike fleets.

4 CONCLUSION

The backbone of a successul public transport service is a rapid transit - high capacity, high frequency- rail or bus network. However, these networks usually take time to extend, and are not always the best response to

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less-densily populated area such as suburban and rural regions. This is why public transport operators should shift towards becoming mobility providers and play a larger role in developping the urban transport system, alongside governements and municipalities. This can be done by successfully integrating a variety of modes and services, such as “virtual services“ (e.g. ticketing application) and “physical services“ (e.g. parking, shuttle-services, parcel pick-up stations) and multiple transport modes (cycling, walking, taxi, carsharing and public transport). With this in mind, it is also necessary to rethink the metrics that drive performance. Current metrics are focused on operational measures such as route ridership, unlinked trips, or passenger revenue miles. Additional metrics taking into account the whole mobility picture, including reductions in solo car trips and increases in linked, multimodal trips should be developped (APTA, 2016). This can be particularily true when evaluating the success of shared mobility projects in lower density areas, where costs will be higher and ridership lower than in dense urban areas. For example, an on-demand service in Milton (Ontario, Canada) had a high success rate, attracting new transit users, one rider even chose not to buy a car because the service served his needs adequately, but ridership was less than the bus that served the same station (ARUP, MaRS, 2018). Setting the proper metrics would help inform decision making and clarifiy the objectives of each service, which may not be high ridership.

A cultural change is also needed for public transport operators to shift towards becoming mobility providers. They can increse their agility by reducing their planning and delivery time and playing an active role in shaping services with communities and strenghthen their partnership with municipalities. They must also become more customer-centric by tailoring solutions to customers needs and ensuring social acceptability. Promoting and developing new shared mobility services is expected to reduce car-use and eventually car-ownership. As studies have shown this can result in an overall increase of public transport use and even contribute to community building (FFG 2019; APTA 2016). Therefore, it is essential to create new partnerships between traditional operators, communities and private transport companies (e.g. local taxi companies, TNC’s). The development and implementation of new mobility solutions is not without risk (e.g. Car2go closure in North America) (CBC, 2019). Hence, it is preferable to set-up pilot projects to learn and accept to sometimes fail while being be fully aware that there is no single-fit solution. However, public transport operators can use their industry knowledge and strong customer relationship to promote theses new services and develop sustainable business models that have regions, cities and citizens best interests at heart.

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Herausforderungen der städtischen Szenerien an die Automatisierung von Fahrzeugbewegungen – wo sollen welche Anwendungen aktiviert werden?

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1 ABSTRACT

Die Vielfalt der Stadtlandschaften in Europa schafft eine Unzahl an Herausforderungen für die Automatisierung des Kraftfahrbetriebes im urbanen Straßennetz und für die praktische Anwendung von Funktionalitäten in den Kraftfahrzeugen. Testfahrten mit solchen Fahrzeugen im Rahmen von „Living Labs“ erbringen punktuelle Erfahrungen und lassen selektive Erkenntnisse zu, werden aber vermutlich noch keine systematischen Grundlagen für den Einsatzbereich im urbanen Verkehrssystem liefern können.

Dazu bedarf es einer Herangehensweise, die mit der Vielfalt der Erscheinungsformen städtischer Szenerien und mit der Unmenge an evozierten Szenen im Verkehrsgeschehen umzugehen weiß. Die verheißungsvollen Nutzanwendungen von Automatisierungsfunktionalitäten im Fahrbetrieb fokussieren bislang auf den Einsatz einzelner Kraftfahrzeuge und leiten daraus eine allgemeine Nützlichkeit für das Mobilitätssystem ab. Zur Nachweiserbringung fehlen aber noch Prüfroutinen, die für die allgemeine Zulassung in definierten örtlichen Einsatzbereichen ausreichend fundiert sind. Darüber hinaus werden die Mobilitäts-, die Verkehrs- und die Stadtplanung der Gebietskörperschaften gefordert sein, sich mit dem von der Industrie getriebenen Technologiethema auseinanderzusetzen, spätestens wenn die Entscheidungen anstehen, wo welche Anwendungen aktiviert werden oder ausgeschlossen bleiben sollen.

Keywords: Verkehrsszenen, Städtische Szenerien, Automatisierte Kraftfahrzeuge, Evaluierungszugänge, Funktionalitäten

2 VERRÄUMLICHUNG DER TECHNOLOGIEANWENDUNG

2.1 Begriffliche Abklärung zur Automatisierung und Autonomisierung des Kraftfahrbetriebes

Zu den Begriffen, wie sie im folgenden Beitrag verwendet werden, sei vorweg erläutert:

Die Automatisierung betrifft einzelne Funktionalitäten in der Ausstattung des Fahrzeuges, die über eine Erweiterung der Wahrnehmung eines Fahrzeugführers hinausgehend in das Fahrverhalten aktiv eingreifen und unter Umständen denselben für eine bestimmte Steuerungsaktivität korrigieren oder ihn sogar ausschalten, wie es beispielsweise ein Notbremsassistent oder ein Tempomat tun. Die Autonomisierung des Fahrbetriebes bedeutet, dass der Lenker von seiner Steuerungstätigkeit für eine bestimmte Strecke im Straßennetz entbunden wird, weil das im Kraftfahrzeug installierte Automat-System dieses befähigt, den Lenker zu ersetzen. Dabei kann es exogen durch interkonnektiven Datenaustausch mit „adjazenten“ Fahrzeugen, die relevant für das akute Fahrverhalten sind, sowie durch interaktive Datenübertragung mit einem übergeordneten Verkehrsfluss-Management entlang des Fahrweges unterstützt werden.[1]

Das durch Algorithmen gesteuerte, autonomisierte Fahrzeug hat nicht nur sein Umfeld auf der Fahrbahn zu detektieren, sondern muss die nächsten Sekunden seines Laufweges voraussehen. Das bedeutet, in der Automat-Kette müssen entscheidungsrelevante Szenarien der Verkehrsabwicklung generiert werden, um dementsprechende Steuerungsbefehle an Antrieb und Fahrwerk richten zu können. Dabei ist von einer Fülle von Randbedingungen auszugehen, die einen enormen Datenbedarf auslösen, wenn die Entscheidungskompetenz und die Verantwortlichkeit an das Automat-System des Fahrzeuges abgegeben werden. Die informative Vernetzung unter den situativ agierenden Verkehrsteilnehmern und mit der örtlichen Verkehrsinfrastruktur wird eine ausschlaggebende Rolle spielen. Ebenso wird der „Radarblick“ auf Bewegungen abseits der Fahrbahn in der Enge städtischer Räume noch viele Fragen aufwerfen, was an Echtzeitdaten davon operativ gebraucht wird, oder ob vielleicht der Datenschutz Unbeteiligter betroffen sein könnte. Somit geraten die geodätischen Dimensionen der Technologienanwendungen in den Fokus, ehe noch die Abwicklung von Interaktionen mit anderen Verkehrsteilnehmern zu thematisieren ist.

[1] An dieser Stelle darf an den Beitrag zur CORP 2019 von Dörr, Marsch und Romstorfer: „Automatisiert Bewegen durch Stadt und Land – Gesellschaftliche Implikationen der Implementierung von ITS-Technologien in das Verkehrsgeschehen des zukünftige Mobilitätssystems“ erinnert werden, der in die Thematik eingeführt hatte.

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2.2 Räumliche Kategorisierung der Anwendungsfelder

Dazu wird es erforderlich sein, in der jeweiligen Stadtlandschaft die Fahrwege nach statischen Merkmalen (Topographie, Netzgestalt, Erschließungsdichte, Fahrbahnzustand, Verkehrsflächenaufteilung für Mobilitätsgruppen) zu erfassen und nach dynamischen Eigenschaften der zeitabhängigen Befahrbarkeit (Level of Service) zu gliedern. Daraus folgend erweitert sich das Blickfeld auf die Umgebung der Straßenräume.

Denn dort entstehen Mobilitätsbedürfnisse und erzeugen die Flächennutzungen als Quellen und Ziele Wege motorisierter und nicht-motorisierter Personen. Eine überschießende Funktionalisierung ihrer Mobilitäts-ausübung zugunsten eines automatisierten Kraftfahrbetriebes ist in Hinblick auf etwaige Ausschlusseffekte zu hinterfragen. So könnte es zur Folge haben, dass alle verkehrsteilnehmenden Gruppen mit Transpondern ausgerüstet sein sollten und sich in streng reglementierten Bewegungsräumen gängeln lassen müssten.

2.2.1 Einbettung des Kraftfahrverkehrs in die urbane Umgebung

An repräsentativen Anwendungsräumen, wie in Wohngebieten oder entlang von Geschäftsstraßen mit Mischverkehr unterschiedlichster Mobilitätsgruppen oder im Umkreis von kritischen Standorten, wie von Schulen, ÖV-Haltestellen oder Portalen von Einkaufszentren, sollte der Einsatzrahmen der Kfz-seitigen Automatisierungstechnologien nach Zweckmäßigkeit im Fahrbetrieb, Angemessenheit im Verkehrsgeschehen und Sozialverträglichkeit im Mobilitätsmilieu evaluiert werden.

Abbildung 1 & 2: Typische Verkehrsszenen in der Innenstadt: Bunter Mix an Fahrzeugen, die sich ihren Weg bahnen (links: entlang der Ladenzeile in der Kaiserstraße in Frankfurt (Main) und rechts: Kreuzung Avenue La Fayette/Magenta in Paris, 2019)

Damit kann der partizipativen Komponente bei der Technologieentwicklung in ihren Auswirkungen auf das Mobilitätsverhalten in öffentlichen Räumen entsprochen werden. Schließlich stellt sich an Nahtstellen zwischen der Verantwortung für den öffentlichen Straßenraum und den privaten Verkehrsanlagen die Aufgabe der Harmonisierung an den Schnittstellen in technologischer Hinsicht bzw. an den Orten der Übergänge in verkehrspraktischer Hinsicht. Das Spektrum der anstehenden Aufgaben lässt sich an Bildern beobachteter Verkehrsszenen anhand typischer stadträumlicher Szenerien anschaulich machen, um einen aufklärenden Diskurs mit relevanten Akteursgruppen anzustoßen und die Entwicklung methodischer Ansätze für Weichenstellungen zur künftigen Ausgestaltung unserer Mobilitätssysteme voranzutreiben.

Abb. 3 & 4: Potenziell kritische Interaktionsräume für künftig automatisierte Fahrzeugbewegungen (links: Straßenbahnhaltestelle Schwedlerstraße mit Kindergarten in der Umgebung in Frankfurt (Main) und Begegnungszone in der Wiener Altstadt ohne strikte Trennung der Bewegungsräume für die Mobilitätsgruppen (Herrengasse, Bild: Viktoria Marsch, 2017)

Die Vielfalt und das zufällige Zusammentreffen von Fahrzeugen und allgemein von Verkehrsteilnehmern im Straßenraum stellen höchste Anforderungen an die Interaktionsbereitschaft der Kraftfahrzeuge als Bewegungskörper. Dazu wird es der einprogrammierten Verhaltensregeln zur „Vorfahrt“ und zum „Nachrang“ bedürfen, die weit über die Straßenverkehrsordnung praktischerweise hinausgehen müssen, weil Eventualitäten mit einzubeziehen sind und nicht alle Standard-Situationen durch ein wie immer geartetes übergeordnetes Leit-Management abgedeckt werden können. Mit einer rein mechatronischen Prozesslogik, wie sie etwa bei industriellen Fertigungsstraßen oder in der Warenallokation in Logistiklägern eingesetzt

wird, wird es nicht allein getan sein. Man darf die These wagen, Künstliche Intelligenz beginnt erst mit dem situativ kreativen Umgang mit noch nicht eingelernten Interaktionen.

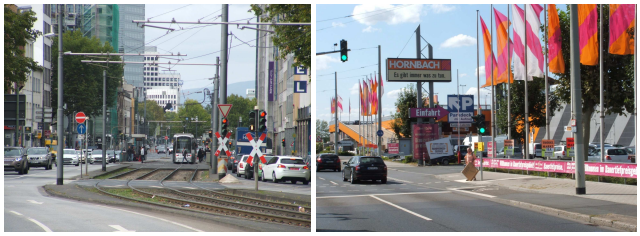

Abb. 5 & 6: Nahtstellen zwischen öffentlicher Verkehrsfläche und privaten Abstellanlagen durchzogen von Fußwegen sowie Schnittflächen zwischen Individualverkehr und Schienentrassen des ÖV sind im großstädtischen Straßenraum häufig anzutreffen. (links: ein Baumarkt an der Hanauer Landstraße und rechts: Tram-Trasse nahe Hauptbahnhof in Frankfurt am Main).

Wie aus den Abbildungen 5 und 6 ersichtlich wird, muss die Automat-Kette nicht nur eine Fülle von Bildern und erfassten Objekten verarbeiten, sondern dabei relevante von irrelevanten Informationen selektieren, also unnötige oder verwirrender Bildinformationen wegfiltern. Auch wird die Unterscheidung von statisch feststehenden Objekten und von Bewegungskörpern, mögen sie auch gerade unbeweglich erscheinen, schwerfallen. Im Wind flatternde Fahnen sind feststehende Objekte, eine Einkäuferin vom Baumarkt ist ein wartender Bewegungskörper mit einer schwer erkennbaren „Traglast“. Mit dem Straßenbahn-Zug könnte interkonnektiv Datenkontakt hergestellt werden, aber mit den möglicherweise über die Fahrbahn eilenden ÖV-Fahrgästen eher nicht. In solchen Fällen müsste das Automat-System eines Kfz sehr defensiv konditioniert werden, um die Wahrscheinlichkeit von Vorfällen so gering wie möglich zu halten.

2.2.2 Das Aktionsfeld eines autonomisierten Kraftfahrzeuges

Ein zum autonomen Fahren befähigtes Fahrzeug bedarf einer durchgängigen Automat-Kette, die folgende Aufgaben verlässlich, nämlich verlässlicher als ein Fahrzeugführer, durchzuführen imstande sein muss:

Beginnend mit der laufenden Detektion zur Laufwegbahnung mittels mehrerer Sensorik-Technologien und der die Bilder bzw. Signale interpretierenden Software zur Objekterkennung und deren Verhaltenseinordnung, müssen die akuten Bewegungen der sich annähernden Objekte vermessen und prognostisch berechnet werden, um kritische Annäherungen auf dem Laufweg des autonomen Kfz zu vermeiden. Dazu muss das Automat-System die Szenarien für die bevorstehenden Interaktionen mit den adjazenten Bewegungskörpern – es sind ja nicht nur Kraftfahrzeuge im urbanen Straßenraum unterwegs, sondern auch besonders verletzliche Verkehrsteilnehmer – entwickeln, aufgrund derer die Entscheidungen über die Steuerungsbefehle an Antrieb und Lenkung vom System getroffen werden.

Dazu braucht es „künstliche Intelligenz“, die zu erlangen, von „Deep learning“, also dem Erfahrungssammeln und -bewerten durch spezielle Praxisfahrten erhofft wird. Dabei wird klar, dass es dazu noch viele Jahre Entwicklungszeit brauchen wird. Die Anforderungen sollten aber schon frühzeitig eingebracht werden, um diese Phase von „Deep Learning“ – sozusagen Learning by Doing – zu unterstützen. Ferner kann dadurch die Auswahl von ODDs (Operational Design Domains) als Testfälle auf Teststrecken für die Bewährung von Funktionalitäten beraten werden. Nicht zuletzt würde somit die Technologieentwicklung aus der Labor- und Computerdesign-Umgebung der Automobilunternehmen in die wahre Mobilitätswelt der Menschen geholt werden.

Zurückkommend auf die räumlichen Dimensionen stellt sich eine Abfolge von Detektionsfeldern aus der Sicht der Laufwegbahnung des Kfz und von Einwirkungsfeldern aus der Sicht potenzieller Störfaktoren ein. Diese Raumkategorisierung stellt des Weiteren mobilitätspolitische Eingriffs- und Gestaltungsebenen für die verschiedenen Entscheidungsträgerschaften dar, die in der folgenden Systematik aufgeschlüsselt werden:

- Das Umfeld:
    - Im Wesentlichen für den Kraftfahrbetrieb die Fahrbahn mit ihren Fahrstreifen als Leitlinien
    - Im Allgemeinen für die Mobilitätsausübung der organisierte Bewegungsraum für die Laufwegbahnung verkehrsteilnehmender Gruppen
    - Schnittflächen für die Bewegung unterschiedlicher Mobilitätsgruppen
    - Verkehrsschnittstellen im Fließverkehr (Exits, in der Netzhierarchie, mit Schienenwegen)

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- Die Umgrenzung:
  - Rückhalte-Anlagen und Ausschlussflächen auf der Fahrbahn
  - Träger von die Automatisierung unterstützenden Einrichtungen (für digitale Leiteinrichtungen)
  - sowie Emissionsschutz-Anlagen
- Die Umgebung:
  - Nutzungsstruktur des Mobilitätsbedarfs und der Verkehrserzeugung entlang des Fahrweges
  - Quelle von Interventionen verschiedenster Art
  - Standorte von Sensibilitäten bei mangelnder Abschottung
- Die Umstände:
  - Zeitabhängiger Level of Service (A bis F) im Richtungsverkehr des Laufweges
  - Fahrzeug-Mix nach typischen Zeitfenstern (zu den Spitzen, Anteil Schwerverkehr)
  - Exogene Beeinflussung der Befahrungsbedingungen (Witterung, Fahrbahngriffigkeit, Sichtverhältnisse, Querverkehre und „Merging“ unterschiedlicher Mobilitätsgruppen)
- Die Umwelt:
  - Bevorzugung oder Kontingentierung von Verkehrsbewegungen durch bestimmte Fahrzeuge aus Gründen der Immissionsbegrenzung, der Stauvermeidung oder/und der Verkehrssicherheit
  - Gebote oder Verbote des Wirksamwerdens gewisser Automat-Funktionalitäten in bestimmten Zonen vorherrschender Flächennutzung bzw. in Abschnitten der Straßennetzhierarchie (wie in Fußgängerzonen, Wohnanliegerstraßen, Anlieferzonen, Vorfahrten oder in Stellplatzanlagen)

3 DIE STADTLANDSCHAFT ALS SZENERIENBILDENDE AUSGANGSBEDINGUNG

3.1 Konstitutive Ausgangsbedingungen für die Implementierung automatisierten Straßenverkehrs

3.1.1 Die landschaftlichen Gegebenheiten als Rahmen der Verkehrserschließung

Eine kaum noch aufgegriffene Forschungsfrage ist die der naturgegebenen Disposition von Siedlungsräumen für die Implementierung von automatisierten Verkehrsabläufen. Für die Technologieentwicklung der Fahrzeugindustrie ist diese Fragestellung zunächst von geringer Relevanz. Erst nach einer technologischen Ausreifung, die die Einsatzfähigkeit solcherart ausgestatteter Kraftfahrzeuge unter Beweis stellen sollte, wird in Hinblick auf die Verkehrstauglichkeit in Verkehrsräumen bei der Testung unter realen örtlichen und regionalen Randbedingungen diese Thematik schlagend werden.

Ausgehend von einer großräumigen Betrachtung der geländemorphologischen Bedingungen in Europa bieten die Flachländer gänzlich andere siedlungs- und verkehrstopographische Voraussetzungen für die Automatisierung als zum Beispiel Schichtstufenlandschaften, Alpenländer oder Steilküstenregionen. So zeichnet Flachländer im Allgemeinen eine siedlungsräumliche und verkehrsinfrastrukturelle Großzügigkeit aus, die sich in einer im Wesentlichen berechenbaren Geometrie der Trassenführungen, einer gewissen Regelmäßigkeit in der hierarchischen Netzgestaltung und einer gewissen Gleichmäßigkeit in den Kapazitätsparametern der Verkehrswege niederschlägt. So sind die Voraussetzungen im Talkessel von Stuttgart andere als wie in der Ebene der Stadtregion Hannover. Es mag kein Zufall sein, dass die Erwartungen an die Einsatzmöglichkeiten autonomisierter Fahrzeuge von der Verkehrstopographie beeinflusst differieren und auch die Forschungsschwerpunkte dazu geographisch unterschiedlich verteilt sind. Natürlich spielt die Nähe zu den Standorten der Automobilproduktion auch herein, wo solche Forschungen betrieben werden.

3.1.2 Die Geoinformation als Unterstützung automatisierter Verkehrsabläufe

Eine Herausforderung wird die Erstellung exakter Karten des zugrunde liegenden Geoinformationssystems darstellen, ob sie nun als Datenbank on-board eingespeichert oder via WLAN in Echtzeit übertragen werden sollen, weil dabei nicht nur die Fahrwege cm-genau geodätisch in 3D aufgenommen werden müssen,

sondern auch die Umgebungssituation in geeigneter Realitätstreue dargestellt und auch risikobewertet werden sollte. Dabei werden sowohl die zur Laufwegbahnung notwendigen Detektionsräumen, die sich nicht allein auf die Umgrenzungen der Fahrbahn beschränken lassen, als auch die auf den Straßenraum natürlichen Einwirkungen (z.B. Schattenwurf und wechselnde Fahrbahngriffigkeit) und allfällig menschlich ausgelösten Interventionen, etwa im Umkreis von ÖV-Haltestellen, zu berücksichtigen sein. Das geodätische Koordinatensystem wird mit „schiefen Ebenen oder ungewöhnlichen sphärischen Winkeln“ bei der Detektion zu tun bekommen und die Prädiktion wird dazu die Dynamik der sich annähernden Fahrzeuge bzw. Bewegungskörper zu berechnen haben, damit eine Risikoeinschätzung möglich wird und die Steuerungshandlungen darauf ausgerichtet werden können. Dabei geht es aber nicht nur um die Prognose eines potenziellen Konfliktpunktes, sondern auch um die Schadensrisiken in Hinblick auf die kinetischen Massen der Fahrzeuge als Bewegungskörper einerseits und die Verletzlichkeit der Interakteure andererseits.

3.1.3 Das Kraftfahrzeug als Bewegungskörper im Verkehrsgeschehen

Der Stadtverkehr ist geprägt von einer bunten Mischung an Kraftfahrzeugen, die sich nicht nur nach Gebrauchstypen bzw. Fahrzeugklassen unterscheiden, sondern auch nach Leistungsklassen der Marken und Modelle. Ihr Einsatz wird unter den Bedingungen beengter Fahrwege und gedrängter Verkehrszustände bei der Generierung von Szenen und der Konstruktion von Szenarien in Abschnitten des Straßennetzes, hier als Interaktionsboxen bezeichnet, noch besonders zu berücksichtigen sein. Schließlich ist auch für die Zukunft keine Vereinheitlichung des Fahrzeugbestandes beschränkt auf wenige Standardtypen zu erwarten. Somit wird dem „Eigenleben“ und der Konditionierung des automatisierten und letztlich autonomisierten Kraftfahrzeugs besondere Aufmerksamkeit zu widmen sein.

3.2 Anschauungsbeispiele für herausfordernde Szenerien

3.2.1 Die Modellstadt als Anwendungsfall: La Défense im Nordwesten von Grand Paris

Eine Fülle von Herausforderungen wie auch von Optionen bieten sich am Anschauungsbeispiel La Défense, einem aus der Kernstadt Paris in den nordwestlichen Vorstädtegürtel auf den Gemeindegebieten von Courbevoie, Nanterre und Puteaux ausgelagerten Büroviertel für Konzernsitze, für automatisierte Verkehrsabläufe dar. Dort wurde nach dem städtebaulichen Leitbild der Charta von Athen, die nach dem Zweiten Weltkrieg den Wiederaufbau und die Restrukturierung der europäischen Städte wesentlich geprägt hatte, eine nicht nur horizontale, sondern in Bezug auf Basisfunktionen des Verkehrs und der Versorgungsdienste vertikale Funktionstrennung auf mehreren Ebenen vorgenommen.

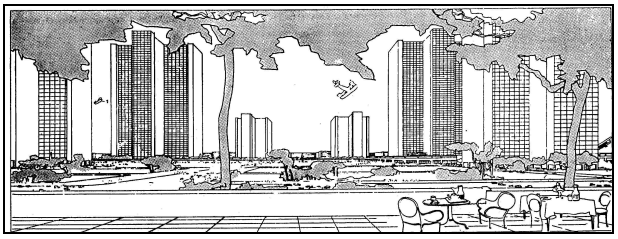

Abb. 7: Die Stadtvision „La Ville contemporaine“ von Le Corbusier 1925 vor der Automobilisierung in Europa, Abb. 8: Die Umsetzung des städtebaulichen Konzepts der Charta von Athen (Le Corbusier et al. 1941) ab den 1950er Jahren am Beispiel von La Défense im Vorstadtgürtel von Paris (Bild September 2019)

Dieses geradezu babylonische Stadtgerüst ist kaum wandlungsfähig, geschweige den umbaubar. Jeder technologische Wandel in der Mobilitätsinfrastruktur wird sich daran orientieren müssen, sodass sich die Immobilienbetreiber samt ihrer privat bewirtschafteten Infrastruktur, wie Tiefgargagen und unterirdische Anliefer- und Vorfahrtbereiche, die Verkehrsträger des allgemeinen Straßenverkehrs und des Öffentlichen Verkehrs eng abstimmen müssen, wenn eine Teilautomatisierung der „Letzten-Meilen-Verkehre“ angestrebt werden sollte. Verschiedene Leit- und Lenkungssysteme werden auf ihre Machbarkeit und Praxistauglichkeit in den betonbunkerartigen Räumen oft abseits des Tageslichts und im Funkschatten zu prüfen sein. Jenseits technologischer Lösungen wird sich das Erfordernis zur Standardisierung ergeben, denn eine Vielzahl proprietärer Lösungen auf engstem Stadtraum wäre problematisch im täglichen Stadtbetrieb zu praktizieren.

Bleibt schließlich die Fußgängerebene an der Sonne. Dort werden autonom fahrende, elektrisch betriebene „Navettes“ daraufhin getestet, ob sie als Zubringer lange Fußwege vermeiden helfen, ohne von Passanten in

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ihrer Fahrt zu sehr gestört zu werden und auch umgekehrt, wenn reservierte Bewegungsflächen für autonome Fahrezeugbewegungen nicht in Frage kommen sollten.

Abb. 9 - 11: Die Gürtelstraße rund um La Défense sammelt und verteilt den bunten Mix an Kraftfahrzeugen, die auf den Tiefebenen ihre ersten und letzten Meter fahren, halten oder parkieren. Die Esplanade für Fußgänger ist strikt fahrzeugfrei. Abb. 12: Die Bürostadt ist eine der langen Fußwege sowohl von den Tiefetagen (rolltreppengestützt) herauf als auch an der den Menschen vorbehaltenene Oberfläche. Fahrzeuge und mobile Dienste, noch dazu autonom sich bewegend, dort zuzulassen, wäre ein Tabubruch. Der Probebetrieb stellt also nicht nur technologisch, sondern auch ideologisch ein heikles Experiment dar.

3.2.2 Die wachsende Stadt in epochetypischen Sequenzen: Beispiele aus Innsbruck-Hötting West

Die Abbildung 13 zeigt anhand des permanenten Stadterweiterungsgebietes im Nordwesten der Tiroler Landeshauptstadt Innsbruck diese kleinräumige Vielfalt an verkehrsinfrastrukturellen Randbedingungen auf, wobei nahezu jede dieser verkehrsfunktionellen Flächenkategorien spezifische Einsatz- und Ausschlussgründe als Szenarien für Automat-Modi mit sich bringen könnte. Sei es nun in Hinblick auf die Verkehrsabwicklung am Fahrweg selbst oder wegen mehr oder minder unvermuteter Interventionen an Mobilitätsbewegungen aus dem „Hinterland“ der städtebaulichen Nutzungsstrukturen aufgrund von heiklen mobilitätsauslösenden Standorten, wie Schulen, Sportplätzen, Seniorenresidenzen, Einkaufszentren oder Universitätsgebäuden, die sich dort im Stadtteilzentrum befinden. Sie bilden einen festen Rahmen an exogenen Randbedingungen für die Mobilitätsausübung. Die Gartenstadt-Siedlung hatte zeitbedingt in ihrer Konzeption noch gar keinen individuellen Autoverkehr gekannt und weist daher ein flächensparendes Wegenetz auf, das heute im Mischverkehr benutzt wird. In den 1960/70er Jahren wurden die Autoabstellplätze ins Vorfeld der Wohnanlagen (offen oder in Garagenzeilen) gestellt, in den darauffolgenden Jahrzehnten jedoch in Tiefgaragen oder auf Parkdecks verbannt, um die innere Erschließung der Wohnquartiere vom Fließverkehr frei zu halten. So tauchen zahlreiche Tiefgaragen-Ausfahrten aus dem Untergrund auf, aber das innere Wegenetz muss dennoch für Service-Fahrten oder als Feuerwehrzufahrt befahrbar bleiben. Die kollektive Stellplatzbewirtschaftung auf getrennten Ebenen erleichtert zwar die Einrichtung automatisierter Abläufe, würde aber die Betreiber der Wohnanlagen oder der Arbeitsstätten (wie die Universität) in die Pflicht nehmen, ihre Stellplatzanlagen dahingehend auszurüsten.

3.2.3 Automobilisierung im historischen Korsett einer modernisierten Gartenstadt

Zoomt man in das Stadterweiterungsgebiet hinein, nämlich diesfalls in die Pioniersiedlung, stellen sich kleinräumige Szenerien dar, die eine Fülle von Detailfragen zu alltäglichen Szenen offenbaren. Diese Quartiersstruktur ist sozusagen die antithetische Analyse zu den gigantomanischen Bildern aus La Défense zuvor. Aber beiden Anschauungsbeispielen ist gemeinsam, der „Teufel sitzt im Detail“! Kennzeichnend für die Siedlungsgenossenschaft sind das „unvermehrbare“ gemeinschaftliche Wegenetz als Anwohnerzone mit Tempo 30 km/h reguliert und die dichte Abfolge von Hauszugängen und Gartenzufahrten (s. Abb. 14).

Die Modernisierung der Wüstenrot-Musterhäuser hat den Stellplatzbedarf beinhaltet, der notgedrungen auf der Parzelle seitlich oder rückwärtig untergebracht werden musste. Nur, wenn Grundstücke zusammengelegt wurden, konnte eine gemeinschaftliche Stellplatzanlage im Zuge dessen eingerichtet werden. So bunt sehen die Lösungen nun an den Quellen und Rückkehr-Zielen täglicher Kfz-Fahrten aus. Daran knüpfen sich Fragestellungen trivialer Art, wie: Gilt hier der Rechtsvorrang? Wohin reicht der Detektionskegel zweier herausfahrender Kfz? Wie sieht die initiale Programmierung auf den verschiedenen Automat-Levels und Kfz-Modellen dafür aus? Welches Kfz mit welchem Ausstattungsprofil beansprucht Vorrang oder verzichtet auf Vorrang? Kann mit Interkonnektivität die Rangfolge entschieden werden? Hat das minderausgestattete Kfz jedenfalls Vorrang oder ist das Einfädeln in die gemeinsame Ausfahrt auf jeden Fall mit Nachrang belegt? Wird in solch beengten atypischen Szenerien gar die Automatisierung auszuschalten sein und die Human-Steuerung als Gebot vorgeschrieben werden? Oder braucht es Lichtschranken oder gar eine GPS-

Ortung, die jedoch in der Tiefgaragenausfahrt Schwierigkeiten hätten? Was könnten daher die unaufwändigsten Mittel sein, diese trivialen Situationen zu meistern, wenn Kfz autonomisiert werden sollen?

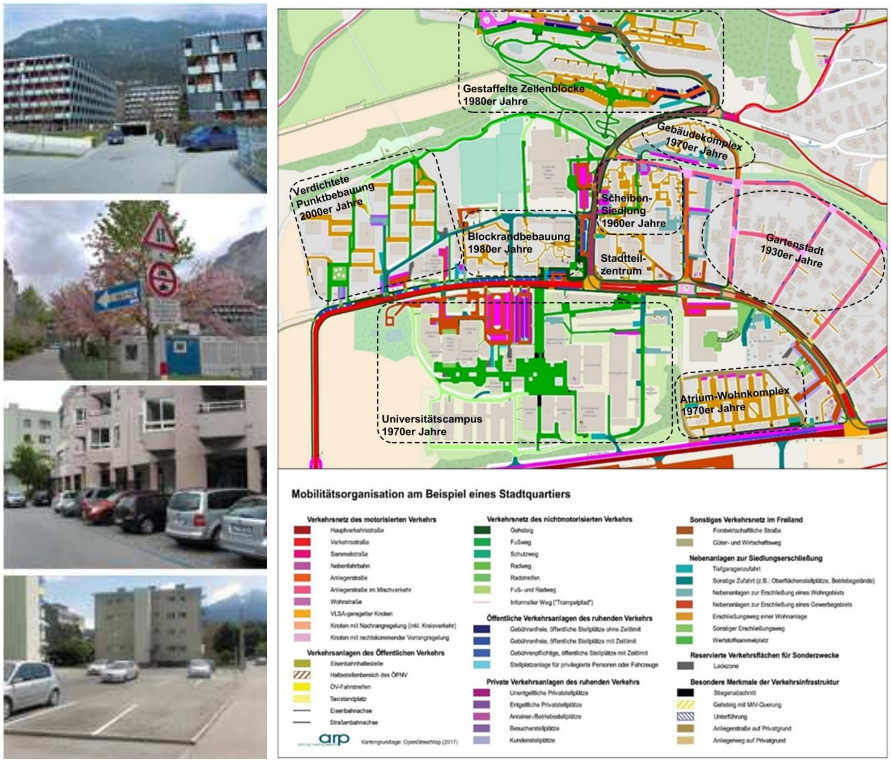

Abb. 13: Die vielfältige Verkehrsflächenorganisation des Stadterweiterungsgebietes Innsbruck Hötting-West mit den siedlungshistorischen Quartieren und ihren Erschließungskonzepten für den Kfz-Verkehr von den 1930er Jahren bis heute (Quelle: Transforming Cities, 3/2017, 50)

Abb. 14: Die Umbaustadien der Wohngebäude (oberes Bild: grün: weitgehend original, dunkelrot: neu verdichtet errichtet mit dem Bedarf einer kollektiven Stellplatzanlage) und Erschließung der Wohngebäude (rote Pfeile Stellplatzausfahrt, blaue Pfeile Hausausgänge) als Unsicherheitsfaktor für Fahrzeugbewegungen im engen Straßenraum und als Datenschutzproblem für die Privatsphäre der Anwohner. (Quelle: Transforming Cities, 2/2016, 13)

Abb. 15 & 16: Das genossenschaftliche Wegenetz ist beruhigte Wohnanliegerstraße. Die Lösungen für die Kfz-Hinterstellung sind von bunter Vielfalt und schwer einsehbar, gleichwohl ist der tägliche Kfz-Gebrauch hier allgegenwärtig.

3.2.4 Schnittstellen im urbanen Straßennetz am Beispiel A59-Exit 11 nach Duisburg-Zentrum

In der Stadt Duisburg verläuft eine Transitautobahn zwischen dem Stadtzentrum westlich und dem Hauptbahnhof östlich in unterfluriger Trassenlage, dennoch weist die Autobahn etliche Anschlussstellen zur Erschließung der inneren Stadtgebiete auf. Diese Nahtstelle könnte eine Herausforderung für die Automatisierung des Fahrbetriebs werden. Generell weist das hierarchisch organisierte urbane Straßennetz

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an den Übergängen zwischen den funktionellen Straßenkategorien zahlreiche Schnittstellen auf, die im Fall einer Automatisierung der Verkehrsabläufe regulatorisch und technologisch bewältigt werden müssten. Dabei wird die Harmonisierung durch die Straßenverkehrsgesetzgebung und die gebietskörperschaftliche Verkehrsplanung unausweichlich sein. Gegenwärtig werden als Einstieg in diese technologische Epoche die Autobahnen neben den in proprietärer Verantwortung stehenden isolierten Verkehrsanlagen („off road“) favorisiert. Autobahnstrecken durchziehen als Achsen und umfassen als Gürtel die Ballungsräume mit einer dichten Abfolge von Exits. Unter den häufig beengten Verhältnissen sind Abweichungen von den idealen Trassierungsparametern bei der Ausfädelungsspur und den Bogenradien oft nicht vermeidbar. Der Übergang von autonomisierten Fahrbewegungen auf die herkömmliche Fahrzeugsteuerung durch einen Fahrzeugführer unterstützt von ADAS (= Advanced Driving Assistance Systems) wird dadurch zeitlich und laufwegmäßig empfindlich eingeschränkt. Schließlich werden die menschliche Reaktionszeit und die Übernahmebereitschaft Kriterien für die Generierung von Szenarien in einer solchen „Human-Machine-Interaction“ (HMI) darstellen. Die hohe Anfahrgeschwindigkeit verkürzt zudem die Reaktionswege.

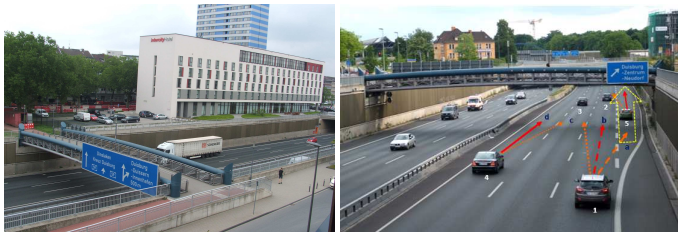

Abb. 17 & 18: Die Transitautobahn A 59 zwischen Duisburg-Hauptbahnhof und Exit 11 ins Zentrum verläuft tieferliegend, stellt aber einen „Emissionskessel“ dar. Die klare Umgrenzung würde einem geleiteten automatisierten Fahrbetrieb entgegenkommen, die Schnittstelle (Übergang als gelber Pfeil, Fahroptionen als Pfeile in rot und orange nach Häufigkeitswahrscheinlichkeiten dargestellt) zum städtischen Straßennetz mit der Etagenauffahrt müsste im Zuge einer „Human-Machine-Interaction“ aber bewältigt werden.

Die Szenerie widerspiegelt durch den Etagensprung die strikte funktionelle Trennung der Verkehrsflächenorganisation zwischen den Daseinsfunktionen der Stadt und dem Transit- und Schnellverkehr. Die Umgrenzung schottet gegenseitige Interventionen weitgehend ab, es sei denn, kriminelle Aktionen oder höhere Gewalten werden wirksam. Abseits von städtebaulicher Kritik an solchen Situationen sind recht klare Verhältnisse für automatisierte (d.h. mit Fahrerverantwortung) oder autonomisierte (d.h. ohne Fahrerverantwortung) Fahrzeugbewegungen gegeben, weil die Kraftfahrzeuge als Mitspieler auf dem Spielfeld Fahrbahn (= Umfeld) als Verkehrsteilnehmer unter sich bleiben und die Straßenanlage günstige Voraussetzungen für die Installierung von steuernden Leiteinrichtungen anbietet. Dazu müssten sich allerdings dafür ausgestattete Kfz in das externe Steuerungssysteme für diesen Straßenabschnitt ausnahmslos einklinken. Das würde sodann den Ausschluss ausrüstungsbedingt nicht kompatibler Fahrzeuge auf diesem Streckenabschnitt bedeuten. Des Weiteren werden sich Schnittstellen mit der herkömmlichen Fließverkehrsabwicklung im Stadtstraßennetz an den Exits ergeben, wo die systemaren Übergänge, wie die Übergabe der Lenkerverantwortung an den Fahrzeugführer, eingerichtet werden müssten. Was aber, wenn dieser nicht in Sekundenschnelle übernimmt, wie vom Automat-System aufgefordert, weil er sich gerade mit Wichtigerem beschäftigt hat? Werden für solche Fälle einer verspäteten Übernahme Nothalteflächen angelegt werden?

Leitet man aus dem Bild „Ausfahrt in das Stadtstraßennetz“ mit einer zufälligen Ausgangssituation nun eine Szenen-Generierung ab, so offenbart sich selbst bei einer konfliktarm erscheinenden Anfangsszene die Komplexität der optionalen Handlungsabläufe in den Interaktionen zwischen den fünf Fahrzeugen des Zufallskollektivs. Angemerkt sei, dass es sich um einen Zeitpunkt des vormittäglichen Sonntagsverkehrs gehandelt hatte, woraus sich der „entspannte“ Verkehrszustand (ca. Level of Service B) erklärt. Dem gerade heranfahrenden Kfz (1) auf dem rechten Fahrstreifen bieten sich die Optionen Ausfahrt ansteuern (a), gerade auf der Spur weiterfahren (b) oder auf den mittleren Fahrstreifen schwenken (c), um am voranfahrenden Pkw (2) vorbeizufahren, sollte dieser langsamer fahren als sein Nachbar am mittleren Fahrstreifen (3). Werden die prinzipiellen Handlungsoptionen noch um „Eventualitäten“ erweitert, könnte das der Ausfahrt zustrebende Fahrzeug (5) „es“ sich anders überlegen und wieder auf den Richtungsfahrstreifen hinüberschwenken, was „es“ darf, solange keine Sperrlinie durchgezogen ist. Oder das Kfz auf der „schnellen“ Spur (4) könnte auf den mittleren Fahrstreifen wechseln, weil „es“ beabsichtigt, den übernächsten Exit (A59-12) zu benutzen.

4 FAZIT FÜR DIE MASTERPLANUNG UND KONSTRUKTION VON IN-SITU-SZENARIEN

Resümierend kann anhand der herausgegriffenen Anschauungsbeispiele festgestellt werden:

- Die Szenerien sind trotz ihrer Vielfalt und mit ihren Abweichungen in der örtlichen Ausprägung dennoch typologisch aufgrund der stadtteilfunktionellen (Umgebung), verkehrsorganisatorischen (Netzhierachie) und topographischen Charakteristiken (Trassierung) nach Ähnlichkeit einordenbar.
- Gleichzeitig muss aber bei aller Ähnlichkeit dieser „Interaktionsboxen" den spezifischen Ausprägungen sowohl der statischen Verkehrsanlage als auch dem ortstypischen Verkehrsaufkommen im Zeitablauf Beachtung geschenkt werden, um realistische Szenarien zu generieren, anhand derer Testanordnungen und Prüfroutinen abgeleitet werden können.
- In Stadtgebieten ergeben sich zahlreiche Nahtstellen zwischen den Bewegungsräumen der Mobilitätsgruppen (wie Bordsteinkanten, Fahrstreifenteiler und zugewiesene Verkehrsflächen) und Schnittstellen, die Übergänge im Verkehrsverhalten und in der technologischen Unterstützung der Verkehrsteilnahme bedingen. Diese kritischen Orte sind auf ihre Disposition in Hinblick auf eine weitgehende Automatisierung des Verkehrsgeschehens zu identifizieren, um Kosten, Nutzen und Risiken abschätzen zu können.
- Hoch technisierte Verkehrsabläufe sind anhand von situativen Außergewöhnlichkeiten zu bewerten, wie das bei der Dimensionierung technischer Lösungen (wie bei der Statik von Bauwerken oder der Kollisionsfestigkeit von Fahrbetriebsmitteln) üblich ist und vorgeschrieben wird. Gewöhnlichkeiten bilden den Nutzen ab, Außergewöhnlichkeiten zielen auf die Verlässlichkeit ab. Dabei könnte es bei der Einführung und Zulassung von Automat-Funktionen im Kraftfahrbetrieb noch Aufholbedarf geben.
- Wie erwähnt werden Schnellverkehrswege als Hoffungsträger für die Verbreitung von Technologien zur hoch automatisierten Verkehrsabwicklung angesehen, darob darf die gesamte alltägliche Wegekette von Kfz-Fahrten nicht ausgeblendet werden (durchschnittlich ca. 42 km Pkw-Tagesfahrleistung, davon vermutlich nur wenige Kilometer auf einer prinzipiell dafür ausrüstbaren Autobahn).
- Einer der Knackpunkte wird der Umgang mit den Fahrmanövern auf den ersten und letzten Metern darstellen, weil sie entweder weitgehend durch autonomisierte Fahrzeugbewegungen abgelöst werden können (Gateway zu beschränkt öffentlichen Verkehrsanlagen) oder aber je nach örtlicher Situation weitgehend ausgeschlossen bleiben, um die uneingeschränkte Lenkerverantwortung zu wahren (z.B. in einer Wohnanliegerstraße).

In klar geordneten Szenerien ist eine örtlich begrenzte Übergabe der Lenkerverantwortung an ein externes Lenkungssystem, das die Fahrzeugbewegungen der Kfz-Kollektive gegeneinander abgestimmt außensteuert, vielleicht in längerfristiger Zukunft ein Thema. Dabei werden jenseits der technischen Machbarkeit die ambivalenten Effekte in Hinblick auf Verkehrssicherheit (vermutlich positiv), die Kapazitätsausnutzung der Fahrwege (vermutlich moderierend), die Emissionssituation (vermutlich ausgeglichener und an Grenzwerten orientiert), die freie Benutzbarkeit des Fahrweges (vermutlich eingeschränkter) und die Zugänglichkeit des Erschließungsgebietes (möglicherweise mit Kontingentierung des Zuflusses in das Stadtzentrum) politisch abzuwägen sein. Das bedeutet, die involvierten Stakeholder sollten sich zeitgerecht miteinander im Rahmen einer landesweiten Mobilitätsstrategie mit solchen Szenarien in raumtypischen Szenerien abstimmen, also der Fernstraßenbetreiber (die Landesstraßenverwaltung bzw. künftig die Bundesautobahngesellschaft), der kommunale Straßennetzbetreiber, der/die Mobilfunknetz-Provider und die Verkehrsdiensteanbieter u.a.m. Schließlich ist die Beteiligung der ansässigen Bürgerschaft und Wirtschaftstreibenden bei der Masterplanung Mobilität heute nicht mehr wegzudenken. Es wird viele Schnittstellen nicht nur automobil-technologischer, sondern auch verwaltungsübergreifender und subsidiär-demokratischer Art zu bedienen geben.

5 QUELLENHINWEISE

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Innovative Sustainable Energy Solutions in Smart Cities

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1 ABSTRACT

Rapid urbanization poses multiple environmental and social risks. More than half of the world's population lives in cities today, and cities account for two-thirds of global energy demand and around seventy percent of global CO2 emissions. Energy management in urban agglomerations becomes a strategic factor in the process of decarbonization of global economy. Digitization offers some revolutionary solutions for sustainable energy transition and enhancing energy efficiency. The most important concepts are Smart City, Smart Grid and Smart House. The general objective of the present research is to verify if new technologies, promoted by digitization, could remedy the negative impact of urbanization on the environment and to estimate how significant their contribution could be.

Keywords: smart city, smart grid, digitization, energy efficiency, smart house, sustainable energy transition

2 CHALLENGES AND OPPORTUNITIES OF URBANIZATION

2.1 Demographic and economic trends

The process of urbanization has significantly accelerated in recent years. Over a period of just 118 years the speed of urbanization has quadrupled.The last jump, from 13 percent of urban population in 1900 to 55 percent in 2018, owes something to science and technology. The world's population has been experiencing rapid urbanization since 1950. By 2050, 101 countries should have more than 80percent of the urban population, which is opposite to the overall distribution of rural-urban populations in the mid-20th century (UN DESA, 2018).

Apart from a high speed, the process of urbanization has obtained some new features not to be underestimated. First of all, when it comes to the phenomenon of urbanization, it no longer refers to megacities with more than 10 million inhabitants. Inspite of being financial and cultural centers, megacities do not more represent the majority of the urban population and are not the fastest growing urban centers. Small and medium - sized cities currently account for about 58 percent of the world's urban population and are growing at faster rates (UN DESA 2018). In such a context it becomes appropriate to talk about crucial role of urban agglomerations in sustainable development of rural neighbourhoods, especially in the countries where the percentage of rural population remains high. The second significant feature of modern urbanization is that it is not more closely linked to the industrialization process and economic growth and sometimes is rather associated with unbearable and health-damaging living conditions. The reason for this is that most of rapidly urbanizing countries belong to the middle-high income countries, like Brasil, China, Iran or Mexico, or even low-income countries, like Nigeria or The Democratic Republic of Congo. More than 90 percent of future urban population growth is expected to be in low- and middle-income countries (UN-Habitat, 2016). Many of the small and medium-sized cities do not have the technical capacity to conduct such an important urban development process and suffer from unintended difficulties (e.g.: climate change) without being able to take preventive measures, thus impeding their planning capacity. As a result, the ability of urban governments to protect both natural resources and the rights of their citizens is severely limited. Such areas carry significant risks, but they also represent the greatest opportunities for future greenhouse gas emission reductions, because their form and urban infrastructure have not been already established.

2.2 Environmental issues and international urban cooperation

Elaboration of a new urban model to implement in rapidly growing cities all over the world becomes a crucial factor in a fight against climate change. The scale of contemporary urbanization is now so large that it affects global resource flows and global cycles. Urbanization affects the entire planet, not just urban areas. Through networks of exchanges, migration and infrastructure, cities are influencing the natural environment far beyond their surface. The damage caused by uncontrolled urbanisation increases proportionally in the context of media- and low-income countries, where environmental standarts are insufficient. Rapid urbanization is leading to sustainability problems linked to segregation and rising social tensions, congestion, air pollution, waste, and the high consumption of energy and materials, often inefficient. According to the

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most recent report on the use of renewable energy in the city, produced in 2019 by the International Association for the Development and Promotion of the Use of Renewable Sources, cities account for 65 percent of total global energy demand and 75 percent of global CO2 emissions (REN21, 2019). Such a significant carboon footprint of the cities is caused by a strong dependence of urban economies on energy sector, which over the past 10 years has remained the largest contributor to emissions over any other sector (IPCC 2014). In the nearest future global energy consumption is destined to grow. Most of this growth is expected to come from non - OECD countries, and especially from the countries where energy demand is driven by strong economic growth, in particular in Asia. Emerging economies' cities with a population growth of more than 2 percent per year, for example, are expected to account for 70 percent of global growth in energy consumption by 2030 (IRENA 2019). At this point, implementation of innovative sustainable energy tecnologies in urban areas could become a key to decarbonising the global economy.

Such a point of view is commonly shared by the international cooperation bodies. Thus, even in one of the first declarations of the UN on sustainable development "The Future We Want" (A/RES/66/288) in the point 128 the need for energy efficiency measures in urban planning was highlighted (UN Rio +20, 2012). Eventually a significant role in the urban energy transition was occupied by the innovative technologies. Thus, in the New Urban Agenda, signed during the United Nations Conference on Housing and Sustainable Urban Development - Habitat III in 2016, smart grids, district energy systems and community energy plans are seen as the key tecnologies to successful adoption of sustainable renewable energy in end-use sectors[1] and for improvement of synergies between renewable energy and energy efficiency (UN-Habitat, 2016). On the non-governmental level two key international organizations dedicated to sustainable urban development are to be mentioned: C40 and Global Covenant of Mayors. The C40 is a network of megacities around the world, committed to tackling climate change. C40 enables cities to collaborate effectively, share knowledge and promote meaningful, measurable and sustainable actions on climate change. According to the 2017 annual C40 report, cities have the potential to contribute to more than 40 percent of the emission reductions needed to fulfill the Paris deal's highest ambitions and avoid climate change (C40, 2017). The C40 Cities Finance Facility provides intensive technical assistance to project preparation for C40 cities in developing countries. The promotion of the use of renewable energies is considered as one of the priority activities of C40. In 2017, the Clean Energy Network was established by the C40 to support the efforts of member cities to plan and implement initiatives in order to increase the supply of low-carbon energy. Member cities have shown an interest in starting to use a wide range of renewable energy sources on and off site to provide energy for residential, commercial and municipal buildings. Another important C40 project is the "C40 Cities Bloomberg Philanthropies Awards". The awards are granted annually in five categories, including Cities4Energy, dedicated to the application of energy efficiency technologies and the use of renewable energy in the cities of the United States and the world (City4Energy US and City4Energy Global) . The awards provide global recognition for cities that are demonstrating the leadership in the fight against climate change by implementing high tecnologies.

The Global Covenant of Mayors for Climate and Energy (GCoM) is the largest global coalition of cities and local governments committed voluntarily to actively combating climate change and moving towards a low-carbon, climate-resilient economy. Established in 2016, it is aimed to adress three key issues: climate change mitigation, adaptation to the adverse effects of climate change and universal access to safe, clean and affordable energy. The three GCoM initiatives address the vital need for research, innovation, technical assistance and intelligence in urban areas to push the signatory cities to contribute to a global climate solution. These initiatives, Innovate4Cities, Data4Cities, and Invest4Cities, focus on developing the next generation of knowledge, data, tools, and technical support, through which local politicians can address the challenges of sustainability (GCoM, 2018).

3 ENERGY MANAGEMENT IN SMART CITIES

3.1 The concept of Smart City

Even if having a noticeable carbon footprint, cities, at the same time, are the centres of technological innovation and scientific research. Strengthening links between cities and education institutions have led to rapid technological progress in urban areas. So the phenomenon of digitization has arisen, characterized by

[1] Residential, commercial and industrial buildings, industry, transport, waste and sanitation

some scientists as the fourth industrial revolution because of the amount of changes that it's bringing. One of the most significant ones is those of Smart Cities. Being launched as an experimental project realised by IT industry giants Cisco and IBM, it became, in 2020, a rather social phenomenon, shared in real time by users of different digital services. Many cities claim to be smart. The phenomenon of smart cities was formed by several technical concepts. Among them are: Information and Communication Technologies (ICT), Smart Grid technologies, the Internet of Things (IoT), and the technologies that are encouraged to increase energy efficiency in buildings, combined under the category of Smart House. The main feature which distinguishes a smart city from a traditional model of urban agglomeration is a presence of an additional digital layer over the urban infrastructure. This digital layer provides an interconnectivity and a big range of new services, delivered through multiple apps.

The first generation of Smart Cities is represented by the cities built from zero by the giants of the Industry 4.0, such as IBM and Cisco. Smart Cities have been projected as technological and efficient cities, designed to attract innovators and become the centres of technological progress. Technology solutions for the first-generation smart cities were imposed by IT multinationals Cisco and IBM and were designed mostly as commercial products. The general concept of Smart Cities is hiding behind the two first large-scale smart city projects: Maasdar City (UAE) and in Songdo (South Korea). The main difference which Both first-generation smart cities were developed near international airports and modern megacities with a common incentive not only to promote an innovative urban infrastructure model, but also to attract the "smart" citizens from different countries around the world. The second objective, despite significant investments, has not been achieved. The possible reasons are in the exclusion of the social factor from urban development strategies and in high costs of living. Despite these social disadvantages, the first generation of smart cities models have demonstrated the successful implementation of innovative solutions in the framework of a sustainable energy in urban areas.

A rapid spread of smart cities has provoked a huge debate in the academic world. While in the early 21st century the concept was precepted as "the rationalization of the city through technologies" (Graham, Marvin, 2001), over the years the concept became increasingly focused on improving the quality of daily life of the citizens, exploiting the benefits of ICTs and the capabilities of sensors built into urban infrastructure to optimize the management of electricity, transport, and other logistical operations (Chen 2001, Pardo 2011). In the coming years, science begins to talk about human capital as a significant factor in smart cities (Caragliu 2012), making the concept increasingly focused on well-being of the citizens (March 2016, McKinsey Institute 2018) and the environmental aspect of smart cities (Zygiaris 2013). Such an overview corresponds to the second generation of smart cities.

Unlikely to the first-generation, the implementation of projects in the smart cities 2.0 is conducted by local authorities, with a steady increase in the participation of citizens, who represent the main target group for the implementation of services. Adoptation of innovative technologies in the context of already existing infrastructures is a key characteristic of a new generation of smart cities. So very often it appears in practice in the framework of urban requalification programmes and individual Smart Home buildings. main factor making smart cities a key solution for global sustainable development is the implementation of innovative solutions for sustainable energy, among which Smart Grid and Smart Building are the most important.

3.2 Smart Grid and renewable energy manageent

Traditionally, the energy was centrally produced by large power plants, and was then transmitted to cities and then distributed to different consumers, such as: households, companies or service providers. This corresponds to a linear progression from centralized production to decentralized distribution. The main problem with these systems is their inflexibility and rigidity, which create difficulties in accommodating the highest levels of energy produced from multiple sources. Traditional centralized systems of electricity distribution do not allow the small quantities of energy to be counted. Such respectively small quantities often are lost due to unefficiency of the system of electricity ditribution. However, this landscape is changing rapidly at all stages of its supply chain: the production process is shifting from centralized to decentralized generation. Smart grid offers an effective solution for a decentralized energy distribution in urban areas by implementation of ICT and IoT tecnologies. In contrast to centralized systems, Smart Grid tecnology allows a complete inclusion of all electricity producers, independently from the amount of energy produced. All the quantities of energy distributed within a Smart Grid together form a unique network where

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all producers interact with each other. Communication between the producer and the consumer of energy becomes bilateral. Thanks to the Smart Grid technology, the energy generated in individual households can also be restored to the network. In such a framework consumer transformes into a so-called “prosumer” of electricity.[2]

A Smart Grid technology opens up great prospects for the introduction of renewable energy sources in the modern urban energy infrastructures, reducing costs for consumers and making renewable sources for energy production more competitive (Mommoh, 2012). This technology adresses both two main obstacles for a widespread of renewable energy transition. First of all, since renewable energy is nature-based, it results impossible to maintain a constant electrical voltage all the time, as it occurs in case of traditional power plants. The amount of energy produced depends on weather and climate conditions. Due to this factor it becomes impossible to maintain a constant voltage in the electrical network, which is a necessary condition for the correct operation of most electrical appliances. Smart Grid, being a flexible system, offers an effective solution to this problem, providing the use of energy from different sources at the same time in order to maintain a constant electrical voltage. The second obstacle for renewable energy widespread comes from the first one. Such inconsistency in power generation causes the need for powerful batteries, which costs often exceed the cost of the power plant itself. A high cost of storage batteries often hinders the acquisition of solar panels by individual households. Energy storage plays an important role in the process of energy production from renewable sources. It is important both for load leveling and uninterrupted power supply. Powerful storage options are particularly important when variable sources are used in isolated and autonomous power supply systems. An extremely high cost of powerful batteries is one of the main obstacles to massive distribution of renewable energy power plants. Smart grid tecnology enables its’ users to emit in the grid the unconsumed amount of electricity and to get it back from the grid with significant price benefits in case of need. Such a function of smart grid removes the necessity for a pricey powerful battery. The most practical example of this configuration is represented by the wind energy production.

Wind energy is one of the most widespread renewable sources. Turbines produce electricity at affordable cost without additional infrastructure investments. Compared to photovoltaic, wind is the most economically competitive renewable source. The greatest disadvantage of wind energy is instability in the amount of energy produced. This requires the use of powerful extremely expensive batteries to accumulate all the energy produced and maintain the same level of distribution over time. Smart Grid, by providing the efficient distribution of electricity from all renewable energy sources, can compensate for the instability of wind farms. As wind energy itself has a very low cost of production, the prices for consumers in such case will are falling significantly. Implementation of smart grid tecnology for micro-hydropower energy production demonstrates the same extremely positive effect. Hydroelectric power is the world's largest and one of the most affordable renewable energy sources. The maintenance costs are low and allow micro-hydropower plants to be installed in individual households. Small hydroelectric generators work at variable speed due to changes in water flows. In the event of a decrease in the amount of energy produced by turbines, the Smart Grid makes it possible to remedy the amount of energy missing, using energy from other sources. Another example where the Smart Grid is bringing about significant change is Photovoltaic. Within urban areas, the installation of solar panels on the roofs of the buildings is becomming a common practice. Under urban conditions, it is difficult to install a large photovoltaic plant because of the lack of space. So these are quite small amounts of energy produced on single solar panel. The smart grid tecnology, which offers high possibilities for the distribution of electricity within cities, makes it possible to achieve a maximum profit from each panel, bringing all producers together in a common grid. This allows, for example, individual homes to restore the energy produced by their solar panels to the grid, thereby generating costs. For biomass energy, Smart Grid offers opportunities to enter the urban energy market. The potential of individual biomass power plants is not sufficient to make them economically competitive to participate in electricity distribution in urban areas. The Smart Grid allows a full inclusion of biogas energy in the energy circuit in urban areas, rendering it competitive and convenient. Smart Grid technology opens up unprecedented possibilities for consumers to directly control and manage their own individual consumption patterns, in turn of providing strong incentives for efficient energy use when combined with time-dependent electricity prices. According to the European Commission, Smart Grids will push the development of the future decarbonized electricity system (EC, 2011). The first large-scale smart grid project in the world was launced by Italian multinational

[2] With the possibility to emit electric energy in the grid consumers can at the same time be also producers of energy

energy company Enel Spa. one of the first in the world has introduced a smart grid tecnology to its' clients in 2005 (Torriti, 2020). Since then, numerous italian households have installed solar panels on the rooftops being attracted by a flexible system of energy acquisition and emission back in grid,which permits quickly pay back the cost of the panels. However, the best profit from the smart grid implementation can be obtained only if applied together with the adaptation of the energy efficiency measures.

3.3 Energy efficiency and Smart Home

The decarbonization of energy infrastructure takes place in two important ways: decentralized energy distribution and energy efficiency technologies. The increase in demand for electricity and the need to introduce the quantity of energy produced from renewable sources into urban infrastructures makes energy efficiency technologies increasingly important. In the context of urban areas, this is primarily about heating and cooling systems. According to data produced by the European Commission, heating and cooling systems together account for 50 percent of EU energy demand and a large part of it is wasted. Although the heating and cooling sector is shifting to low-carbon, clean energy, more then 50 percents of the fuel used is still coming from fossil fuels (World Energy Council, 2019). Optimization of heating and cooling systems in buildings could contribute to a significant reduction in energy demand and the transition to sustainable energy infrastructure.

The concept of "Smart Building" is very close to the concept of smart cities. The Organization for Economic Cooperation and Development defines the Smart Building as a building based on a set of technologies that improve the energy efficiency of the building and increase the level of user comfort (OECD, 2010). Smart Buildings are closely linked to smart grids. This technology includes new and energy efficient building materials and information and communication technologies. Innovative solutions in building construction may include the designation of various thermal insulation technologies. One of the most common solutions of today are different external panels of thermal insulation, which can be placed above existing buildings, making buildings more energy-efficient at a low price. One of multiple examples of "New Generation" of energy-efficient building materials is a glass pane that is able to estimate and manage the amount of daylight that can enter the room. The building that owns these technologies already exists: it is The New York Times Building, designed by Renzo Piano, a famous Italian architect. The building has a continuous facade that acts as a sunscreen and changes colour during the day. The building is equipped with additional ICT-based shadow control systems. The shading system detects the position of the sun and relies on a network of sensors to automatically actuate the tent lift and down. The cheapest version of this technology is the high-reflectance and durable outside coatings applicable to roofs and walls of buildings. These coatings reflect solar radiation in both the visible and the infrared parts of the spectrum. Applied on roofs and walls, reflection of solar energy reduces the temperature of the roof and walls and therefore also reduces the heating of spaces under the roof and inside walls. Coatings of this kind, applied in the warmest climate regions, can save up to 15 percent of the energy consumption of air conditioning. The costs of this technology are affordable.

While innovative materials make it possible to optimize the heating and cooling systems of buildings from the outside, information and communication technologies (ICTs and IoT) optimize energy consumption inside the buildings. ICTs can be integrated into building management systems that control heating, lighting, ventilation and water circulation. Observation of the internal environment is carried out by the numerous installed sensors. The results of development and adoption of innovative technologies that contribute to further improvements in the energy efficiency of buildings in Europe and USA can be seen even now: between 2020-2040 the total energy demand in residential sector in these regions is expected to decrease without making any damage to the economy (World Energy Council, 2019), unlike in the rest of the world, where rapidly growing energy demand could put under threat natural balance of the planet.

4 CONCLUSION

Global urbanization poses multiple challenges for global leaders and local authorities all over the world. Among them rapid growth of urban populations in the abcence of necessary economic growth and environmental impact of the cities. Urban agglomerations are responsible for the majority of CO2 emissions into the atmosphere. The growth of the urban population leads to an increase in demand for electricity, while the energy production sector is responsible for the major part of emissions. Emissions from cities are very

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often the result of inefficient urban infrastructures and insufficient interaction between different sectors of an urban systems. With the prevalence in the global proportion of cities with a population of less than 500 000 people, one can speak of a constant transformation of the rural population into the urban one. It is important to emphasize that emerging countries, in recent years, are facing rapid and often uncontrolled urbanization, and governments in these countries very often lack the instruments and fundings needed to implement effective urban infrastructure management. At the same time high-income countries have already succeed in reducing emissions through implmentation of new tecnologies, such as smart grid or smart house. According to the latest data provided by the International Energy Agency, an effective implementation of energy efficiency tecnologies together with the expanding role of renewable sources resulted in a sharp decline in CO2 emissions from the power sector in advanced economies. At the first time since 2016 global energy-related CO2 emissions have flattened in 2019 at around 33 gigatonnes (Gt), following two years of increases. (IEA 2020). Such a successful model should be introduced and possibly implemented in rapidly urbanizing countries in order to prevent a distructive environmental impact of an uncontrolled urbanization in asian and african countries. This transition of a highly-effective model of urban infrastructures from high-income countries to media- and low- income ones should be realized on the basis of multiple global knowledge-exchange platforms, dedicated to sustainable urban development, such as UN-Habitat, C40 and Global Covenant of Mayors. Innovative solutions for urban energy infrastructures provided by digitization contribute to acceleration of sustainable energy transition, significantly reducing costs of power generation from renewable sources in the cases of all types of sustainable energy sources. Application of the Smart City and Smart Grid concepts in cities could help to reduce the negative impact of urbanization on the environment. Technological development should lead to a decrease in the cost of technologies, significantly accelerating the clean energy transition process. Such an approach opens up great prospects for international cooperation in the area of urban development and sustainable energy transition. A vital role of innovation and research in the process of reducing emissions from urban areas schould not be underestimated. Therefore, scientific research has a significant role in the implementation of sustainable development projects. International scientific cooperation is crucial as far as it enables the development of innovative urban energy system solutions that base on a common experience.

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Modelling Milieu-specific Housing Demands for Augsburg Oberhausen using BPD-MOSAIC

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1 INTRODUCTION

Planning and developing new residential areas is a knowledge-intensive and challenging undertaking. One particular challenge is to adequately anticipate both the quantitative and qualitative needs and preferences of the future residents early on in the planning process. At such an early stage it is usually not possible to know exactly who the future residents will be and therefore hardly feasible to take individual housing needs and preferences into account. Formulating a comprehensive vision statement that serves as a guideline for the development of the new residential area is therefore of utmost importance. Drafting such a statement requires the developer to address a number of issues: Who could be the future residents? What are their socio-demographic characteristics? What target groups should be addressed? What are their housing needs and preferences? Which conceptual requirements result from this for the planning of the future residential area?

Answering such questions requires an in-depth understanding of local and regional housing demand dynamics. While housing demand statistics provide a rough estimate as to how much new construction is needed to meet the existing demand for housing, they tell us very little about who the future residents might be and what qualitative requirements they have. To fill this gap, the area developer Bouwfonds Property Development has developed a model called BPD-MOSAIC. The model, which builds on a geodemographic data set, is a tool to assess the potential housing demand for a specific residential project by identifying target groups together with their typical housing needs and preferences, and forecasting the probability of these groups moving in. The findings should help to develop and market the future residential area according to the needs and preferences of particular target groups, and thereby reduce the risk of maldevelopments. Using Augsburg Oberhausen as an example, the following paper aims to discuss the capabilities and constraints of the model as a data-driven decision-making support tool for planning new residential areas.

Keywords: housing demand, residential development, geodemographic model, MOSAIC, milieu

2 METHODOLOGY

The model draws on a comprehensive database made up of primary and secondary data, which are then analysed using a sequence of computational operations. The following section will first address the configuration of the database used in the model and then proceed with a brief description of the different calculation procedures.

2.1 Data preparation

For the model calculation, an extensive database has been compiled from several data sources. At the core of this database lies the MOSAIC data set developed by the commercial data privider EXPERIAN, which holds geodemographic information on more than 42 million households in Germany. To ensure data privacy, EXPERIAN's data has been aggregated at a building level. This guarantees that information cannot be attributed to an individual household. Using geodemographic information such as age, household size, income, education, consumer behaviour, as well as residential location and building type, the aggregated households are clustered into milieu groups of similar geodemographic characteristics (EXPERIAN, 2014). The cluster algorithm used by EXPERIAN classifies the households into a total of ten milieu groups, which again are divided into subgroups (Table 1). Altogether, this allows the assignment of a specific milieu group to 22 million addresses in Germany.

Based on the geodemographic characteristics of the different milieu groups, some conclusions can already be drawn regarding both, housing needs (household size, age, salary) and preferences (inner city, suburban location, rural area). To gain a deeper understanding of how the housing needs and preferences differ between and within the various milieu groups, a telephone and internet-based household survey was conducted in cooperation with the market research company USUMA. Altogether, around 24,000 households were interviewed throughout Germany. The survey involved questions about the desire to relocate, preferred residential location, and the appearance of buildings and their surroundings. To link the survey results to

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specific milieu groups, the respondents were also asked to state their current address. Overall, 70% of the respondents have been assigned to a corresponding milieu group.

Group	Name	Group	Name
A	The Upper Class	E2	Low-Income Dwellers in Disadvantaged Regions
B	Established Suburbanites	F	Traditional Elderly People
C1	Succesful Urbanites	G	Baby Boomers in Stable Region
C2	Young Digital Academics	H1	Suburban Families
C3	Urban Middle Class	H2	Families in Stable Regions
D1	Metropolitan Workers Milleu	H3	Traditional Rural Families
D2	Urban Low-Income Dwellers	I	Rural Dwellers in Stable Economic Conditions
D3	Low-Skilled Achievers	J	Rural Low-Income Dwellers
E1	People Affected by Structural Change	U	Unknown Milieu

Table 1: MOSAIC milieu-groups

Given that the MOSAIC dataset itself only provides information on where certain milieu groups live, but not from which milieus households are relocating, the MOSAIC dataset was supplemented by a relocation dataset provided by EXPERIAN. The data set includes address information of origin and destination for a total of 22 million relocation movements made between 2012 and 2018. As these account for only half of all relocation movements within Germany, the data set has been calibrated using the migration statistics of the Federal Statistical Office. By joining the milieu and relocation data set, relocation flows can be analysed both in terms of their size and milieu-specific composition.

2.2 Data analysis

Data analysis is performed using the SPSS statistics software. In a first step, a target area is defined upon which the analysis is performed. This could be, for example, the district in which the future housing project will be located. It is important that the target area is chosen in such a way that there is a spatial-structural relationship. However, from a structural perspective the target area should neither be too homogeneous nor too heterogeneous. For the case presented in this paper the postal code area 86254 is used as a target area, coverring the southern part of Augsburg Oberhausen. For the defined target area, the following probabilities were then calculated for all of the 22 million households:

- P1: The probability of a household relocating within the next year.
- P2: The probability of a household relocating into a certain property type (new/old building, single-family house/multi-family house), type of ownership (property/rent) and residential location (city centre, urban area, outskirts, periphery).
- P3: The probability of a household relocating to the defined target area.
- P4: The probability of a household having a certain preference (facade design, number of parking spaces, size of apartment, etc.)

While the probabilities P1 and P2 are calculated using a binary logistic regression method, P3 and P4 represent empirical values. By summing up the expected values (P1, P2, P3, P4) for each of the 22 million households, the results yield information on relocation flows to the previously defined target area. The calculated flows can then be broken down both by target groups (milieu, income, age groups, household sizes) as well as preferred and actually chosen housing types (single-family house/multi-family house, new buildings/old buildings), allowing the user to draw conclusions about the location-specific housing demand potential. In other words, using the cumulative expected values, the model can be used to calculate the probability of households living in Munich to relocate to a multi-family home in Augsburg Oberhausen.

3 RESULTS

For Augsburg Oberhausen (86254) the probabilities P1, P2 and P3 have been calculated. The results of the MOSAIC model calculation will be presented in the following section.

3.1 Which target groups live in Oberhausen und which are moving in?

A look at the milieu structure of Oberhausen (86254) shows that with a share of 84.3%, the D1-milieu accounts for the largest proportion of households (Fig 1). The D1-milieu is generally made up of industrial workers, living in prosperous and industrially dominated conurbations. These households are usually made up of singles or patchwork families living in rented apartments, predominantly in historic inner-city locations or large-scale housing estates. Households in this milieu group tend to be low-educated and earn modest incomes. Furthermore, this milieu group relocates relatively often. The second most common milieu group in Oberhausen (5.9%) - the Urban Low-Income Dwellers (D2) - shows an equally high relocation frequency. Similar to the D1-milieu, the D2-milieu is characterised by relatively low incomes and low-levels of education. Both milieu groups are also very similar in terms of household composition and residential location. However, a key difference lies in the generally younger age of the D2-milieu compared to D1. An examination of the milieu composition of the city of Augsburg as a whole shows that the D1 and D2-milieu not only plays a dominant role in Oberhausen, but in the city as a whole. At the same time, it becomes apparent that other milieu groups living in Augsburg, such as the milieu of the Urban Middle Class (C3), the Young Digital Academics (D2), or the financially much better-off Successful Urbanites (C1) and Established Suburbanites (B), are almost absent in the target area Augsburg Oberhausen. These findings indicate that Oberhausen (86254) constitutes, at least from a socio-demographic perspective, a relatively segregated part of Augsburg.

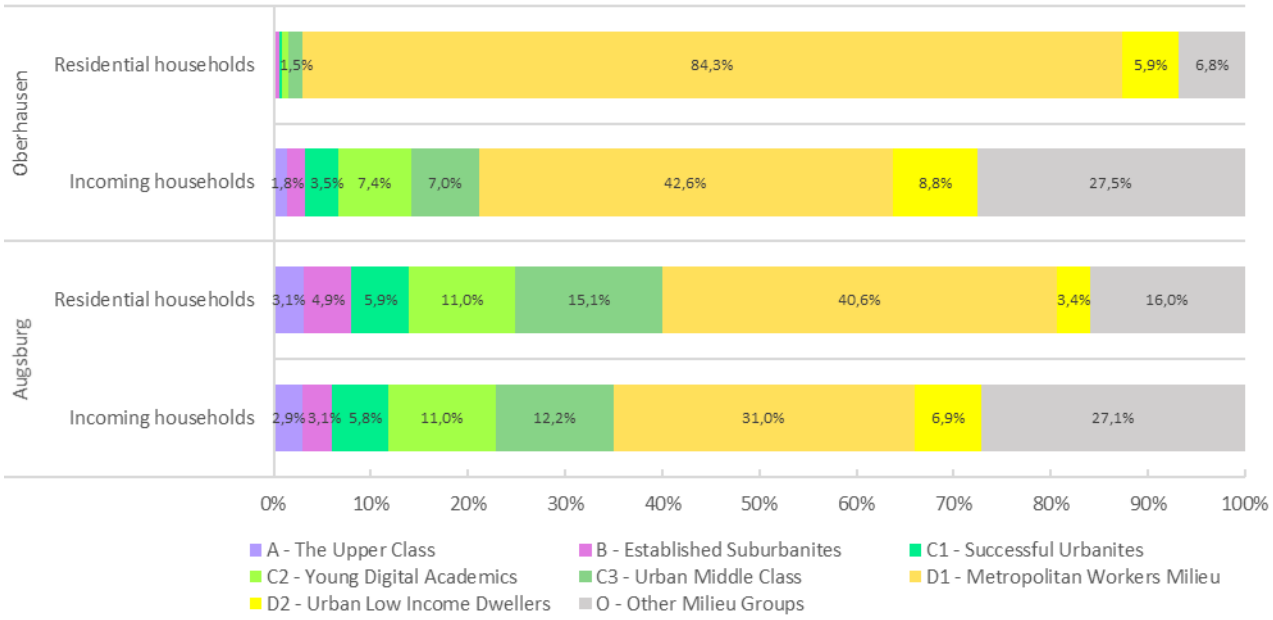

Fig. 1: Milieu composition of residential and incoming households in Oberhausen and Augsburg.

A look at the milieu groups of the households relocating to Oberhausen reveals that also among the incoming households the D1 and D2-milieu plays a key role, with shares of 42.6% and 8.8% respectively. However, an influx of other milieu groups can also be observed. Around 7% of incoming households belong to the Urban Middle Class (C3), which represents a very broad sociodemographic group in terms of age, household size, income and educational background. Also Digital Young Academics (D2) are relocating to Oberhausen (7,4%). These are typically students or households pursuing a rather student-like or alternative lifestyle. Being a university city, this group plays a relatively large role in Augsburg as a whole, although it is only sparsely represented in Oberhausen. On the whole, however, the influx of these milieu groups indicates a tendency towards an increasing diversity within the milieu structure of Oberhausen.

3.2 Where do the households moving to Oberhausen come from?

The analysis of relocation movements shows that between 2012 and 2018 around 15,228 households relocated to Augsburg, of which about 10% (1,523) relocated to Oberhausen. Around 23% of the relocations to Oberhausen represent internal relocations within the postal code area 86254 (Fig 2). A further 34% relocated from other parts of Augsburg. Thus, the share of intra-city relocations to Oberhausen amounts to a

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total of 57%. However, this comparatively high proportion is by no means unusual for a large city like Augsburg with a population of around 300,000. The results indicate that Oberhausen as a residential location is not only of local, but also of regional and even nation-wide significance. 13% of the households that relocated to Oberhausen between 2012 and 2018 came from the neighbouring counties Augsburg and Aichach-Friedberg, with the county of Augsburg playing a key role as a place of origin (10%). Furthermore, more than a quarter of households originated from municipalities located in the rest of Germany, with southern Germany accounting for a share of 19%. The City of Munich, on the other hand, plays a rather minor role as a place of origin (3%).

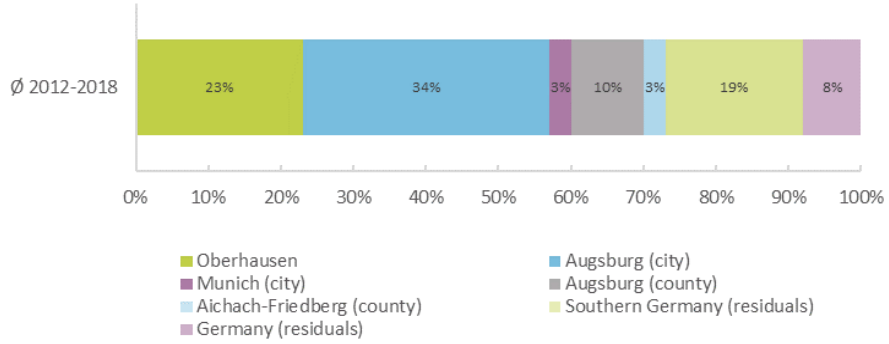

Fig. 2: Origin of households relocating to Oberhausen (2012-2018).

3.3 What is the regional probability of a household relocating to Oberhausen?

The results of the calculations P1 (the probability of a household relocating) and P2 (the probability of a household relocating to the target area) are illustrated in Figure 3. The findings show, that households living in the target area or in the adjacent postcode areas show the highest probability of relocating to Oberhausen (86254) within the next year (P>0.05). Households from the remaining areas of Augsburg show a slightly lower probability (P0.02-0.05). The same applies to households living in the eastern municipalities of Augsburg county. By contrast, households from the county Aichach-Friedberg are much less likely to relocate to Oberhausen (P0.005-0.02). Overall, the results show that the probability of a household moving to Oberhausen decreases with increasing distance to the target area.

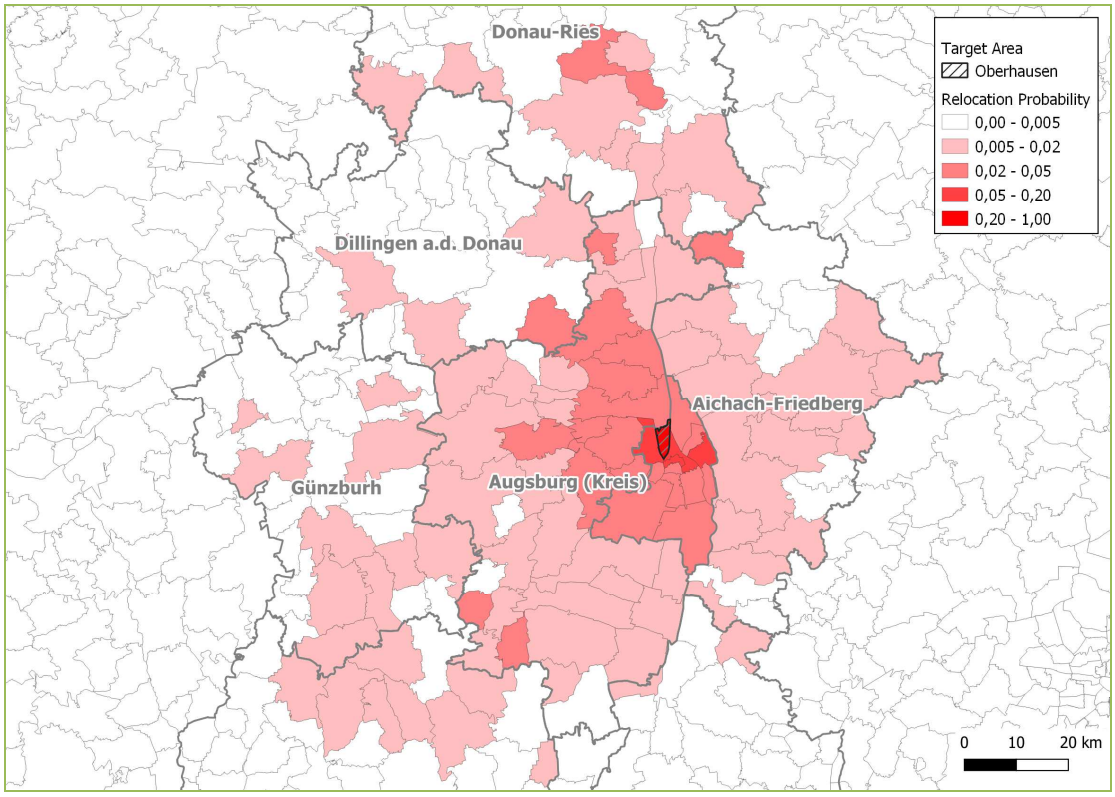

Fig. 3: Regional probabilities for a household relocating to Augsburg Oberhausen.

3.4 Which housing types are preferred among households relocating into new residential properties?

The calculation of the cumulative probabilities P1+P2+P3 shows that out of the total of 1,523 households that relocated to Oberhausen between 2012 and 2018, only 81 relocated into newly built residential properties (<3 years). At 54%, small multi-familiy houses with three to four units accounted for the largest share of relocations to new residential properties. A respective 18% moved into one- and two-family houses as well as medium-sized multi-family houses with five to ten units. On the other hand, only 9% of households relocated to large multi-family houses with more than ten units.

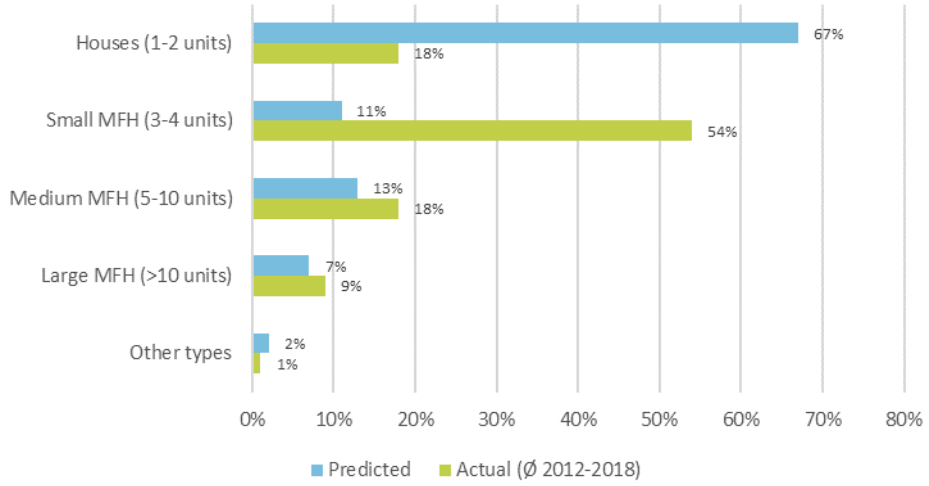

Fig. 4: Actual and predicted relocations to newly built properties in Oberhausen by housing type (2012-2018).

A comparison of the empirical values obtained from actual relocation movements (2012-2018) with the values obtained from the model (which takes into account the milieu-specific housing preferences) reveals some substantial discrepancies. The model assumes that 67% of the households moving to Oberhausen would move into newly built one- and two-family houses, as a result of their milieu-specific housing preferences. The opposite is expected for small multi-family houses. In this case, the model calculates a share of only 11%, which turns out to be significantly lower than the 54% of actual relocations to newly built small multi-family houses between 2012 and 2018. However, for medium-sized (Δ=5%) and large multi-family houses (Δ=2%) the difference between empirically observed and modelled values turns out to be considerably smaller.

4 DISCUSSION

The results of the analysis revealed that the target area Augsburg Oberhausen (86254) represents a classic working-class district. Furthermore, the analysis showed that also among the households relocating to Oberhausen the D1 and D2-milieu plays a prominent role. However, there are also households from the A, B and C-milieu relocating to Oberhausen. Due to the large proportion of the D-Milieu in Oberhausen and its above-average relocation frequency, it can be assumed that a considerable share of the relocations movements of this milieu group are attributable to internal relocations. The opposite can be assumed for households from the A, B and C-milieu. Given that these milieu groups make up only a small proportion of the population of Oberhausen, it can be assumed that the relocations movements of this milieu group are mainly attributable to relocations originating from outside of Oberhausen. The influx of these milieu groups may result in a greater diversity within Oberhausen's milieu structure. However, the D-Milieu will certainly remain the dominant milieu group in Oberhausen.

Based on the milieu structure of the households living in and relocating to Oberhausen, a strong overall demand for low- to middle-income housing can be expected. At the same time, it must be assumed that there is an elevated demand for rental apartments suitable for small to medium-sized households. Despite the D1-milieu's strong preference for rental housing, there is also a significant proportion of households within this milieu group with a desire to own property. However, in order to serve this target group in the owner-occupied segment, it is necessary to develop an affordable product suitable for this group. Since financially

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well-off milieu groups such as the A, B and C1-milieu only relocate to Oberhausen to a limited extent, restricted demand for high-priced housing can be expected.

Regarding the question which housing types are being preferred among those household relocating into new residential properties in Oberhausen the model does not provide a clear answer. Partly the results show significant discrepancies between the empirical and modelled values for relocations to newly built one and two-family houses as well as small multi-family houses. Despite their expected milieu-specific preference for one and two-family houses, households relocating to Oberhausen rather opt for multi-family houses, particularly for small multi-family houses. This raises the question of whether these households would actually have preferred to relocate into one and two-family houses, but instead relocated into multi-family houses as a result of an inadequate supply. Another explanation would be that within the respective milieu groups the preference for one and two-family houses is not as high as the survey results and geodemographic characteristics would suggest. Indeed, the high preference for one and two-family houses among the D1-milieu is a phenomenon specific to Bavaria. Unlike in other parts of Germany, in Bavaria the D1-milieu lives unusually often in one and two-family houses, despite their predominantly urban living environment. This might be explained by the circumstance that, because of their comparatively low incomes, this milieu group often settles in suburban areas in order to avoid the high housing costs in the inner-city locations of Bavarian cities. In the suburbs, the D1 milieu then encounters a housing supply consisting mainly of one and two-family houses. Due to this peculiarity, it must therefore be assumed that in a metropolitan location such as Augsburg the preference of the D1-milieu for one and two-family houses must be lower than in the aforementioned suburban locations. However, in order to solve this issue it is necessary to recalibrate the housing preferences of the different milieu groups according to the varying local conditions.

5 CONCLUSION

As the example of Augsburg Oberhausen shows, BPD-MOSAIC provides in-depth insights into local housing demand structures. Using the MOSAIC milieus developed by EXPERIAN, the model allows to identify potenial target groups and draw conclusions about their housing needs and preferences based on their geodemographic characteristics. In so doing, the model goes far beyond the static nature of the milieu approach by exposing the relocation movements of the different milieu groups and thus providing important insights into their relocation behaviour. Thereby the milieu approach acquires a spatio-temporal dynamic. By combining the milieu and relocation data set with the findings of a housing preference survey, milieu-typical housing preferences and actually made housing choices can be compared. Using these information, the different needs and preferences of potential target groups can be integrated into the planning process at an early stage. The model thus offers a promosing approach to plan and develop residential environments that are in line with the actual housing needs and preferences of their future residents, while at the same time reducing the risk of maldevelopments. These capabilities and its localized approach make BPD-MOSAIC a promising tool for data-driven decision-making when planning new residential areas.

At the same time, however, it is also evident that regardless of the mathematical method used, forecasts of future housing demands, are subjected to certain constraints. This is partly due to the circumstance that even the most sophisticated models are unable to represent the complexity of reality to its full extent. On the other hand, quantitative model calculations always build on past observations and extrapolate the relationships and developments established for the past into the future under certain conditions. Especially when dealing with complex systems such as housing demand behavior, in which the uncertainty factor "human being" with its spatio-temporal changeable behaviour patterns plays a central role, one must be aware of the capabilities and boundaries inherent in the predictive power of mathematical models. At this point it should therefore be emphasised that the strength of the model presented in this paper lies not so much in forecasting but rather in simulating local housing demand potentials. Implementing the results of the model calculation one-to-one into the planning process is neither intended nor desirable. Rather, the results should serve as a foundation for discussing different development scenario from which a vision for the development of the future residential area can be derived. This also illustrates the main strengths of the model: increasing transparency and encouraging ideas.

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Multicriteria Assessment of Urban Development Projects – from Objectives to a Project Priority List

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1 ABSTRACT

Impact assessment is a crucial basis for decision-making. Characterization of projects, identifying objectives and indicators for the justification and comparison of alternatives represent essential elements of any impact assessment. Comparing alternatives against a set of objectives and criteria addresses different impact types, understanding merits of each option, and establishing a preference ranking calls for a framework to integrate information on effects and impacts, with values and preferences of decision-makers and stakeholders.

This paper refers to a study on "Integrated Urban Design Concepts" for the World Bank Consultancy for pilot cities under the "Uzbekistan Medium-Size Cities Integrated Urban Development Project" (MSCIUDP, World Bank, 2018). The focus of the paper is on multicriteria assessment that allows for a ranking of urban development projects for cities in Uzbekistan to enhance urban sustainability. The approach starts with the definition of a set of urban development objectives related to selected projects for several Uzbek cities. Based on the defined objectives, a set of indicators is extracted which allows describing the benefits on economic prosperity and well-being of society and on environment and climate improvement. Based on the assessment urban development projects shall be selected to be implemented in the pilot cities to foster their urban centrality.

The paper describes the suggested projects for one of the Uzbek cities, the selected indicators to examine wether the urban development objectives with their related criteria are met, and discusses details on quantifying, weighting and merging the indicators to achieve a final priority list.

Keywords: priority definition, assessment criteria, development objectives, urban development, Multicriteria asseesment

2 BACKGROUND AND OBJECTIVES

The "Integrated Urban Design Concepts" for the World Bank Consultancy was carried out by superwien urbanism ZT OG (project management), AIT-Austrian Institute of Technology GmbH and Umweltbundesamt Gmbh – with minor contributions. Superwien has designed a set of urban development projects together with AIT. AIT has carried out a spatial impact analysis to provide assessment indicators and conducted the assessment and prirotization of the designed projects.

A pilot city for which the assessment of the urban development projects has been carried out is Chartak (aka "Chortok"), a town with around 100,000 inhabitants, located in the Namangan Region in Eastern Uzbekistan. Projects in the framework of Uzbekistan Medium-Size Cities Development shall help to redirect in-migration from the capital city towards medium-sized cities like Chartak to allow a more balanced regional development of the country. The development of the medium sized cities as growth poles shall be fostered by strengthening the cities and especially the city centres through tailored urban planning and design activities. Only a populated centre can guarantee a lively urban city life with thriving local economies and the perspective for growth. The urban development challenges for Chartak are to make the city centre more attractive for the population, for entrepreneurs, as well as for tourists. (see: http://superwien.com/portfolio/chartak/)

The purpose of the assessment is to elaborate a priority list for the urban development projects, defined earlier, to foster urban centrality, economic prosperity and touristic attractiveness. The paper presents the activities of one work package of the project in the MSCIUDP framework: to describe, assess, and prioritize the suggested projects based on urban development objectives, related to a set of indicators. The evaluation and prioritization process will be conducted through a Multi-Criteria Analysis (MCA) that can be easily repeated and modified by the client himself. There are many different approaches (e.g. Haseli, et al. (2019). Ortiz G. et al. (2018)), as well as assessment tools (Weisroffer et al., 2005) available. But the requirement of the client was to provide a simple approach, that can be carried out with indicators which can be again easily derived with some basic spatial analysis skills, by using an easily accessible tool.

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3 PROJECTS, URBAN DEVELOPMENT OBJECTIVES AND RELATED INDICATORS

The general objective of the "Uzbekistan Medium-Size Cities Integrated Urban Development Project" is to improve state and dynamics of medium sized cities in Uzbekistan. Improving the city of Chartak shall be carried out by developing a set of projects which are fostering urban centrality, improving the built-up environment as well as the blue-green infrastructure of the city. The paper describes the approach based on these projects, as carried out during summer 2019 at an early project stage, indicators have been later recalculated (accessibility, spatial extent, costs) and the judgement has been changed later.

The addressed projects are the following:

A. Old Bazaar

B. Central Park

C. Walkable Corridor

D. New Bazaar

E. Western Waterfront

F. Urban Upgrade (Alisher Novoiy Mahalla)

G. Eco-trail

H. "Chartak City" Development

The map below gives the overview of location and extent of these projects within the city centre.

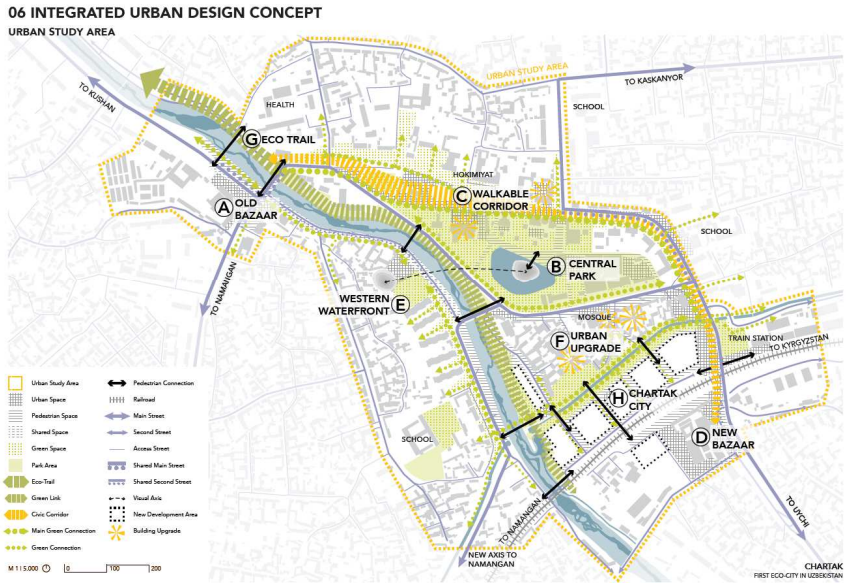

Fig. 1: Urban development projects for Chartak (Version June 2019)

Source: Superwien et al. (2019) Overall investment program for Chartak, Report Task 2. Version July 2019

The eight projects can be described roughly in the following way:

A - Upgrade of the Old Bazaar

This project proposes the redesign of public spaces adjacent to the Old Bazaar into a pedestrian friendly area with WIFI spots, trees and pergolas providing shade among other urban furniture. The road sections will be partly redesigned into shared-spaces. Speed bumps at the entrance points to the shared spaces will lower the speed for individual car traffic. The Eco-trail, which has its entry point there, will be integrated through a walkable access.

B –Central Park Revitalization

Through the redesign of the Central Park, the city centre will get a facelift of its most important and central green area. The pond will be revitalized, and a small bridge will allow access of the historic hill of Chartak. The park will have more trees that provide shade that will serve as a recreational park. The renovation of the Cultural Pavilion will be essential to activate the park and will create a link to the Walkable Civic Corridor.

C – Walkable Corridor

The main street of Chartak will be partly converted into a pedestrian zone or shared spaces with attractive pocket parks and green spaces. The first section will be car free and fully pedestrian. Important attractors will be the renovated Kindergarten with its new function as a gallery. Bike lanes and green pockets are implemented throughout the whole street. The railway bridge is the entry of the Civic Corridor and will be renovated.

D – New Bazaar

The public space adjacent to the new bazaar will be upgraded into a pedestrian friendly environment. A new bus station will be located closely that customers can reach the market conveniently. A new parking lot in the back also will serve the bazaar. New pedestrian connections to the surrounding areas across the railway facilitate better access to the new market.

E –Western Waterfront

The Western Waterfront will be converted into a linear park with a promenade and extensive green spaces. A public plaza will be equipped with benches and other street furniture. Trees and pergolas will provide shade. A community center will stimulate the plaza and its use for the surrounding communities. A new pedestrian bridge will serve as a link to the Eastern part of the waterfront and the Central Park.

F – Urban Upgrade of Alisher Novoiy Mahalla

The traditional residential use will be kept through the upgrade of this mahalla (neighbourhood). The streets will be renovated with an improved water and sewage system. The local mosque will be renovated, and its adjacent public space will be upgraded. Along the water channel, an esplanade with trees will be constructed. Also, a new park at the river will be built and a development site for new housing in the center is identified.

G – Eco-Trail

The Eco-Trail along the Chortoksoy river has its entry point at the Old Bazaar and leads to the water reservoir, a sanatorium and pilgrimage sites. The trail will have a length of 12 km, of which 5 km is located in the urban area of Chartak. It will be established as a 5 meter wide trail with a 5 – 10 m green buffer zone and seven attractor-zones (of approximately 100 m2), with 7 platforms to watch wild life and nature.

H – “Chartak City” - New Residential and Business Hub

This project will be a brownfield development of a former coal storage site that will include the integration of the railway station. The project will trigger private housing development on defined urban development areas, an education center including a public library in the area serves as an urban attractor. A 30 m wide linear park along the water channel will be estabished and new walkable connections to the mahalla and the new bazaar will be implemented.

For these projects a framewortk of major objctives has been defined: (1) Foster local identity, (2) Foster economic develoment and tourism, (3) Increase connectivity, (4) Foster residential functions in the centre, (5) Provide public greenopen spaces, (6) Improve non-motorized mobility.

These objecties are related to the eight projects serving as basis for indicators to assess and rank the projects with respect to the city’s benefits. The assessment and ranking / prioritization of the projects does not require to integrate all possible indicators. Here just a set of selected representative key performance indicators is defined, which allows to judge how the objectives are met by these projects. The addressed indicators refer to the number of affected inhabitants, number of affected workplaces, accessibility, extent of area by selected functions representing different aspects of urban development, as well as expected costs.

The number of population/workplaces within a distance range, do not only show the quality of accessibility but the amount of people living or working near these projects, which will experience their positive impact first. The land use classes by area indicate the increase of space for selected functions, making places more attractive. Green areas and shaded space indicate climate adaptation effects with respect to cooling.

The indicators are the following (the relation to the objectives shown above are listed in brackets):

- Population number within 15 minutes walking distance (1,3,4,6)
- Workplaces number within 15 minutes walking distance (2,3,6)

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- Pedestrian area, bike lanes (1,2,4,3)
- Urban area, commercial / mixed use (4,1)
- Cultural heritage area – site nearby (1,2,4,5)
- Social/ cultural – infrastructure (4,5,6)
- Recreation area, green space (additional shaded area) (4,5)
- Costs (divided into public and private costs to be covered by potential investors)

The following table shows the indicators for the 8 projects serving as proxies for accessibility, multi-functionality, and climate sensitivity:

Indicators / Projects	population within 15 min	workplaces within 15 min	pedestrian area/bike lane	Urban (commercial, mixed use)	culture, heritage	social, cultural infrastructure	recreation /green area
Old Bazaar improvement	8.000	5.000	19.300		510	-	
Central Park construction	9.850	4.340	-	16.500	2.600	-	41.600
Walkable civic corridor	10.300	4.480	25.900		3.900	2.200	
New Bazaar and Business Disrict	3.000	2.000	-	17.200	-	-	1.370
Public space along Western waterfront	10.800	4.300	6.900	4.100	-	1.250	7.500
Urban Upgrade Alisher.Nov.Mahalla	3.500	2.000	3.800	9.000	1.100	-	17.200
Ecotrail construction	15.000	5.500	3.200		700	-	99.999
Chartak City	5.000	2.000	10.100	9.300	300	3.300	22.500

Table 1: Indicators for project assessment. Source: AIT (2019) Overall investment program for Chartak, Report Task 3. Version July 2019

4 ASSESSMENT APPROACH AND APPLICATION - RANKING OF PROJECTS

There exist various sophisticated approaches to merge variables to common indicators – like factor analysis, cluster analsis etc. (c.f. Johnson, et al., 2007), all requiring statistical transformation and standardization. But the concept here is to provide a simple as possible transformation and aggregation technique which can be understood by every stakeholder, involved in the assessment process. As the indicators are quantified through different units, they must be transformed into ordinal-scaled indicators, which can then be aggregated in an additive way and can thus be further weighted to consider the different impact of the project tasks towards the initially defined development goals. Thus transformation towards ordinal scale with identical ranges and additive merging of the transformed indicators has been carried out. The transformation has been conducted achieving values between 0 and 10 where 0 indicates little impact and 10 indicates very high impact. The transformation equation has the following form:

$x^*_{p,i} = (x_{p,i} / (\max(x_i) - \min(x_i)) * 10 \quad (1)$,

where

$x_{p,i}$ = indicator x describing project (p),

$x^*_{p,i}$ = transformed indicator x judging project (p),

$\max(x_i) - \min(x_i)$ = the range of indicator x_i for all projects (p) as transformation base

Then a further weighting when summarising the transformed indicators towards weighted scores has been carried out to inegrate the importance of the indicators in representing to meet less or or more objectives by implenting the projects. The score S_p (the weighted sums) for each project have been calcuated by multiplying the transformed indicators with the particular weight w_i before summarizing, using equation 2:

i

$$S_p = \sum (x^*_{p,i} * w_i) \quad (2)$$

All calcluations have been conducted through an MS Excel spreadsheet with embedded equations, allowing all stakeholders for interactive changes of tranformation and weighting. The following table depicts the output: the transformed indicators, weights (below), weighted sums (scores) and initial ranking.

Indicators / Projects	population within 15 min	workplaces within 15 min	pedestrian area/bike lane	Urban (commercial, mixed use)	Public infrastructure, culture, heritage	social, cultural infra.	recreation /green area	weighted sum	rank
Old Bazaar improvement	5	9	7	-	1	-	-	**3,2**	**6**
Central Park construction	7	8	-	10	7	-	4	**5,0**	**3**
Walkable civic corridor	7	8	10	-	10	7	-	**6,1**	**1**
New Bazaar and Business Disrict	2	4	-	10	-	-	0	**1,8**	**8**
Public space along Western waterfront	7	8	5	2	-	4	1	**3,9**	**5**
Urban Upgrade Alisher.Nov.Mahalla	2	4	3	5	3	-	2	**2,4**	**7**
Ecotrail construction	10	10	6	-	2	-	10	**5,8**	**2**
Chartak City	3	4	8	5	1	10	2	**4,4**	**4**
weight	**1,0**	**1,0**	**0,5**	**0,5**	**1,0**	**1,0**	**1,0**	**6,0**	

Table 2: Project comparison –transformed indicators and weights, scoring, initial ranking. Source: AIT (2019) Overall investment program for Chartak, Report Task 3. Version July 2019

Then a final prioritization has been conducted considering cost efficiency and quick wins by modifying the ranks by adding bonus points (between 0 and 2). The lower the investment costs are and the faster a project can be implemented the more bonus points are distributed, as decided during stakeholder discussions.

Ranking / Projects	weighted sum	rank	area m2	Invest in Mill USD	Triggered invest > Mill USD	bonus for cost-efficiency,	bonus for quick wins	weighted sum 2	final rank
Walkable civic corridor	**6,1**	**1**	234.325 m²	3,1	-	**1**	**2**	**9,1**	**1**
Ecotrail construction	**5,8**	**2**	199.549 m²	5,0	-	**0**	**2**	**7,8**	**2**
Central Park construction	**5,0**	**3**	60.170 m²	4,6	-	**0**	**2**	**7,0**	**3**
Public space along Western waterfront	**3,9**	**5**	25.975 m²	1,7	-	**2**	**1**	**6,9**	**4**
Old Bazaar improvement	**3,2**	**6**	23.660 m²	1,7	-	**2**	**1**	**6,2**	**5**
Chartak City	**4,4**	**4**	54.208 m²	5,1	40,0	**0**	**0**	**4,4**	**6**
New Bazaar and Business Disrict	**1,8**	**8**	23.245 m²	1,5	-	**2**	**0**	**3,8**	**7**
Urban Upgrade Alisher.Nav.Mahalla	**2,4**	**7**	76.550 m²	2,8	-	**1**	**0**	**3,4**	**8**

Table 3: Final project prioritization – initial ranking, areal extent, costs, bonus points, final ranking. Source: AIT (2019) Overall investment program for Chartak, Report Task 3. Version July 2019

Table 3 depicts again the initially weighted scores, the initial ranks and as further information the project extent, leading to the final weighted scores and ranks for the projects.

The project prioritization with some important arguments and public costs are shown in the following list:

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(1) The Walkable Civic Corridor is expected to improve the accessibility and walkability of the city center – the costs are compared to the spatial extent moderate (3.1 M USD).

(2) The Eco-trail Project is matching with the objectives to become an ECOCITY and fostering tourism. Costs are compared with the impact on tourism, on local identity, boosting non-motorized traffic and the spatial exent of the project reasonable (5 M USD).

(3) The Central Park Project costs of 4.6 M USD are rather high, but the park would serve as attractive recreation area with an additional large scale cooling effect in the city centre.

(4) The Western Waterfront is expected boosting the attractiveness of centre and neighbourhood. The costs are, compared to the spatial extent of the project low (1.7 M USD).

(5) The Old Bazaar improvement will support fostering local identity, but will have no additional effect on economy. The costs are rather low (1.7 M USD), so quick wins can be expected.

(6) The "Chartak City" development will provide new housing and commercial use with high costs (5.1 M USD) to provide the basic infrastrucure there. Private investments of 40 M USD are required.

(7) The New Bazaar is expected to support local economic development south east of the center. Costs are expected to be low (1.5 M USD).

(8) The Urban Upgrade of the Alisher Mahalla will improve the local housing quality with high costs (2,8 M USD). It will only affect the population living there but not the whole city.

If the costs for all projects exceed the city budget, ranking gives priority to projects within the budget range.

5 DISCUSSION AND CONCLUSIONS

This multicriteria assessment is based on 4 steps: (1) definition of indicators reflecting criteria meeting the objectives, (2) transformation of the indicators to allow further merging, (3) initial weighting of the projects and (4) modifying the scores through additional points. While step 1 and 2 delivers objective results, step 3 adds a general weighting to the transformed indicators establishing an initial scoring, while step 4 interferes heavily through bonus points, changing the results in a distinct, subjective way. Although possible the stakeholder bonus points distribtuion does not affect the first places – ranks 1 and 2 remain at the same place, ranks 3 to 6 swap, while ranks 7 and 8 remain at the last places.

The client requests an approach, which provides initial expert judgement, but allows also to modify the outcome by adding own preferences. Enabling the distribution of individual bonus points allows controlling the assessment results by including own – subjective - policy opinions after recognizing the experts' objective judgement. Thus, this mixed objective-subjective assessment by adding step 4 to the process lead to satisfying results for the client as the initial assessment approach provide valid multcriteria assessment results reflecting the experts' opinions, which can be fully or partially accepted and finally modified by adding the client's policy preferences.

This mix of objective and subjective assessment is from a scientific viewpoint not correct, but allows the client to finally keep control. When working for clients the scientifically correct way is not always what the clients want. Working as policy advicers, requires to accept that decision making is the final responsibility of policy makers not of the experts which just support decision making.

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Reflexive Städte: Magneten des Wissens im Kontext globaler Digitalisierung

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1 ABSTRACT

Antworten zur Zukunft großer Stadtregionen im 21. Jahrhundert verlangen vertiefte Querschnittsbetrachtungen. Die dispersen Entwicklungslinien räumlicher Veränderungen wurden vielfach beschrieben und sind weitgehend bekannt, ihre bestimmenden Faktoren, die diese Dynamiken des Wandels antreiben oder blockieren sowie die Konsequenzen in ökologischer, wirtschaftlicher und sozialer Hinsicht werden in den Stadt- und Regionalforschung jedoch noch nicht hinreichend verstanden. Verkürzt gesagt: Einerseits verlieren die Städte Westeuropas nicht nur lohnintensive Industrien, sondern zunehmend auch den Handel sowie standardisierbare Dienstleistungen mit dramatischen Folgen für die Städte. Andererseits übernehmen sie im Kontext globaler Verflechtungen, des Klimawandels und zunehmender Digitalisierung auch neue Funktionen als Magneten komplexen Wissens, kreativer Innovationen, der Macht und der Repräsentation.

Städte sind (wieder) bevorzugte Orte des Wohnens; künftig profilieren sie sich verstärkt aber auch (wieder) als Zentren des Informationsaustausches, des Planens und des Entscheidens, seien es der Unternehmen, nationaler oder regionaler Regierungen, von Verbänden und Behörden, der Medien oder kultureller Institutionen. Das scheint nicht neu, mit der Digitalisierung ändert sich aber die Dynamik und die Geschwindigkeit des Wandels. Die Digitalisierung erlaubt zum einen weltweite Vernetzungen im Sinne schnellerer Datentransmission. Gegenläufig zur Enträumlichung kodifizierbarer Daten- und Informationsflüsse bleiben Städte zum anderen bedeutende Orte der Zusammenführung von Daten aus unterschiedlichsten Quellen sowie und der Interpretation fragmentierter Rohelemente des Wissens. Daten und Informationen bedürfen der Analyse und der Interpretation, um angesichts global unsicherer Rahmenbedingungen Chancen und Risiken zu bewerten, ohne die weitsichtige Entscheidungen nicht möglich sind.

Dazu ist personengebundenes Wissen unverzichtbar. In den größten Städten gelingt das reflexive Abwägen noch immer am schnellsten, weil sich hier die besten Köpfe und Teams konzentrieren, denen es vorbehalten bleibt, internes Wissen zu generieren, externes, fehlendes Wissen zu absorbieren und beides mit örtlich vorhandenem Wissen zu kombinieren, um verantwortbare Entscheidungen zu generieren. Künstliche Intelligenz kann zwar helfen, komplexe Megadaten zu sichten und aufzubereiten und Lösungen vorzuschlagen, reflexive Kompetenzen kann sie jedoch (noch) nicht ersetzen.

Keywords: Stadtregionen, Digitalisierung, Wissen, Stadt- und Regionalforschung, Zentren

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Research College NRW "Sustainable Energy Systems in the Quarter" – Collection of Abstracts

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1 INTRODUCTION

This paper collects the abstracts of the REAL CORP 2020 special topic session "Sustainable Energy Systems in the Quarter" in the order of their appearance for presentation at the conference:

- Wesely, Karin: Towards a better understanding of emotional drivers and barriers in the context of local renewable energy projects – An empirical investigation on homeowners' motives from a marketing perspective (Work&Progress)
- Slabik, Simon: The Integration of Resource Efficiency in the Building Stock through Efficiency and Sufficiency Measures – Life Cycle Assessment Comparisons and Models
- Taruttis, Lisa; Weber, Christoph: The Impact of Energy Efficiency on Housing and Rental Prices – Evidence from North Rhine-Westphalia
- Treude, Mona: Smart Cities – from the Handling of a Technology Concept to the Transformation Tool of Sustainable Cities
- Kränke, Lisa: Participation in Urban Real World Laboratories – Case Study of Bochum Hamme
- Hernández Galvis, Dione: Digitalisation of the "Energiewende": Legal Framework for a more Efficient Implementation of Solar Energy in Smart Neighbourhoods
- Kröger, David: Market and Transmission Grid Simulations Considering an Increasing Number of Integrated Energy Systems
- Paulus, Anne: Acceptance of Sustainable Modes of Transport with Focus on Neighbourhoods

Keywords: sustainability, energy, transition, resources, community-oriented

2 TOWARDS A BETTER UNDERSTANDING OF EMOTIONAL DRIVERS AND BARRIERS IN THE CONTEXT OF LOCAL RENEWABLE ENERGY PROJECTS – AN EMPIRICAL INVESTIGATION ON HOMEOWNERS' MOTIVES FROM A MARKETING PERSPECTIVE (WORK&PROGRESS)

To manage the energy transition in Germany and enable a shift from using fossil energy sources to an energy supply based on renewable energies, sustainable solutions for whole communities and quarters need to be developed. When implementing collectively used systems (e.g., block heat and power stations), the resistance and lack of willingsness to participate among residents need to be considered, besides technical and legal aspects. Recent research shows that in the context of energy saving investments, financial incentives perform less successful and emotional factors play a critical role in homeowner's decision making process. Understanding the decision behavior of homeowners, as well as identifying the emotional drivers and barriers of their motivation, is crucial to successfully manage renewable energy projects.

A significant amount of reseach is concentrated on the acceptability and determinants, (e.g. community identity and trust) of influencing citizens' willingness to participate in local renewable energy projects. An aspect that only received little attention in this context represents the homeowners' need for energy autonomy. Studies have shown that people strive for a certain degree of independence, when dealing with

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integrating renewables in their energy supply or even long for completely autonomous houses. With regard to this, we assume that people tend to feel more independent with their own heating boiler rather than with a collectively used system. Furthermore, we suggest that this need for autonomy can lead to a lack of acceptance and resistance among residents, when trying to implement sustainable energy systems in quarters. Since the construct of subjective energy autonomy remains unexplored so far, an in-depth study is needed to understand homeowners' motivation and develop a measurement tool for subjective energy autonomy. Additionally, practical implications should be derived to incentivize homeowners to accept as well as participate in neighborly- and community-oriented projects concerning energy efficiency.

Since this investigation represents an explorative approach, a qualitative research design has been chosen. To gain deeper insights, problem-centered interviews will be conducted with homeowners and experts. Interview partners will be determined through purposive sampling to ensure a heterogeneity amongst interviewees. A part-structured guideline is used and improved iteratively after each interview. All interviews are recorded, transcribed and analyzed with the software tool MAXQDA. In addition, a focus group with an energy cooperative owned by citizens is planned to gain further insights.

In conclusion, this study represents a first step into developing a measurement tool for future research, by conceptualizing the construct of energy autonomy through qualitative techniques. Furthermore, it provides insights into emotional drivers and barriers of homeowners' motivation, which are confronted with sustainable community-oriented projects. Besides that, it also contributes to the motivation research in the field of energy saving investments. On this basis practical implications will be derived to activate homeowners to accept and participate in local renewable energy projects in order to successfully manage energy transitions.

3 THE INTEGRATION OF RESOURCE EFFICIENCY IN THE BUILDING STOCK THROUGH EFFICIENCY AND SUFFICIENCY MEASURES – LIFE CYCLE ASSESSMENT COMPARISONS AND MODELS

The German building stock in 2016 is accounted for 35.3 percent of the total share of energy demand and approximately one third of the greenhouse gas emission in Germany [2, 3]. In order to achieve the climate goals of the German government of a nearly climate-neutral building stock by 2050. It is of great importance to renovate the existing buildings, as the majority of all these buildings will still exist by the year 2050.

Thus, the energetic refurbishment of the building stock is essential for an effective integration of resource efficiency in the building sector. By upgrading the building envelope in conjunction with efficient energy systems, significant reductions in operational heat and electricity demand can be achieved. The neighbourhood level is the small-scale interface between the individual building and the urban building stock.

In this work the development of a neighbourhood-based Life Cycle Assessment (according to EN 15978 [1]) of existing buildings as well as renovations is elaborated initially. The LCA are carried out with the software LEGEP and will serve for the quantification of environmentally relevant effects of the investigated buildings. Here, the analysis is performed on predefined lifecycle phases of the constructions and the used materials. The refurbishment measures include the installation of new windows and doors, insulation on the exterior wall, basement ceiling such as the top floor. An extrapolation of the LCA of different building typologies within the neighbourhood should provide initial results. Due to the subsequent impact on the building material by refurbishment measures, the system boundaries of the LCA need to be adapted. The consideration of the energy production, the infrastructure as well as the open space also requires an adaption of the system boundaries. The definition of a suitable functional unit forms a further investigation aspect. It is used to quantify the performance of a product system as a reference unit. A comparative analysis of area-related and resident-relate results should provide insights into the resource efficiency and environmental impact of the different refurbishment measures. The calculations are drawn up in different neighbourhoods in Germany, whereby finally a control of the developed methodology by the application at an existing neighbourhood is carried out.

The multifunctional analysis approach on the neighbourhood refers to the objective of this work.The work aims to elaborate a coherent analysis of the construction material and modernization. The environmentally

relevant impacts are compared. Thus, the energy systems in connection with operational and supply-technical approaches within the neighbourhood can be evaluated in detail.

This work is funded by the North-Rhine Westphalian Ministry of Culture and Science within the scope of the project “Graduate School for Sustainable Energy Systems in Neighbourhoods”. The authors gratefully acknowledge the assistance of all concerned.

4 THE IMPACT OF ENERGY EFFICIENCY ON HOUSING AND RENTAL PRICES – EVIDENCE FROM NORTH RHINE-WESTPHALIA

In Germany, about 35% of the final energy consumption as well as about one third of the CO_2 emissions are related to the housing sector . According to the Energy Efficiency Strategy for Buildings (ESG), the German government aims at a climate-neutral building-stock by 2050 to reach the goals defined in the Climate Action Plan 2050. Increased energy efficiency of buildings is one of the main targets formulated in the ESG, which can be achieved notably through energy efficient retrofits.

In order to identify some potential monetary benefits and possible rental premiums for private homeowners and for landlords when investing in retrofits for a better energy performance of their buildings, we investigate whether energy efficiency is reflected in the property value of single-family houses as well as in rental prices. We focus on North Rhine-Westphalia as the federal state with highest population and highest energy consumption. More specifically, we also examine whether there are heterogeneous effects in the Rhine-Ruhr metropolitan region, which is the largest urban area in the state and used to be the industrial heart of Germany, compared to more rural areas in NRW. With about 99,000 individual observations for singe-family houses and 388,000 observations for rental units on a 1km²-grid-level for the period 2014 to 2017, this study adds to the literature 1) by examining the effect of energy efficiency on housing values and rents on a more small-scale level and 2) by specifically investigating regional disparities in this context.

Applying a hedonic regression, we find a negative relationship between energy consumption measured in kWh/m²a and asking prices per square meter for single-family houses. This implies that energy efficiency (which results in less energy consumption) has positive effects on property values: a one-unit increase in energy efficiency results, on average, in a 0.06% increase in asking prices per square meter, holding everything else constant. For rental units, we find weaker, but also statistically significant positive effects of energy efficiency on asking rents. If energy consumption decreases by 1 kWh/m²a, rental prices increase, on average, by 0.018% per square meter. When including energy efficiency ratings instead of energy consumption measures in our regression, we find that an “A”-rated flat is offered with a rental premium of 0.42 €/m² compared to average “D”-rated units, whereas “H”-rated flats are offered with a 0.77 €/m² discount.

Additionally, we find evidence for regional disparities: In the Rhine-Ruhr metropolitan region, energy efficiency has weaker effects on asking prices for single-family houses compared to all other districts in North Rhine-Westphalia. While a one-unit increase in energy efficiency results in 0.07% higher asking prices per square meter in the latter, it only results in a 0.04% price increase in the Rhine-Ruhr area. For rental prices we see opposite effects: In the metropolitan region, a 1 kWh/m²a decrease in energy consumption is related to a 0.019% increase in rents per square meter whereas it amounts to 0.015% in all other districts. These differences become even clearer when again looking at energy efficiency ratings. An “A+”-rated flat (compared to “D”-rated ones) is offered with a rental premium of 0.90€/m² in the Rhine-Ruhr region and only with a premium of 0.18€/m² in all other districts of NRW.

5 SMART CITIES – FROM THE HANDLING OF A TECHNOLOGY CONCEPT TO THE TRANSFORMATION TOOL OF SUSTAINABLE CITIES

Smart cities are on everyone's lips, promotional programmes, city rankings and beautiful promises make digital design appealing to cities - but it is no surefire success.

Tolerance and rather acceptance are needed, knowledge and understanding, information and media must be conveyed and the differences between these understood. Also the knowledge about one's own rights, the forwarding and the handling of data are the prerequisites for this acceptance of the people who live surrounded by data collecting street lamps. Technology has left many people behind in the areas surrounding smart cities.

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How do you create a smart urban design without a smart surveillance state like Georg Orwell or Big Brother? These are the questions that today's cities are asking themselves - cities that sometimes have historical reasons, their own functionalities and dysfunctions, which besides the daily business of collecting dog tax or providing daycare places must become smart in order to be attractive and to be allowed to play in the Smart City Rankings?

To approach these challenges, this paper takes a closer look at two smart cities. One will be a new quarter under construction in a city that does not lack a good image.. The second city, which will be examined in more detail, is an existing quarter. The depiction of two neighbourhoods at different stages of development is deliberately chosen because the focus is not on the technological equipment of a neighbourhood but on knowledge, cooperation, actors and networks.

6 PARTICIPATION IN URBAN REAL WORLD LABORATORIES – CASE STUDY OF BOCHUM HAMME

Cities play an important role in the societal and academic discourse on sustainable development. They are places where societal transformation takes place and where social, economic and technical solutions are developed and new strategies are implemented. They are considered to have a „transformative power“ (WBGU 2016). However, cities are also places where the Grand Challenges are most evident.

Cities are subject to continuous change. Urban renewal projects aim to promote the development of a city and its various neighbourhoods. One of the key factors for a sucessful urban renewal process is often seen in the participation of the local community. Participation in neighbourhoods is therefore both: a component of transformation strategies and an objective of sustainable transformation. Citizen participation has the ambition to increase the legitimacy of decisions. However, it does not always fulfil this ambition. One reason is that participation takes place at a late stage in the process. In some cases even when everything has already been decided. Other reasons are the low percentage of citizens who participate and the lack of representativeness in participation.

In addition to the participation of citizens, the WBGU also argues for the participation of the scientific community. The WBGU describes science as a „catalyst for urban development“ (ibid: 356) and recommends a „transformative science“ (WBGU 2011: 22 and in detail: Schneidewind and Singer-Brodowksi 2014). The core elements of this concept of science are inter- and transdisciplinarity. Real world laboratories and related concepts provide a corresponding methodological approach in the context of a transformative science (for "Real World Laboratories": Schneidewind & Scheck 2013, for "Urban Transition Labs": Wiek & Kay 2015, for "Living Labs": Liedtke et al. 2015).

In the research on urban development real world laboratories on city or neighbourhood level have become an important approach in recent years. Especially in German-speaking countries an increasing number of real world laboratories has been established. One of these real world laboratories is Bochum Hamme. It is a joint endeavour of the City of Bochum as municipal partner and the Bochum University of Applied Sciences as academic partner. The cooperation focuses on the scientific monitoring of the urban renewal process in Hamme by the Bochum University of Applied Sciences. The scientists' task is to bring together people and institutions in the neighbourhood as well as actors from local politics and the city administration.

The presentation will focus on the cooperation between city, university and citizens. It illustrates particularly the aspect of participation and discusses the possibilities and limitations of real world laboratory approaches. The research design, the characteristics of Bochum Hamme (especially the social structure), the constellations of key actors and the results of two participation events carried out by Bochum University of Applied Sciences will be presented.

The interdisciplinary and transformative approach of the project refers to geographic city research, but also addresses the question of legitimacy, which is particularly relevant from a political science perspective.

7 DIGITALISATION OF THE “ENERGIEWENDE”: LEGAL FRAMEWORK FOR A MORE EFFICIENT IMPLEMENTATION OF SOLAR ENERGY IN SMART NEIGHBOURHOODS

The aim of the research is to develop a proposal in order to optimize the current German legal framework for the development of the German “Energiewende” through digitalisation and for the more efficient use of solar energy in neighbourhoods.

The existing German legal framework is no longer seen as a motor, but rather as an obstacle to the German "Energiewende". In the area of solar energy, there is a specific problem: homeowners are becoming entrepreneurs due to the problem of tenant flows. In addition, solar power cannot be distributed in neighbourhoods. The main question will therefore be to what extent the existent German legal framework will have to change in order to harness the opportunities offered by digitalisation for the energy industry. The focus will be on energy law, civil and contract law, data protection and IT security law.

First of all, the current status of the German legal framework will be examined. Then, a comparative analysis of the other modern legislations will follow. Various regulatory approaches and "best practices" examples may as well will be used to develop a reform proposal. The comparative analysis will focus on the EU level. Nevertheless, the inclusion of supra-European best practices cannot be ruled out. The countries that will serve as comparative goals will be determined after the deficits in the German legal framework have been identified. This will make it easier to assess which regulatory approaches/frameworks/means of control or similar can be used in Germany.

The main topics of investigation are the so-called "smart contracts", the IoT, the digitalisation as a megatrend and the new business models (these would represent the connection to neighbourhoods, e.g. the prosumers and the distribution of solar energy in neighbourhoods). The term "neighbourhood" is initially alien to German (energy) law, nonetheless there are neighbourhood-relevant arrangements in the sense of criteria which can be helpful for the formation and demarcation of a neighbourhood. We must acknowledge the inexorable development of new scenarios that are not yet provided for in our current legal dimensions or framework conditions. The unimaginable developments in the technological field with which we will be confronted represent for our institutions and our coexistence in society great challenges. However, it is necessary to acknowledge the importance that the conditions of our legal framework have, since they can decisively influence the actors involved. Without extensive digitalisation of the energy industry, it will be difficult to achieve the intended "Energiewende". Following the motto "Think Global, Act Local", this interdisciplinary approach helps to answer the main questions of the Graduate School on the one hand, and on the other hand to shape the future social and political challenges in a positive way.

8 MARKET AND TRANSMISSION GRID SIMULATIONS CONSIDERING AN INCREASING NUMBER OF INTEGRATED ENERGY SYSTEMS

The joint generation of electricity and heat in combined heat and power (CHP) plants and the generation of heat using power-to-heat (PtH) systems based on renewable energy sources (RES) open up the potential for decarbonizing the heating sector. At the same time, electricity-heat cogeneration technologies can help to integrate intermittent electricity generation from RES into the system. Depending on their design, CHP plants have one or two degrees of operational freedom. In CHP plants with two degrees of freedom, the feed-in of thermal and electrical power can be partly controlled separately from each other and thus contribute to the integration of RES in the short term.

During periods of negative residual load, particularly large-scale PtH systems can be used to transfer surpluses from the electricity sector into the heat sector and use them there. The additional use of heat storages make it possible to decouple heat generation and heat consumption over time, further increasing the flexibility of the overall system.

Within the research project, Sustainable Energy Systems in Neighbourhoods (Nachhaltige Energiesysteme im Quartier NEQ), an existing European electricity market and transmission grid simulation framework is being further developed to be able to map the realistic operation of CHP plants and PtH systems and to examine and evaluate their effects on electricity markets and grids.

In order to model the heating sector, the locations, installed generation facilities and storage technologies as well as heat demands of a large number of district heating networks in Europe have been researched and temporally resolved. Subsequently, additional operational restrictions and degrees of freedom resulting from the sector coupling as well as different target functions of producers are considered and implemented. Finally, the unit commitment of CHP plants and PtH systems as well as heat storages can be determined and examinations regarding flexibility and grid load can be carried out. Preliminary results show apparent changes in European electricity markets due to the joint examination of both the heating and power sector.

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The second phase of the research project deals in particular with research questions regarding integrated energy systems at the neighbourhood level – for example examinations considering the effects on markets and the grids for different penetration rates of solution approaches developed at the neighbourhood level.

9 ACCEPTANCE OF SUSTAINABLE MODES OF TRANSPORT WITH FOCUS ON NEIGHBOURHOODS

This research is interested in conditions which lead to changes in behaviour regarding mobility decisions. Transport systems have significant impacts on the environment. To reach the climatic objectives for 2030 it is crucial to involve passenger transport. The quantity of vehicles is still increasing and results in traffic jam especially in cities and metropolitan areas. To solve the problem of overloaded roads, air pollution and land consumption it is important to implement new forms and systems of mobility and change the individual behaviour. For the successful implementation of new forms and systems in sustainable passenger transport the acceptance by the residents is essential. Therefore, the project addresses the following research questions: What are the conditions under which people accept sustainable energy-efficient modes of transport for routinely ways in their city and neighbourhood? When are investments in e-mobility, season-tickets for public transport or membership in sharing communities for people reasonable?

Previous studies have shown many factors such as local contexts, distances, availability, attitudes and routines which influence mobility decisions. Moreover, car owners use cars more frequently, even for unnecessary routes or for reasons of convenience. So there is need for research of the acceptance of changes in behaviour and private investments in sustainable transport among people.

Since most ways start and end at home it is necessary to consider the mobility situation in neighbourhoods as the residential places. To change the mobility behaviour of individuals it is important to determine their context of living, working and moving. Accordingly, neighbourhoods with focus on the opportunies in the living environment are sensible as research areas.

Based on three selected neighbourhoods in Bochum, the demands and needs of local people in regard to sustainable modes of transport are supposed to be examined. On that point, about 1,200 people (about 400 per neighbourhood) should be asked via a written survey about their usual mobility behaviour. The survey contains questions about the access to vehicles or season tickets, distances travelled and the modes of transport usually used, as well as socio-economic and socio-demographic factors. Furthermore, as some means of transport involve investments, such as buying an e-car or a season ticket for public transport or binding to a car-sharing community, we will ask how likely such investments are.

As a result of the project, concrete actions to process sustainable energy-effient mobilty in neighbourhoods will be developed. These recommendations arise from the acceptance among the people. The aim is to save energy and resources and increase the livability in neigbourhoods through shifting car ways to more energy-efficient means of transport such as bicycles or public verhicles.

An advantage of this severe quantitative approach is that in consequence of a rule-based selection process of the research areas, the results are much easier to transfer to other neighbourhoods. Especially this part is more difficult or even impossible to survey in qualitative approches such as living labs.

Solidified Branding Function: How the Urban Brand Affects a Small Town's Delopment? Case Study of Wangqingtuo, Tianjin, China

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1 ABSTRACT

Chinese small towns are usually developed with single core industry, and the urban brand is the identity of a town that formed with the development of its industry. However, when the core industry representing its urban brand is facing a changing situation or market, will the brand be a motivation or a obstruction of the development of a town? The paper combined top-down and bottom-up research method to study the function of the urban brand in Wangqingtuo town in Tianjin, China. We studied over 400 samples (including government staff and town citizens) to make questionnaire investigation about the town's branding. And we found that the solidified urban brand is a complicated emotional symbol for both government and citizens. The town has demand of exploring and developing new dominant industry, and it has the expectation to keep branding and upgrade its current core industry.

Keywords: Small town planning, Development, Urban brand, China, Tianjin

2 INTRODUCTION

Cities and towns are closely related to branding. A city is able to form a brand, urban development procedure is to build a new brand (Gotham, 2007). Urban brand is the association image of the city or region (Landry, 2008), and can be regarded as the composition of developing strategy of city (Riza, Naciye, & Mukaddes) (Kavaratzis & Ashworth). It is not only a business card for the world to know a city, but also a most important characteristic for a city to attract industries and residents.

For small and medium-sized towns developing manufacturing as its leading industry, their city brands are usually locally produced products. The case site in this study, Wangqingtuo in Tianjin, developed bicycle manufacturing as its leading industry. The town area is 54.76 km2, with nearly 50000 population. It is called Chinese NO.1 Bicycle Town, which has rapidly formed its own town brand and achieved rapid development with the help of the brand. However, in the process of development, due to the urban space rationing, brand building path and other reasons, after the changes of national and regional industrial strategy and market, the urban development is limited by the brand, so it is unable to carry out industrial transformation and upgrading.

This study analyzed the industrial data of Wangqingtuo from 2011 to 2018, and randomly selected 530 samples and conducted a top-down and bottom-up combined questionnaire survey, to analyze and study the function of brand in urban development, so as to put forward relevant conclusions and suggestions.

3 DEVELOPING TRAP: BRAND SOLIFICATION IN WANGQINGTUO

3.1 Branding tracks

During the development of Wangqingtuo, the pillar industry, bicycle manufacturing, formed the urban brand of the town. And the brand formation and development process are closely combined with the national industrial development and change. In 1966, Wangqingtuo established the bicycle management centre and decided to develop bicycle industry. Then in 2004, 20 bicycle enterprises have obtained ISO9000 certification, and 10 of them have obtained import and export licenses and free import and export rights. In 2012, after the review of the expert group of China's bicycle industry, Wang qingtuo has officially become "China bicycle industry base • Wang qingtuo". And then in March 2013, the industry base was officially awarded the license and signed Chinese bicycle industry agreement. In July 2013, Wangqingtuo took bicycle management center as the service carrier of enterprises and laid a solid foundation for the development of its distinct industries. In this period, there are a large number of small and medium-sized bicycle enterprises in wangqingtuo, but most of them are small or individual workshops. The emergence and development of these enterprises led to the development of Wangqingtuo's economy. Wangqingtuo quickly formed and solidified its urban brand and achieved development with the help of brand effect. But at the same time, these enterprises have played a destructive role in the environment and industrial quality.

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From 2015, China proposes to change the mode of economic development, optimize the economic structure and promote high-quality development. China's manufacturing industry is becoming more and more high-end and innovative and paying more attention to the environment. Under this circumstance, the number of bicycle enterprises in Wangqingtuo kept decreasing. In 2016, Wangqingtuo has 740 bicycle and bicycle-related accessories enterprises. Then the town administered "Scattered, disorderly and dirty" and shut down 72 bicycle enterprises in 2017. In 2019, there are about 400 enterprises in the town.

3.2 Developing bottlenecks

In 2015, China gradually implemented the general strategy of manufacturing upgrading. In this period, under the condition that the production capacity of the bicycle industry is basically stable, the industrial output value of Wangqingtuo fell precipitously in 2015 and failed to recover in 2017. The whole town shows the trend of large fluctuation of industrial output value and growth rate with the decrease of investment. The driving effect of urban brands is getting weaker.

On the one hand, it is due to the transformation of the national industrial manufacturing industry and the adjustment of industey structure, the country proposed to eliminate the inferior production capacity from the perspective of environmental protection and high-quality development. On the other hand, it is because local marketing campaigns are presented in the form of price campaign rather than product quality campaign. This directly led to the shut-down of most Wangqingtuo's enterprises during the adjustment of industrial strategy and structure at the macro level. And urban brand lost competitiveness in the macro environment of high-quality development. Meanwhile, the external market advocates product campaign more. Only high-quality and innovative products can maintain their position in the market. Thus, Wangqingtuo's urban brand influence is gradually replaced by other towns.

In this case, the production capacity and the market will show allometry presented by inconsistent growth and decline. After the solidification of urban brand in manufacturing cities and towns, external recognition of urban brand is decreasing, which leads to the city's or town's weak competitiveness. However, the cities and towns could not adjust the production capacity structure in time with the market changes, which led to consistent bicycle production capacity in Wangqingtuo when the total industrial output value was halved. This reveales that there are inefficient and useless bicycle production capacity in Wangqingtuo, which forms further development bottlenecks.

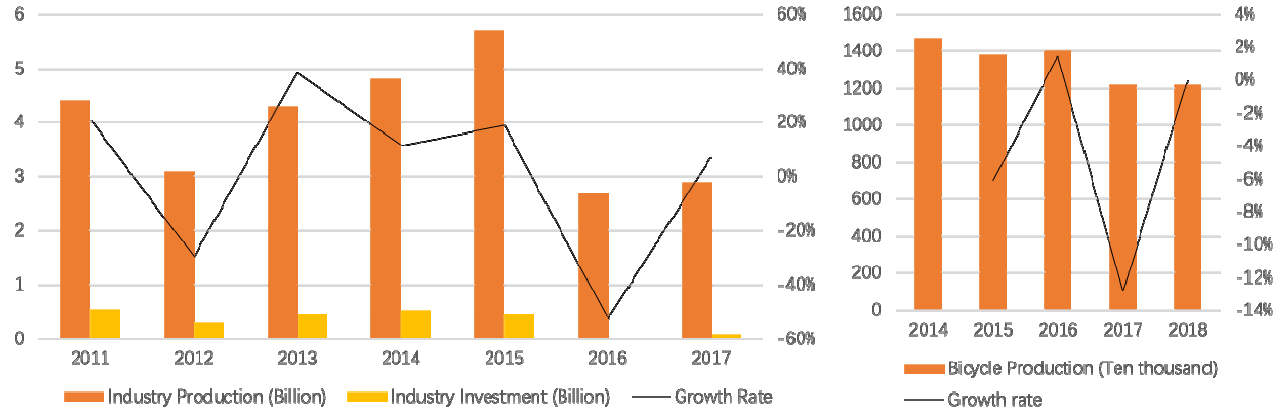

Fig. 1: Town industry development in recent years (left). Town bicycle industry development in recent years (right).

4 VISION OF CITIZENS AND GORVERNMENT

We randomly selected 500 villagers from 22 villages and streets in the town to conduct a questionnaire survey, and 465 valid questionnaires of residents were generated. And we selected 30 leaders and staff of the town government to conduct the same questionnaire survey, and generated 30 valid questionnaires.

As for the internal development power of cities and towns, we investigate from the cognition of insufficient development. The residents generally think that agriculture, bicycle and other manufacturing industries are underdeveloped. However, it can be found that there are occupational preferences in each profession and think that there is insufficient development in the industry they are engaged in, after we subdivided the

occupation. From the government's point of view, manufacturing is still the main shortage, but they think that the main reason is that other manufacturing industries are underdeveloped rather than bicycle industry.

But for the restriction of urban development, the cognition of both sides is consistent. Both sides agree that the most important constraint is the lack of policy support. The difference is that the collective cognition of residents shows that there are various problems and limitations in urban development, and these limitations generally show the characteristics of homogenization and distribution. But government officials believe that only policy, market and resource are constraints. However, the reason for agreement on policy support deficiencies is not only due to the adjustment of national policies, but also related to regional competition. The urban brand is not reflected in the improvement of industrial quality, so it formed a negative solidification. The external recognition of Wang qingtuo's brand is a low-end industry that has a negative impact on the environment, so it is unable to form an effective competitiveness at the regional level (Wuqing District, Tianjin) and strive for policy support. Totally, the government and residents have both seen the restrictions of solidified city brand on urban development, and are hoping to break through the influence of negative solidified effect, modify or even change the city brand.

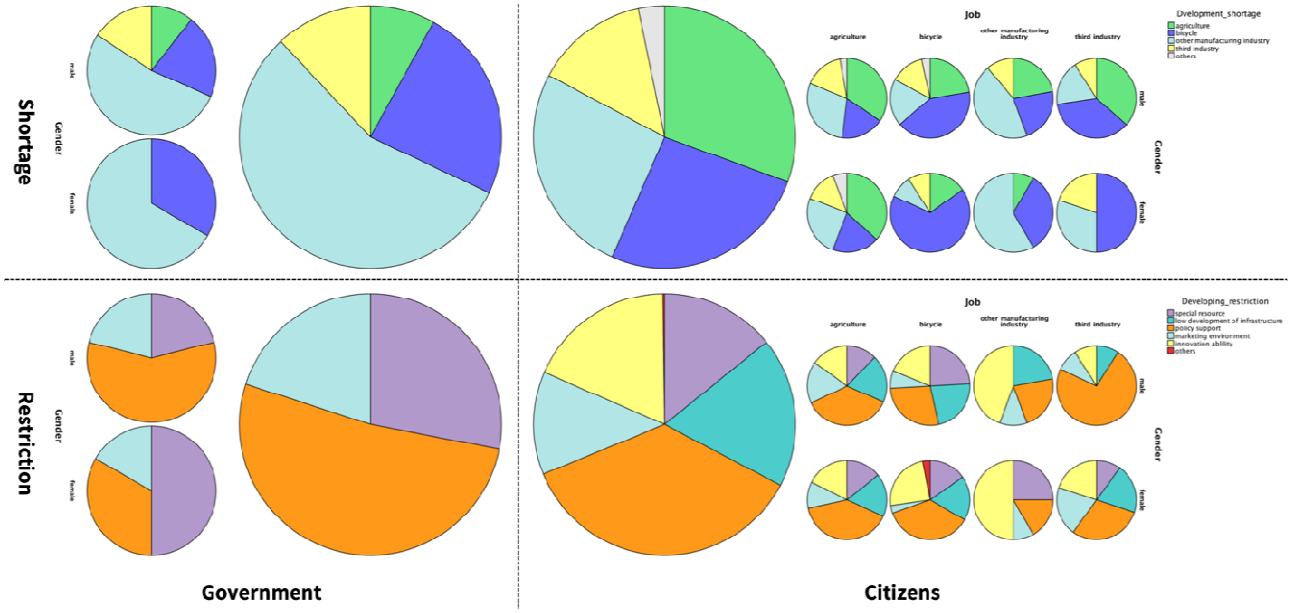

Fig. 2: Questionnaire results of development shortages and restrictions.

5 CONCLUSION

Overall, the brand image of small towns has similar features with their industry, that their industrial structure, development path and urban brand are easy to solidify. In the rise period of industry, urban brand will promote the rapid development of cities and towns and attract a large number of economic flow, flow of means of production and population flow. But when the industry develops slowly or even stagnates due to national/regional policy, market changes, management and other issues, the development of such towns will be affected by their solidified town brands and the brands will become a restrictive element of development.

Therefore, in the process of urban brand formation, cities should start from the industry that the brand relies on, to develop the upstream and downstream of the industrial chain. The upstream has the advantages of high barriers and high profits, and the downstream has the advantages of low barriers and diversification. By giving full play to the advantages of the whole industrial chain, promote the city brand to the outside. At the same time, avoid price competition within the town and enhance the industrial strength, to avoid overly singular city brands, which will limit and bottleneck urban development.

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Study on the Classification Method of Urban Vitality Spatial Pattern Based on Full-Time Vitality Spectrum:A Case Study of Tianjin, China

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2 ABSTRACT

Urban vitality represents the use of urban space. The higher the vitality, the stronger the attraction. How urban space is used in the planning process and how the vitality changes within the space during the day are important evaluation indicators of the quality of urban space. Based on this, this study uses the Internet of Things big data product, the heat map, to change within a day, and draws on the concept of the ground feature spectral curve in remote sensing to propose a full-time urban energy spectral line model. And identify the type of urban space vitality. Taking Tianjin as an example, by classifying and sorting out the temporal-spatial characteristics of urban vitality levels, this paper explores the spatial distribution characteristics of urban vitality in different periods of time, the characteristics of urban vitality changes under day-night contrast, and the spatial distribution of urban vitality types in a full-time perspective feature. Based on the above results, we put forward planning suggestions for Tianjin's vitality promotion and day-night synergy, combined with the business characteristics of key areas, and put forward targeted urban renewal measures and corresponding policy recommendations.

Keywords: Full-time, Vitality spatial pattern, Urban vitality spectrum, Tianjin, China

3 INTRODUCTION

Vitality is the vigorous vitality, and refers to the ability of things to survive and develop. Urban sociology believes that urban vitality is composed of economic vitality, social vitality, and cultural vitality. Spatial vitality is merely a spatial representation of above three parts[1]. Urban planning and architecture pin the vitality on physical spaces such as settlements or streets, expressed as the ability of residents' life diversity, species continuity and use intensity. Vitality study is one of the mainstream research directions in the field of urban planning[2]. In 1961, Jane Jacobs analyzed the vitality of street perspectives and proposed it was composed by mixed-use plots, blocks of appropriate scale, mixed-age buildings and high population density. His study is the beginning of research on urban vitality[3]. In 1977, Alexander proposed that urban vitality was affected by the combination of event mode and spatial mode. The connection between cultural activities and public space formed the basis of urban vitality[4]. The above researches represent two perspectives of existing vitality research in planning science: environmental perspective and event perspective. This study uses Baidu's heat map to characterize the intensity of space activities, defined the vitality by the degree of crowd activity, and explores the spatial and temporal characteristics of urban spatial vitality distribution.

In addition, the research methods of urban spatial vitality have gone through three stages[5-7]. In the past, researches were explained from a qualitative and subjective perspective, for example, by constructing a spatial vitality evaluation system and calculating the probability of event occurrence. Later, it has been developed through voluntary geography Information and data to analyze the impact of small-scale spatial vitality, which is shown in space-time geography. With the development of communication technology and the quantitative analysis revolution, big data has provided new technical methods and data to support for the study of spatial vitality. Some scholars constructed a Social Sensing theory that provided a theoretical framework for urban space characterization through Geo-data and GIS technology[8,9]. In China, Internet map supplier such as Baidu and Gaode recorded the latitude and longitude information of service calls on mobile phones to integrate and form heat map products, which own a wide range of practical and scientific value. This study is based on the concept of social sensing, using heat map products and other data to classify urban space under Tianjin case.

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4 DATA AND STUDY AREA

4.1 Data resource

Heatmap is a new kind of big data visualization product, which was launched by Baidu in 2014. This product is based on the geographic location data collected from mobile phone APP. Through a certain spatial expression processing, it is finally presented to users with different grades of clustering. That is, the distribution of the population in the city is described in real time by different color blocks superimposed beyond on-line map. Specifically, it is based on the location information carried by smartphone users when accessing Baidu products (such as search, maps, weather, and music, etc.). Then calculate the crowd density and speed of crowds in each area to reflect the spatial differences in the flow of people with different colors and brightness.The heatmap is displayed on the mobile phone in the form of tiles. According to the scale of the acquisition area, it can be divided into 12-17 levels of spatial resolution. In each level, 7 types of RGB color differences are obtained by inversion. The colors correspond to 7 levels of vitality intensity, respectively, representing extremely low vitality, low vitality, lower vitality, medium vitality, higher vitality, high vitality, and extremely high vitality. This study uses Baidu heatmaps that are updated every half an hour (0-24 o'clock) during the whole day (0-24 o'clock) on November 21, 2019 (Wednesday).

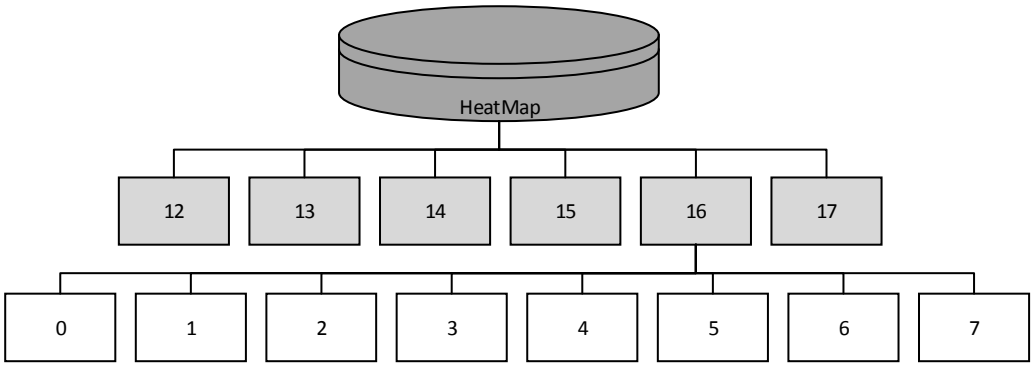

Fig.1 frame of Baidu heatmap product

4.2 Study area

Tianjin is one of the four major municipalities in China, with a resident population of 15.956 million and a total area of 1007.91 km2. In this study, the area within Tianjin's outer ring road was used as the research area, with a total area of 548.97 square kilometers. The Haihe River as an important tourist natural resource passed through the area. Judging from the light conditions at night, this research area covers Tianjin's main economic and social activity areas, and the study is meaningful of megacities with a population of more than 10 million.

5 METHOD

In this study, the 48 pieces of obtained heatmaps is collected into a raster dataset, and the curve is established of each pixel. The curve is called the vitality spectrum. Based on the temporal characteristics of vitality spectrum lines in specific time periods, specific areas, and specific change patterns, the spatiotemporal characteristics of Tianjin's spatial vitality types are summarized. Based on the above results, it is divided into tidal space, quiet space, active space, and transition space.

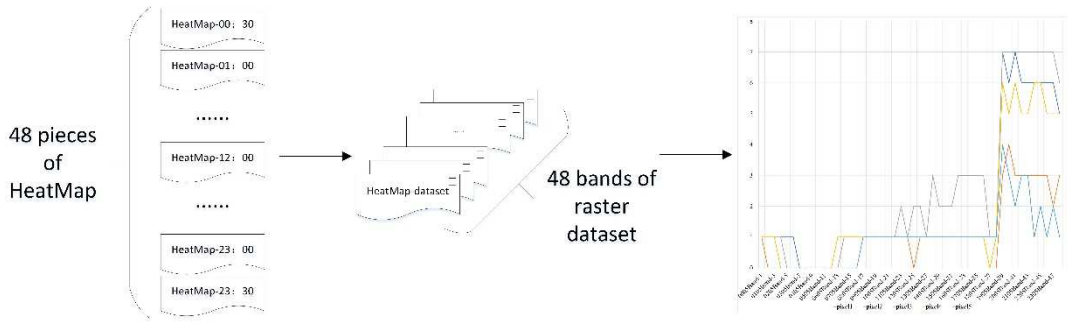

Fig.2 Technical route

6 TIANJIN'S VITALITY SPATIAL PATTERN

6.1 Level Study

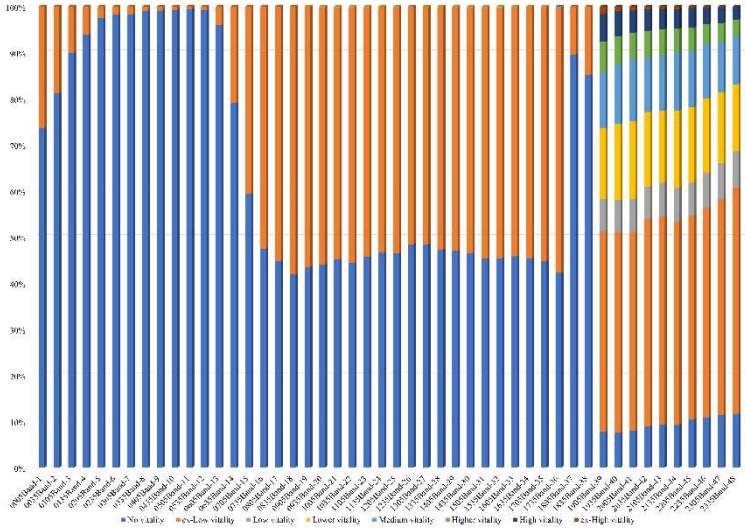

Fig.3 Temporal change of heat level ratio

According to the change of the heat level in a day, the city vitality of Tianjin's 24-hour cycle can be divided into the following phases: 0-5 o'clock means late night period, 6-9 o'clock means morning period, 10-17 o'clock means working period, 18 -23 o'clock means night activity period. At 0-5 hours, there are still some previous-day activities in the city that have not ended. As time progresses, the active public facilities and businesses in the city gradually go out of business, and the city begins to enter the sleep rhythm. At this stage, it shows a decline in urban vitality and heat levels. At 6-9 hours, the city enters the morning busy hour, and the working commute increases, which shows that the level of urban vitality rises and the speed is faster. After 10 o'clock, the morning rush commute phase ends, and the city enters a period of smooth operation. Until 17:00, the city's vitality fluctuates little. After 18:00, the city changed from the working mode to the night active mode. According to the data, the vitality level in the city has changed greatly, from the original 0-1 two-level change to the 0-7 eight-level change. For comparison, the reason for this phenomenon should come from the data itself. Therefore, this study does not explore the difference between day and night, but only performs dimensionless processing at the same time. After analyzing the changes in the area of urban vitality level after 19:00, it can be found that the overall decline of vitality in Tianjin after 19:00, the areas of extremely high activity areas, higher activity areas and high activity areas decreased, and the areas of extremely low activity areas increased. Gradually enter the quiet phase in the middle of the night.

6.2 Pixel Study

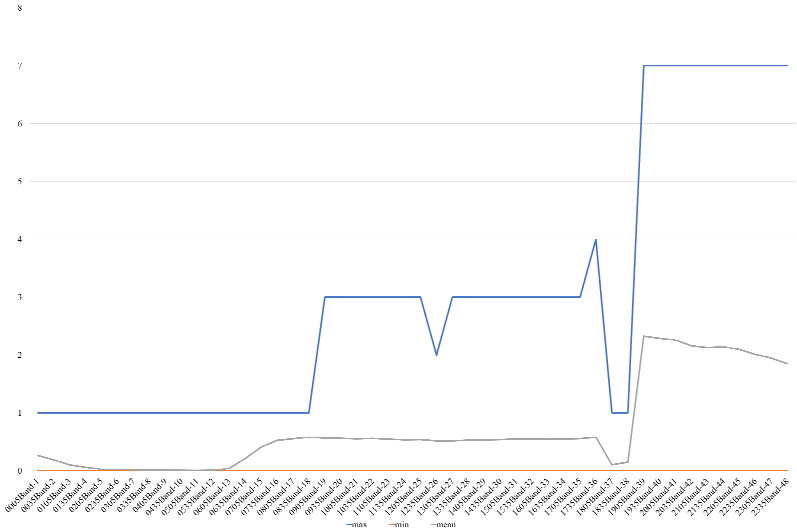

Fig.4 Vitality Spectrum of maximum, minimum and mean heat level

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Analyzing the changes in the maximum, minimum, and average values of the heat level in Tianjin in one day, the above rule can also be found. It is worth noting that the maximum value change curve during the daytime working period has an increase lag from the average value. The trend of active areas and overall vitality varies in individual day. By calibrating the above-mentioned areas with special phenomena, we can find that several locations are typical first-class hospitals, retail centers, and financial centers in Tianjin. Compared with the situation before 12 am and daily life experience in Tianjin, Tianjin residents are used to going out for dealing affairs at afternoon, and the space with functional priority has become the first choice for people to gather. The spatial vitality polarization caused by the scale effect is the main driving force of daytime urban operation in Tianjin.

6.3 Vitality Spatial Pattern

Fig.5 spatial distridution of heat level at 6 time spots

This study selected six time points: 00:34, 07:04, 10:34, 12:34, 19:34 and 22:34 for comparison. From 0-7 o'clock, the city enters the working commute stage from sleeping, and the vitality of the city increases significantly. The vitality area increases, the area of vitality plaques increases, and the vitality upgrade in the study area is evenly distributed. From 7 am to 10 pm, the city transitions from the morning traffic state to the working state. The level of urban vitality continues to rise. The area of vital plaques in the central area of the city has expanded and formed patches, forming a pattern of daytime urban crowd activity. A small number of roads in the city have obvious vitality, indicating that the road has more traffic at this momen. From 10 am to 12 pm, the urban space vitality changes little, and the overall vitality distribution area slightly diminishes, indicating that Tianjin residents have no obvious travel trend during the lunch break. At 19:00, the city entered the night economic time, and the overall vitality of the city increased significantly. It can be seen that local residents have a certain preference for night trips and activities, and the highly dynamic areas are located in the central area. The circle is a typical representative. The southern of the Haihe River has higher vitality than the northern bank. By 22:00, the night activity entered a declining period, and the vitality of the city declined. Only a few entertainment business districts remained with a certain degree of vitality. The city slowly entered the sleep rhythm.

6.4 Space category

Based on the analysis of residents' full-time behaviors and travel characteristics, this study initially considers the space into four categories: quiet space, active space, tidal space and transition space. Quiet space refers to

the area with a small number of users during the whole period, including industrial land, storage land, etc.. Active space is typically represented by business districts and has full-time vibrant urban space. Tidal space is shown significantly dynamic characteristics between daytime and nighttime, such as urban space such as CBD. Transition space refers to the area where the characteristics of vitality change are not clear. In this study, four types of space are distinguished based on the time line of the vitality level: if 80% or less of 48 bands of pixel is lower than average grade ,it is regarded as a quiet pixel; if 80% or more of 48 bands of pixel is higher than average grade, the average value is determined as active pixels; when the vitality level of the pixel shows the opposite situation during the day and night, it is considered a tidal pixel; when the vitality level of the pixel frequently fluctuates near the average value, it is considered to belong to the fourth type of space, the transitional space.

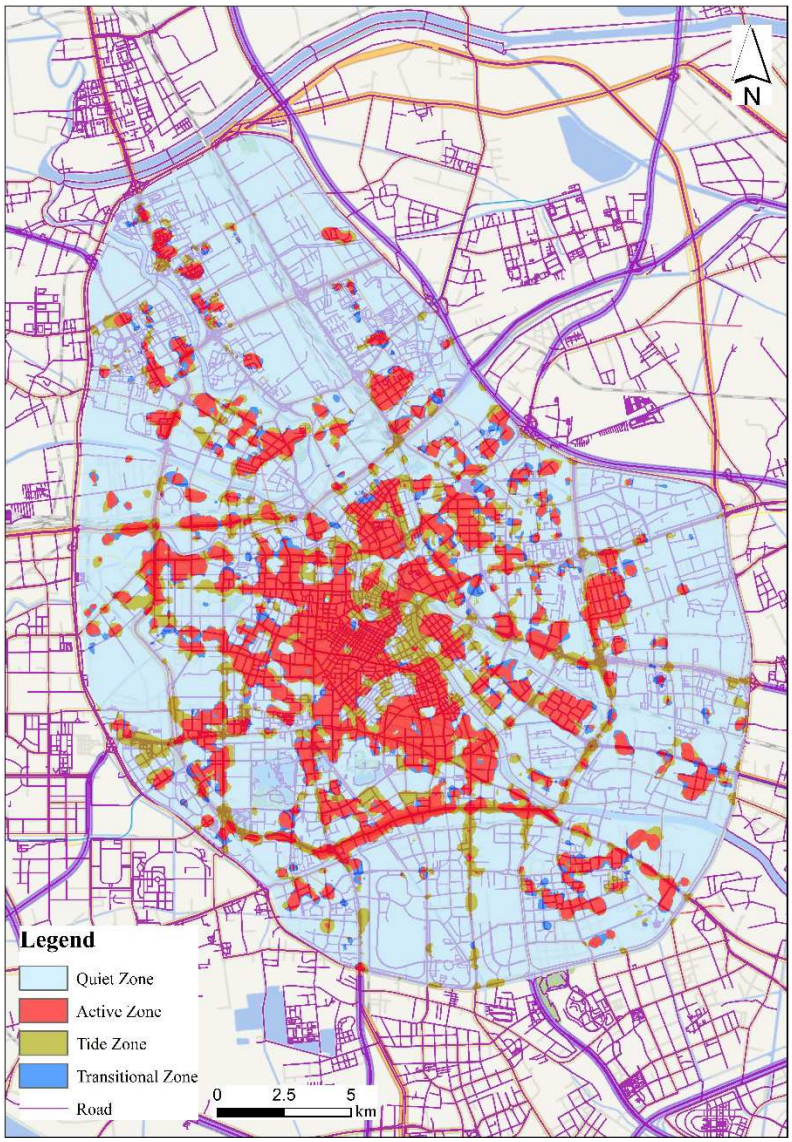

Fig.6 vitality space classification result of Tianjin core area

Through the above classification method, the type recognition of the areas within the outer ring road of Tianjin was performed, and the obtained results are shown in the figure above. Analyzing the spatial pattern characteristics of the vitality types in Tianjin, it is found that Haihe River, as the birthplace of Tianjin, has a strong interference effect on urban vitality. More than 50% of the active space is distributed on the southwest side of it, and its integrity is strong.Patches of vitality distributes independently, the size of patches is basically in line with the scale of the block. In the study of vitality, each block is relatively independent, and the level of activity is not much different. The diffusion effect caused by the vitality of one block isn't significantly stronger than that of other blocks. As a typical tourist area, the Italian style area and Xiaobailou area in the middle of the Haihe River show obvious tidal attributes. It is a dynamic area that promotes urban culture and promotes tourism development during the day, but lacks vitality at night. The blue-green space

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and scenic spots in the city are all quiet spaces. For example, the Five Avenues Tourist Area is located in the southwest side of the Haihe River. It is a quiet space in an isolated and active area. The transition space mostly appears in the outer area of the study area, mostly in the northeast direction, and is wrapped around the small-scale active plaques, indicating that these active plaques have initially attracted popularity, but due to their size and function, the attraction point of vitality has a weak driving effect on the surrounding area.Urban planning can be optimized and organized for specific function combinations.

7 CONCLUSION

The spatial classification method based on heat map in this study has certain practical significance in the study of spatial vitality pattern. This paper can basically achieve the goal of evaluating the type and spatial pattern of urban densely populated areas through Baidu real-time heat map products. Taking the core area of Tianjin as an example, the 24-hour data on November 21, 2019 were processed. The analysis results are as follows: The full-time urban vitality spatial pattern is that the southwestern region is more active, more widely distributed, and the active areas in the northeast of the Haihe River are scattered The connection between the vitality areas in the northeast should be strengthened; the number of peripheral vitality plaques is large and the area is small, and there is a need to plan for vitality improvement and transformation to make it a new space active pole.

From a methodological point of view, this method studies the distribution of urban space vitality from a macro perspective through data methods, which can be used as a pre-analysis and analysis of urban vitality enhancement construction. It is also hoped that through this thesis, more scholars will be able to focus on China's urban data construction, and more data sources will be used in urban planning and construction in the future. Of course, there are still many deficiencies in this study, such as: there must be more data verification of urban space vitality on weekdays, how to adjust the underactive areas needs further in-depth analysis, whether the active areas are too active and form negative space. The above issues urgently need further research and discussion.

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Supporting the Transformation Process to Smart Sustainable Cities in Switzerland: Implementation Guidelines and Promising Practices

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1 ABSTRACT

Challenges such as the digitalisation of administration, the change of cities through urbanisation, climate change and the restructuring of infrastructure systems in the energy and mobility sector require a rethinking of the existing urban development approaches. The Smart City concept enables cities to tackle these challenges in the sense of a holistic development approach across departments, networked with partners and supported by digital technologies. In Switzerland's view, the Smart City concept goes far beyond internal administrative e-government and digitisation strategies. The overriding goal is to develop efficient and resource-saving solutions while at the same time increasing the quality of life and the attractiveness of the location. The overall aim is to create an innovative urban environment that involves the inhabitants and the economy and opens up new design possibilities.

Keywords: digitisation, sustainability, smart city, e-government, holistic approach

2 CONCEPT OF SMART SUSTAINABLE CITIES

2.1 Transformation process based on an integrative approach and the use of ICT

Science and practice agree that Smart City is a concept that provides solutions for the future challenges of cities (cf. Moser et al., 2014). The aim is to create a progressive, networked city that is characterised by a high quality of life for its inhabitants and an efficient use of the required resources (Zwahlen et al., 2016). The path to this goal is to be achieved through a transformation process based on an integrative approach, i.e. focusing on intelligent networking of all relevant actors (e.g. in public-private partnerships with the city's commitment) as well as (urban) fields of action and (new) technologies. This integrative approach should be reflected above all in the smart city activities of the cities. Information and communication technologies (ICT) play a key role here: many practical projects already use ICT, and from a scientific point of view ICT is seen as a necessary framework for smart cities to network fields of action, technologies and stakeholders (cf. e.g. Peris-Ortiz et al., 2017).

2.2 Growing interest in Switzerland for promising smart city use cases and transitions

In comparison to the European pioneers of smart cities, such as Vienna, which already positioned itself as a smart city in 2010, developed a smart city framework strategy based on a broad stakeholder process, set up a monitoring process and established entire smart neighbourhoods in partnership with companies, cities in Switzerland are still at the beginning of their development towards a smart city. This can be attributed to the fact that large cities are more attractive for investors. Cities in Switzerland are expanding their networks and exchanging information with each other, for example in the Smart City Hub Switzerland with companies close to the federal government, in order to serve them as test environments before the nationwide rollout of promising implementations. This networking is intended to make up for the difference in scaling between megacities. Scaling should only be considered for successful projects. Pilot projects allow administrations and companies to identify new fields of application (use cases) and develop marketable services based on them. The general interest in Smart City projects is currently growing significantly in Switzerland, but for most municipalities it is still unclear which use cases can generate local added value and immediate benefits. The first pilot projects will be realised by upgrading the existing infrastructure, such as enhanced broadband connectivity, area-wide fibre-optic network, LoRaWAN, sensor technologies and Internet of Things (IoT), smart grids, smart meters, diffusion of e-mobility and smart lighting systems. Future-oriented transformation processes involving relevant actors are increasingly emerging in Switzerland in order to become Smart Sustainable Cities & Communities. Scenario developments can help in the transformation of cities by

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initiating processes and opening up new perspectives in the transition to a Smart Sustainable City. In addition, the holistic, integrative nature of scenarios can provide a basis for guiding principles, strategies and action plans (Eschenauer et al., 2017) including the upscale of promising Smart City use cases.

2.3 Holistic and participative understandings for sustainable transformation processes

Cities that are committed to sustainable urban development take equal account of technical, social, ecological and economic aspects in their actions. This starting position can form a good basis for cities to begin the transformation process towards a Smart Sustainable City and to shape it successfully in the long term (cf. Peris-Ortiz et al., 2017). Today's Smart City pilot projects focus on the integration of different technologies and areas, the introduction of information and communication technologies and questions of integration and participation of the population (e.g. European Union, 2014).

3 FROM PILOT PROJECTS TO SMART CITY INITIATIVES AND IMPLEMENTATION

3.1 Smart City strategies and pilot projects

Many cities are currently on the way to becoming a Smart City. The most advanced cities have developed smart city strategies that build on and complement their long-standing experiences of sustainable urban development (cf. Bisello et al., 2017). In some cities there are already pilot projects in the form of living labs or urban districts in which smart city approaches are to be developed and tested for a city-wide rollout. Other cities have first experiences in the implementation of individual, topic-specific Smart City pilot projects.

3.2 Promising pilot projects and initiatives to advance smart sustainable cities

One possible solution for reducing energy consumption of street lighting is smart LED lights that only light up when someone is using the street. In addition, the street light could communicate with other lights and traffic sensors via an IoT network, produce electricity itself with a PV system or supply vehicles with electricity as an electric car charging station. New business models and participatory approaches are needed not only to meet the needs of the residents, but also to integrate them into the development process of solutions through co-creation. Further examples are "Share your Bicar", a PV electric vehicle sharing system geared to urban areas, or "Social Power Plus", which aims to raise awareness of energy system transformation among the population through gamification, energy-saving tips and feedback on their own energy consumption. The ZHAW's "Virtual Smart City Hero" project includes a virtual reality game that enables the inhabitants of a city to experiment with an emerging technology while at the same time recognising the potential of a Smart City (cf. West et al., 2019).

In Switzerland and elsewhere, cities moved from pure energy related governance activities such as the European Energy Award for local authorities towards an implementation of broader Smart City initiatives. These activities might accelerate the transition process of cities, since a joint governance and management of energy, mobility and housing issues is applied with the help of ICT. However, the number of successfully realized Smart City projects is still low. There seems to be a large gap between policy visions and implementation. Especially since one third of medium-sized and large cities are expected to define their Smart City roadmaps within the next few years, research governance of Smart City implementation is of key importance.

4 SUPPORTING SMALL AND MEDIUM-SIDZED CITIES

For the majority of small and medium-sized towns and municipalities in Switzerland, the introduction of the smart city theme is challenging. While pioneering cities have already gained initial experience in the implementation of smart cities in recent years, smaller and medium-sized cities need adequate support to get started. In order to meet this need, guidelines have been drawn up on behalf of the Swiss Federal Office of Energy (SFOE) in collaboration with a stakeholder support group. The guidelines present various steps, instruments, variants and practical examples for the implementation of smart cities (cf. figure 1), from which interested cities can choose according to their needs. These guidelines therefore not only summarise the relevant literature and experiences from pioneering cities, but also enable cities and municipalities to develop their own understanding and appropriate measures to implement their Smart Cities. In this respect, they support cities in the development, selection and implementation of project ideas. Once the cities have gone through this phase, many cities want to approach the implementation of Smart City by means of an

overarching strategy and a corresponding organisational unit. For this institutionalisation phase, the guidelines present all relevant steps as illustrated in figure 1 (SFOE, 2019).

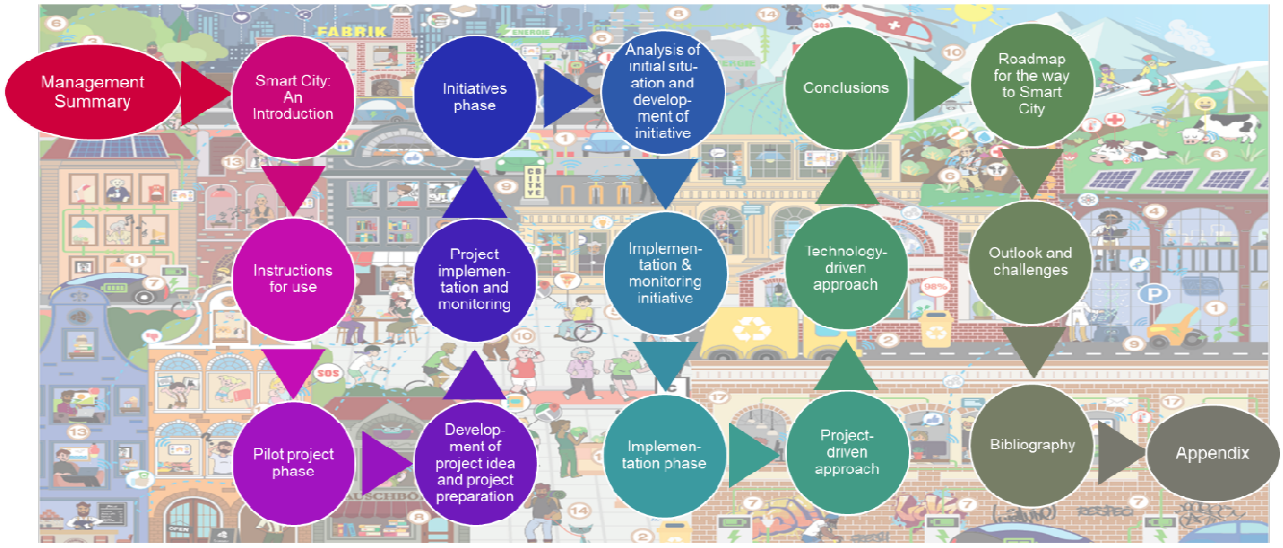

Figure 1: Steps towards Smart Sustainable Cities as illustrated by the Guidelines for Smart City Initiatives (SFOE, 2019)

The ZHAW supports cities and municipalities on their way to Smart Sustainable City and the associated solutions. This can be achieved through the intelligent networking of infrastructures with modern technologies, social innovation and the integration of relevant actors as well as transformation management, process support or support in strategy development. With the specially created ZHAW Smart Cities & Regions platform, the ZHAW bundles competencies and experience across its institutes in order to use them to identify future business areas and innovations, apply promising use cases, implement co-creation platforms, and to work within the Smart City Alliance on the integral or partial handling of future-oriented smart city developments in such a way that quality of life and resource efficiency are increased.

5 CONCLUSIONS

The results of the Smart City research so far (e.g. Furrer et al., 2018) show that there is a need for research first concerning the implementation of pilot projects as well as the coordination and management of an innovation community. In these new urban systems, technologies, infrastructures, organisational structures, regulation and the behaviour of people will interact systemically. Their co-evolution has not yet been sufficiently researched. Maturity models and corresponding tasks for transition management are of particular interest. Therefore, the design, management, implementation and monitoring of successful Smart City projects should be investigated in further research projects in order to provide recommendations for the management of holistic Smart City programmes. The development towards a Smart City is a long-term and complex transformation process to which many technological, institutional and organisational changes contribute. This requires coordinated actions of all relevant actors such as companies, politics and administration, investors, households and research institutions. Ultimately, the aim is to establish and further develop a comprehensive innovation system in which actors enter into new cooperations and build networks.

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The Inclusive City of Johannesburg and the Challenge of Affordable Housing

Edith Hofer, Stefan Netsch, Katharina Gugerell, Walter Musakwa, Trynos Gumbo

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1 ABSTRACT

Johannesburg, as South Africa's largest city and the most important economic center, still suffers under the patterns of inequality of the past. Although the spatial change has been rapid since 1994 after the post-apartheid era, the spatial divisions along class lines still remain. Strategic spatial planning strategies of the last two and a half decades were targeting the reduction of spatial patterns of inequality and exclusion by fostering compact and integrated spatial development on national, regional and urban level and currently the local provision of inclusionary housing. This study, based on literature review and census data evaluation, investigates the current challenges of Johannesburg, such as growing population, existing inequalities and the affordable housing backlog. Moreover, the current affordable housing programmes and new policy requirements in Johannesburg are described and analysed. Despite the release of numerous city-wide policies, such as the Spatial Development Framework 2040 (2016) or the Inclusionary Housing Policy (2019) the research shows that the situation has not significantly improved yet, which is indicated by a lack of restrictions in the requirements, implementation deficiencies and limited policy uptake in planning practice.

Keywords: inclusionary housing, affordable housing, low income, mixed use, development

2 INTRODUCTION

The UN-Habitat (2015) SDG goal to "make cities and human settlements inclusive, safe, resilient and sustainable" until 2030 is a noble goal. Accordingly, this study examines Johannesburg through the lens of social inclusion of lower income households in housing. Johannesburg can be seen as an example of urbanity in the global South, therefore linkages of urban transformation processes can be drawn between Johannesburg and other cities in the world (Harrison, Gotz, Todes, & Wray, 2014). Inclusivity is a central topic in many policies at national, regional and city wide level. Our study focuses at the city level and looks at city and above the new policy on Inclusionary housing, which was approved by the City of Johannesburg in February 2019, and nodal policy. These policies are an attempt to promote equality and inclusion in the city of Johannebsurg. The structure of the study is as follows: first the status quo in Johannesburg is described with regard to the population, existing inequalities and housing backlog. Furthermore, affordable housing programmes and requirements of the Inclusionary Housing Policy are explained. In the conlusion and outlook we give an overview about the obersvations and results.

3 STATUS QUO IN JOHANNESBURG

In this section the growing population, existing patterns of segregation and inequalities including a definition of income levels and their distribution as well as the lack in the housing stock are described.

3.1 Population

Johannesburg, as South African largest city and important economic center, is located in the Gauteng province. (Todes, 2012) Its population increased from 2.63 million people in 1996 to 4.95 million in 2016. Johannesburg attracts many people due to its high economic growth and employment opportunities. Most migrants came from elsewhere in South Africa (92%), the Southern African Development Community (6%) (SADC) and the rest of the world (STATS SA, 2018). The population growth, as well the significantly decreasing number of persons in a household lead to high demand for housing . The average household size declined from 3.5 in 2011 to 2.7 in 2016. (Harrison et al., 2014)

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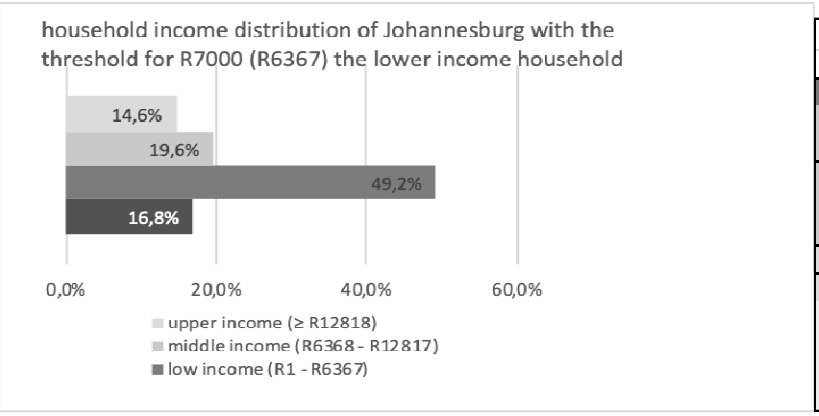
Table universe: Population

Column →	City of Johannesburg, Gauteng
Asia	0.4%
Born in South Africa	92.1%
Latin America and Caribbean	0%
North America	0%
Oceania	0.1%
Rest of Africa	0.5%
SADC	6.3%
United Kingdom and Europe	0.5%
Unspecified	0.1%

Table 1: Region of birth (Wazimap, 2016)

3.2 Segregation and inequalities

During the Apartheid segregating patterns where established in South Africa, which divided people by race. Since the end of this era in 1994 the spatial change within the city was rapid The city spread further and in the north of the city a deracialisation of the middle class could be observed, but spatial divisions along class lines still remain (Todes, 2012). This is despite attempts at a spatial vision to develop a 'compact integrated city'.Accordingly, spatial integration was included in national policy and legislastion in the post apartheid era. Some positive expamples for the implementation of policies were improving conditions in townships, developments and densification along nodes, mitigation of urban sprawl and levels of desegregation in upper income areas. While on the other hand, large low or low to middle income developments like Cosmo city, as well as middle to high-income gated communities were built on the edge of the city. Examples of 'privatised urbanism' for this high-income bracket include Steyn City and Waterfall City. (Ballard, Dittgen, Harrison, & Todes, 2017) South Africa, as well as Johannesburg are one of the world´s most unequal societies in the World. (SDF 2040, 2016; Turok, 2018). This is underlined by the fact that the average household income per month is R15270 while more than 50 % of households earns less than R3500 a month (SDF 2040, 2016; STATS SA, 2011). According to the definition of Inclusionary Housing Incentives, Regulations and Mechanisms (2019) households earning R7000 or less define the low-middle income bracket. Fig. 1 shows the distribution of household income per month in Johannesburg. This inequality is mentioned as the major concern of SDF 2040 (2016) and other policies at national, provincial and municipal level. The SDF 2040 (2016) postulates "if Johannesburg is to become an inclusionary city, it needs to make space for the urban poor majority through planning initiatives such as densification, diversification and integration." Therefore, the housing backlog, mentioned in the sub item 3.3, and the distribution of household income in Johannesburg should be addressed. The provision of housing should be in relation to the income distribution. "As such 25 % of affordable housing should be for households earning below R1751 a month, 15 % for the bracket R1751 to R2487 and 10 % for the income bracket of R2487 to R3543." (SDF 2040, 2016).



monthly household income according to STATS SA (2011)			percentage
R 0			16,8%
R 1	to R	400	3,1%
R 401	to R	800	4,4%
R 801	to R	1633	10,7%
R 1634	to R	3183	16,8%
R 3184	to R	6367	14,2%
R 6368	to R	12817	10,5%
R 12818	to R	25633	9,1%
R 25634	to R	51200	7,7%
R 51201	to R	102400	4,5%
R 102401	to R	204800	1,6%
R 20801	to		0,8%

Fig 1: household income distribution in Johannesburg with the threshold of R7000 or according to available data of STATS SA (2011)

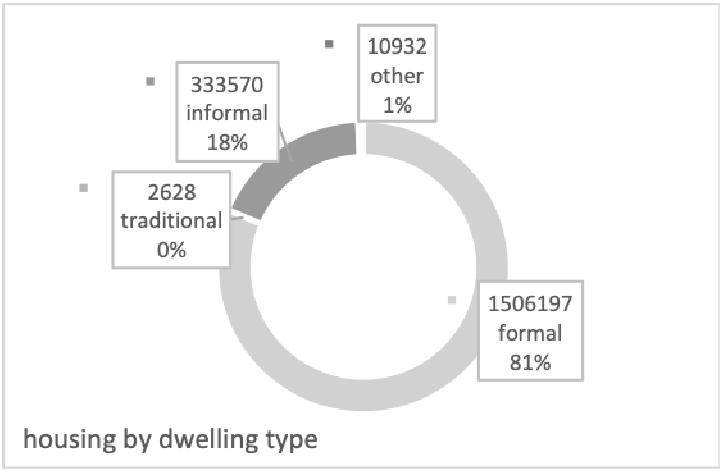


Fig. 2: Distribution of households by type of main in Johannesburg (numbers of households and percentage) (STATS SA, 2018)

3.3 Housing backlog

According to STATS SA (2018) 18 % of all households, in Johannesburg live in informal dwelling units (see Figure 2). Compared with Census data of 2011 these are 83805 households more. There is not only the increase of households living in informal settlements but also a growing backlog as a proportion of total household dwelling units. This housing backlog is one of the major concerns of the City of Johannesburg that has led informal settlements, packed public hostels and inner city overcrowding, backyard accommodation, the burgeoning housing waiting list and homelessness. (City of Johannesburg, 2018a) To demonstrate what the housing needs are, the municipality has to deliver an Integrated Development Plan (IDP) every 5 years (GroundUP Staff, 2017). Within the IDP City of Johannesburg (2018a) an improvement of housing conditions, as a provision of basic services like access to water, electricity and waste removal is targeted. Besides an increase of housing delivery, partnerships with the private sector and the community are addressed. The city contributes to some key projects, like the upgrading of informal settlements and shacks and the provision of basic services, the construction of mixed income housing, social housing and rental housing within the city centre and along transport corridors. In addition, temporary accommodation must be provided by the city to certain displaced persons in case of emergency. These emergency shelters and temporary housing has been built in the inner city. However, the city occasionally has to deal with the following challenges. On the one hand, it should increase funding to enable the provision of subsidised housing at an acceptable level in the face of rising land prices, and on the other hand, the city must consider the accessibility of housing for the low income level as a major concern. (City of Johannesburg, 2018a) The continuously growing population of Johannesburg, mentioned in 3.1, and the huge share of the low-middle income households lead to a housing demand especially in this category. According to Census data (STATS SA, 2011) around 66 % of all households refer to the low-middle income category related to the definition of Inclusionary Housing Incentives, Regulations and Mechanisms (2019) (see 3.2).

Against this background, the South African government and especially the City of Johannesburg have developed some policies, housing programmes and initiatives to address these issues

4 AFFORDABLE HOUSING PROGRAMMES

Affordable housing is defined as a dwelling where the total costs do not exceed 30% of a household's gross income including taxes and insurance for owners, and utility costs. (SDF 2040, 2016)

In the next subsections, different housing programmes in Johannesburg for different income groups will be explained.

4.1 Reconstruction and Development Programme (RDP) houses (government subsidy hosuing) – BNG houses

The government built houses for low-income households earning less than R 3,500 per month under the RDP program. These houses are owned, not rented by beneficiaries. To qualify for these houses one has to be a South African citizen, over 21 years, competent to sign a contract, married or living with a partner, or single and have dependants, and the person should be a first time homeowner and government subsidy recipient. If

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one is a single military veteran or aged person without dependants, he can qualify too. The sale of an RDP house is illegal before a person has lived there for at least eight years. Furthermore, one is not allowed to rent out RDP units. (GroundUP Staff, 2017)

The Department of Human Settlements new policy "Breaking New Ground" or BNG units updated the RDP housing plan. Different types of housing (rented, bought and subsidised) with connected social infrastructure (schools, clinics) and shops are supposed to be integrated in these new developments. The BNG units are supposed to be larger than former RDP units, and consist out of "(…) two bedrooms, a separate bathroom with a toilet, shower and hand basin, a combined kitchen and living room area and electricity installation, where electricity supply is available in the township." (GroundUP Staff, 2017) Within the City of Johannesburg 423 556 RDP units are provided (STATS SA, 2018, p. 41).

4.2 Community Residential Units and Housing Programme (CRU)

This programme targets households who earn between R800 to R3,500 per month and the units for rent and not for sale. This programme is mainly aimed for the refurbishment of inner city buildings and hostels. For the rent, people have to pay municipal rates of the house to the municipality. To qualify for those units one have to be South African citizen, over 18 years old and mentally competent, married or living with a partner or a single person with dependents. Furthermore, people should be registered on the Municipal Housing Demand Database/National Housing Needs Register. There is no restriction if people previously owned a property (GroundUP Staff, 2017)

4.3 "Gap" housing

Households earning more than R3,500 but less than R22,000 per month (which is the minimum amount needed to qualify for a home loan from a bank) can apply for some state-driven housing like for instance Financed Linked Individual Subsidy Programme (FLISP). Besides the higher income level, people have to fulfil the same criteria as that of BNG units. FLISP is a programme, which helps people to obtain a loan for their first house. It reduces the monthly repayment or can be used as a deposit. (GroundUP Staff, 2017) The susidy is depending on the income of the applicant that ranges between R27 960 - R121 626. FLISP is applicable for existing houses and to new buildings. The subsidy is applicable for buying a new or old residential property, a vacant serviced residential-stand, linked to an NHBRC registered homebuilder contract or to build property on a self-owned serviced residential stand, through an NHBRC registered homebuilder. (Department of Human Settlements, 2020)If people sell the house they are not allowed applying for a second FLISP grant. (GroundUP Staff, 2017)

4.4 Social housing programme (SHP)

Under the SHP new housing projects of companies can be subsidised by municipalities or provincial government, if some units are rented as affordable housing. Consequently, costs for building and planning of projects get reduced and can lead to a reduction of rents. This programme focuses on households mainly, earning between R3,500 and R7,500 per month. One is allowed to apply for this programme even if one have been subsidised by another housing project, but not if one own a property. Further, one can qualify as a couple, or single people with dependents. The application process runs through the local institutions or companies (GroundUP Staff, 2017) ,for instance Johannesburg Social Housing Company (JOSHCO).

5 THE INCLUSIONARY HOUSING INCENTIVES, REGULATIONS AND MECHANISM POLICY

The Inclusionary Housing Incentives, Regulations and Mechanism is related and a result of the different legal frameworks like the Spatial Planning and Land Use Management Act, 2013 (SPLUMA), the National Development Plan (2012), the City of Johannesburg Spatial Development Framework 2040 (SDF, 2016) and the Integrated Urban Development Framework (IUDF) (Inclusionary Housing Incentives, Regulations and Mechanisms, 2019). The policy was approved by the City of Johannesburg in February 2019 and came into effect on May 23, 2019. (City of Johannesburg, 2018b)

The City of Johannesburg developed this framework in order to solve i) the existing inequalities of the city, ii) the housing demand of low income households, iii) the lack of social mix in race and income across the city. The targets are increasing housing supply for the lower income, creating a mix of different income

groups throughout new developments and the accessibility of affordable housing units in areas close to jobs and amenities. Further the policy "(…)will serve as a mechanism for land value capture in favour of the City and its residents." Within the city development rights, awarded by the council, usually lead to increasing values. This value add should serve not only the property owner, but also the wider City and its residents.

The policy enables the city to use infrastructure or other investments in such a way that they benefit large parts of the population and result in spatial change. The Framework framework consist of requirements and conditions for inclusionary housing, as well different options that can be chosen by developers. Furthermore, a calculator has been created as a tool for developers and a base for negotiations between the Council and the private developers. (Inclusionary Housing Incentives, Regulations and Mechanisms, 2019)

Inclusionary housing

"A housing programme that, through conditions attached to land use right approvals, require private developers to dedicate a certain percentage of new housing developments to low income and low- middle income households, or to households that may not otherwise afford to live in those developments." (Inclusionary Housing Incentives, Regulations and Mechanisms, 2019)

Dwelling unit

„An inter-connected suite of rooms, designed for human habitat that shall contain a kitchen and with the appropriate ablutions; irrespective of whether the dwelling unit is a single building or forms part of a building containing two (2) or more dwelling units." (City of Johannesburg Land Use Scheme, 2018: New requirements for land use and development, 2019)

Floor area ratio "FAR"

"FAR = Floor Area of a building or buildings / Total Area of the erf or site upon which the building/s are erected" (City of Johannesburg Land Use Scheme, 2018: New requirements for land use and development, 2019)

Residential Building

"means the use of a building/s, excluding a dwelling house and/or dwelling unit, that contains habitable rooms, with or without common ablution facilities and with common kitchen-, dining- and/or lounge facilities such as hostels and dormitories. Such definition includes but is not restricted to hostels, hotels, dormitories, communes, boarding houses, guest houses (excluding converted dwelling houses and/or dwelling units), bed and breakfast and old age homes that may or may not include ancillary frail care facilities." (City of Johannesburg Land Use Scheme, 2018: New requirements for land use and development, 2019)

Township

"means an area of land divided into erven which may be combined with public places and roads as indicated on a general plan, which is used and developed mainly for residential, business, commercial, industrial, institutional, educational or other similar purposes as contained in a land use scheme, or is intended to be so used and developed." (City of Johannesburg: Municipal Planning By-Law, 2016)

5.1 General requirements and conditions

The inclusionary housing programme requires the provision of minimum 30 % inclusionary housing units in each new development that includes 20 dwelling units or more and is in the jurisdiction of the City of Johannesburg. It is a mandatory condition in every land use/development approval in developments of that size. The framework is applicable for both rental and ownership dwelling units and not for residential units as defined under 5.1. These units have to be built on the same site or township as the market units.

Land use or development applications approved before the adoption of this framework cannot benefit from incentives for inclusionary housing. (Inclusionary Housing Incentives, Regulations and Mechanisms, 2019)

5.2 Inclusionary housing options

Table 2 shows the different options a developer has. One of the options have to be chosen in any application for 20 dwelling units or more. (Inclusionary Housing Incentives, Regulations and Mechanisms, 2019) For

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implementing inclusionary housing units developers are benefiting from different incentives, listed in the table too.

Option	Description	Details	Incentives (summary)
Option 1	30% of Dwelling Units are:	Social Housing; or FLISP Housing; or Housing with a rental cap: R2100 per month (2018 prices).	Increase in FAR equal to the total % of inclusionary housing (max 50% increase). Increase in density (in du/ha) to accommodate the extra units. Parking reduction for inclusionary units.
Option 2	10% of the total residential floor area is made up of small units. **At least 30% of total units in the development must be inclusionary housing.**	Minimum: 18m2 Maximum: 30m2 Average: 24m2	Increase in FAR to accommodate the 10% floor area for IH. Increase in density (in du/ha) to accommodate the extra units. Parking reduction for inclusionary units.
Option 3	20% of the total residential floor area is made up of units that are 50% of the average market unit size. **At least 30% of total units in the development must be inclusionary housing.**	Maximum: 150m2 Minimum: 18m2	Increase in FAR to accommodate the 20% floor area for IH. Increase in density (in du/ha) to accommodate the extra units.
Option 4	To the satisfaction (in writing) of City Transformation and Spatial Planning, City of Johannesburg		

Table 2: inclusionary housing options (Inclusionary Housing Incentives, Regulations and Mechanisms, 2019)

Further requirements and explanations:

The rental cap of R2100 (Option1) is made up by 30 % of the monthly income of R7000.

Minimum design requirements Social Housing units

- Inclusionary units must have the same outward appearance as market units of the development
- Common spaces like entrances, lifts, communal spaces, shared amenities must be shared between inclusionary units and market units

Minimum design requirements for FLISP and capped housing

- Within one unit and with access only from that unit, a private bathroom, including a toilet, a shower and a basin as a minimum has to be provided
- The size has to be 7 m² of habitable space per person and at least 18 m² per unit
- Additionally the design requirements for the social housing units apply. (Inclusionary Housing Incentives, Regulations and Mechanisms, 2019)

6 CONCLUSION AND OUTLOOK

Within several policies and frameworks in Johannesburg, the critical need for the provision of housing opportunities for the low income households is identified. The currently approved Inclusionary Housing policy seeks to address issues of inequality, the demand of formal housing opportunities in well located areas and the limited social mix in terms of race and income. (Inclusionary Housing Incentives, Regulations and Mechanisms, 2019). The analysis raised the question to whom the policy is addressed and what needs it can meet. Only the first option of the policy refers to the low-middle income bracket. While demanding a rental

cap of R2100, which is 30 % of the maximum monthly income of the low-middle income bracket, there is no mention of the utility costs, which are required in the debate of "affordable housing". This was already a concern in the review process of the policy. (City of Johannesburg Metropolitan Municipality, 2018) Further options 2 and 3 only address the size of units. That is, if a developer builds market units with, for example, a size of 350 m², he has to provide 30 % of the units with a size of 150 m² to be inclusionary. If the developer can choose, he will most likely take option 3. Consequently, upmarket areas will remain accessible for the upper income group, the enhanced social mix will not emerge, and the lower income group will still not be integrated within new developments.

Another question is, if developers really deliver units for the low income bracket in an upmarket area, what about the infrastructure in their environment? This has already been stated by legal consultants, planning consultants and developers in the City of Johannesburg Metropolitan Municipality (2018). They pointed out the non-observance of the accessibility of jobs, services and social infrastructure. Low income households may not afford living in the same environment as households of middle- upper income bracket in terms of costs for schools, public transport, shopping or even recreational facilities. (City of Johannesburg Metropolitan Municipality, 2018)

Thus, this policy is probably a further step in the debate to make Johannesburg an inclusive city. Nevertheless, it needs to be further developed and implemented in developments to reduce inequalities and significant housing needs in the lower income bracket. Perhaps the policy should be rethought not only guidelines for inclusionary housing opportunities but for inclusionary developments.

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The Pedestrian Traffic of the Inner Courtyards in Graz

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1 ABSTRACT

The UN World Urbanization Prospects: The 2018 Revision report has explained that 54% of the world's populationlived in cities. And based on the forecasts by 2050 this rate will be 66%. All this is due to that in the metropolitan regions high level economic activity is taking place and their services getting better quality. Besides of that the cities are not only information and service nodes but also varied cultural and educational centers which providing a lot of opportunities for occupational change or to learn new professions which could be attractive to the high qualified people too. Therefore the cities of the future will have to face significant demographic and sociological problems because besides moving into the city various ethnic and religious groups according to the characteristic of the western countries the urban population shows an aging trend. And in addition the increasing number of the disabled people whose mobility even in a crowded city must be ensured. Therefore the public spaces will play an even more significant role in the cities life because this is the "space" in every city where regardless of gender, age, religion, qualification, etc. all social classes can be found. This is especially true for the public squares and parks where people can not only meet with each other from the different social groups but they can dialogue with each other as well; actively or passively relaxing, having fun, etc. All of this can significantly contribute so that these groups could get know each other. However the public spaces of the cities including the squares and parks looking at their size are bounded. So for the expansion of the public spaces alternative routes could serve as opportunity. One of these are the inner courtyards, which are similar to the squares and could have restaurants, terraces, benches, etc. In a framework of a scholarship in April 2019 I had the opportunity to study the pedestrian traffic of the inner courtyards of Graz in Austria. The study had proved that the inner courtyards could be used as a public open space but their traffic is not only influenced by the there located stores, restaurants, offices, functions etc. Therefore in my presentation with the example of four in Graz located inner courtyards would like to show how can become an inner courtyard well used and successful in cities.

Keywords: Process-Driven Software Collaboration, Data-Driven Decision Making, Nature-Based Solutions, Blue-Green Infrastructure, Climate Adaptation

2 INTRODUCTION

As many researches have been proved an increasing percentage of the world's population lives in cities. According to the UN World Urbanization Prospects: The 2018 Revision report by 2050 this rate will be 66%. All this is mainly due to that the cities, especially the big city regions got a high level economic activities and services. And these city regions got a significant attractiveness both for the local and foreign residents and as well as those with the low and high qualifications. Because these cities are not just service and information nodes but diverse educational and cultural centres also, which providing many opportunities not just for new professions, but also for changing professions. (Enyedi 2011)

Therefore the cities of the future will have to face serious sociological and demographic problems mainly due to the increased population. So the role of public spaces and green spaces will be much more significant as today, because those are that "spaces" in every cities where regardless of gender, age, religion, education, etc. every society can be found. And on these places can the different social classes meet each other, dialogue, actively or passively relax, have fun, etc. All of this can significantly contribute that these different social classes and groups could get know each other. (Thompson, 2002)

However the extensions of the public spaces because of their bounded nature – especially in the case of the historical city centres – are not easy. Alternative routes such as alleys and inner courtyards can provide a solution. This last one is particularly suited to function as a public space to solve the crowding of the cities. Because the inner courtyards similar to the public spaces can have benches, terrace, stores, restaurants, playground, or even fountain also. During my previous research I have proved that some of the inner courtyards in the city of Győr in Hungary are suitable to function as public spaces. In the last year thanks to

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the Austrian-Hungarian Action Foundation and the OeAD I spent one month in the city of Graz in Vienna where I could study the traffic of four inner courtyards. In my paper I represent the results of that research.

3 THE CITY ARCHITECTURE OF THE OLD TOWN OF GRAZ

The city of Graz is located in the southwestern part of the Graz Basin approximately 150 km from Vienna. It is the seat of the federal state of Styria and has a population of 330,000 according to the latest statistics. The city is defined by the historical city centre and the former Castle the "Schloßberg" and the river Mur. It is bordered by hills from both east and west direction and is divided by the Mur. Each historical periods have left a significant mark on the city, so it has many architectural monuments. It is not coincidence that the old town of Graz is a UNESCO world heritage site since 1999. Due to the middle age three big churches, from the renaissance age a significant amount of inner courtyards, and from the baroque to the buildings specific facades were left behind. From urban architecture aspect it can be dividing into five annular zone which from the first one is the city core. The historical downtown and the Schloßberg dividing former castle wall's traces are still discoverable today on the map of Graz due to the next to it running boulevard. The dense construction of the old town is loosened only by the city park running from north to east. (Schweigert, 1979)

The triangle shaped main square of the city the "Haputpaltz" has begun to build in 1160 in the time of Ottokar III. the Margrave of Styria the major roads of the city core running into it like the Herrengasse, Sporgasse, the Murgasse, and the Sackstraße. In the 13th Century the city core was mostly consisted of medieval houses which was typical that they were located on long narrow plots and had one or two inner courtyards. These inner courtyards can still be found today and most of them operating stores, offices, and restaurants. From urban architecture aspect significant change happened in 1856 when the Ringstrasse was built along the former castle wall and as a continuation of it between 1869 and 1872 in southwestern direction the city park (Stadtpark). On the southern area of the old town in 1890 a significant residential quarter was built in historical style. In the end of the 19th Century and the beginning of the 20th Century were built on that area such significant institutions as the City Hall, the government offices and the buildings of the savings banks. The settling and the construction of the Mur's riverbank also happened on that time. (Schweigert, 1979)

The city centre of Graz as it can be seen is full of inner courtyards which from in 2019 I could study three inner courtyard's traffic in detail. In the next chapter I will represent the results of that study.

Fig 1.: The studied inner courtyards in the old town of Graz: 1.) Porkopigasse 2; 2.) Herrengasse 16; 3.) Bürgergasse 5.

4 THE STUDIED INNER COURTYARDS IN GRAZ

Three pedestrian traffic in Graz's inner courtyards has been explored with a separate study of the numbers of children and adults. The first inner courtyard is located eastern direction from the Hauptplatz between the Hauptplatz 16-17. and the Porkopigasse 2. building. The second inner courtyard can be found under the Herrengasse 16. building which beside to the local legislation “Grazer Ladhaus” gives place for the tourist information centre, a restaurant, and a museum. The third inner courtyard is located approximately 250 meters from the second, under Bürgergasse 5. which another exit opens from the Burgasse 4. building. The special feature of this courtyard is that it connects a modern and a Baroque building (Fig 1.). And in this inner courtyard can be found the Graz artist group centre and a training centre.

The study took place between the 8th and 12th of April 2019 which during were counted to the courtyard walking through people.

5 THE PEDESTRIAN TRAFFIC OF THE STUDIED INNER COURTYARDS

The pedestrian traffic of the first inner courtyard was counted from the direction of the Prokopigasse

2. building. The special feature of this that from it eastern direction can be found the Färberplatz which is one of the major squares of the city centre in Graz. On that square many shops, coffee shop, ice cream shop and restaurant and a musical elementary and high school also can be found. Therefore the pedestrian traffic of that square is significant. As already has been mentioned in the Prokopigasse 2. building can be found inner courtyard leads to the main square of the city center the Hauptplatz. The pedestrian traffic of that square outside of the peak hours is also really high, which among other things also due to that almost every tram line of the city has a stop here. And here leads one of the busiest pedestrian street the Herrengasse and on the square can be found the City Hall and many shops, stores, restaurants, coffee shops, etc.

Fig. 2.: The bicycle storage in the Prokopigasse 2. building can be found inner courtyard

As the Fig 3. also shows in the Prokopigasse 2. bulding can be found inner courtyard on April 12 between 11:30 and 12:30 the pedestrians were counted in 15 minutes period. As it can be seen the most people has walk through on the inner courtyard between 11:30 and 11:45 which from 19 person were children and 7 person adult. And the less people between 12:05 and 12:30 when only 6 adult walked in the courtyard. The extremely high number of the children (19 person) between 11:30 and 11:45 was due to the school ringing during this time, which led most people to approach the Hauptplatz and the there can be found tram stop through the courtyard. During the studied one hour a total of 37 adult and 29 children walked through the courtyard.

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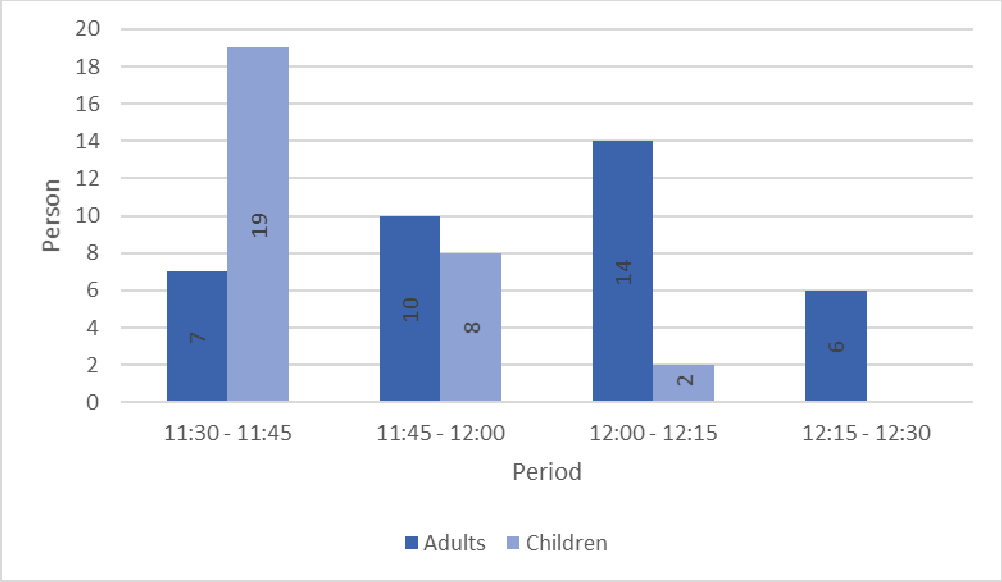

Fig. 3.: The pedestrian traffic of the inner courtyard in the Prokopigasse 2. building on April 12th

A few days earlier on the 8th of April the pedestrians in the courtyard were counted between 15:15 and 16:15. The result of this (Fig. 4.) turned out that the number of the adult were much more consistent as the children and a little lower also. The most of the children has walked trough on the courtyard between 15:45 and 16:15 hour which was primaly due to the end of school teaching. During the study in the inner courtyard it becomes clear that it is used primarily by adults and children so that they can faster reach the Haputplatz. The least adults (5 person) and children (7 person) used the courtyard between 15:30 and 15:45.

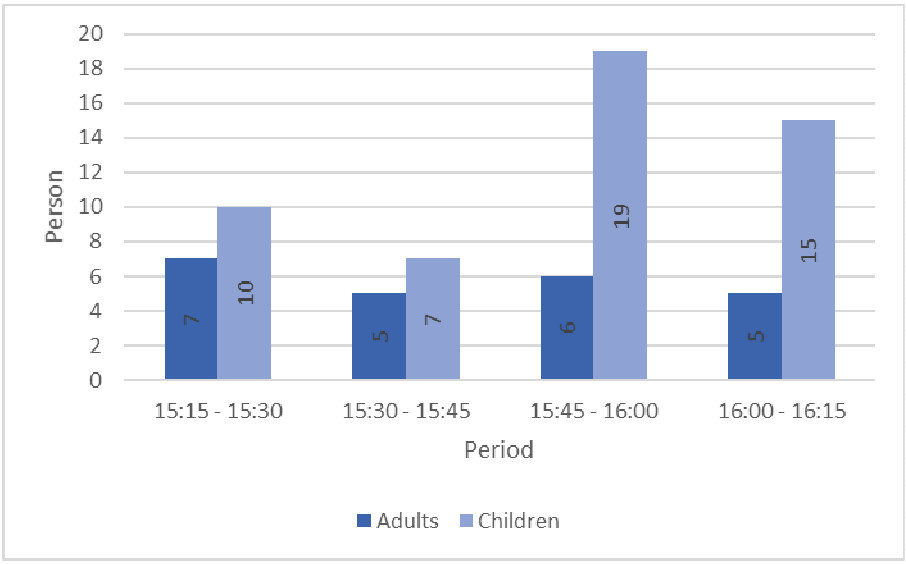

Fig. 4.: The pedestrian traffic of the inner courtyard in the Prokopigasse 2. building on April 8th

The second inner courtyad can be found under the Bürgergasse 5. building and as previously has been mentioned it was created by connecting a modern and a baroque building. And in the courtyard not olny the Graz artist group center can be found but also a multi-apartment condominium, an art gallery, a few smaller offices, and a training center. Due to that the inner courtyard got a significant traffic attractiveness. The two traffic counting in the inner courtyard had proved all this which was happened between the 8th and 9th of April.

Fig 5.: The inner courtyard in the Bürgergasse 5. building

From the results of the April 9. traffic counting turned out clearly that in the studied one hour (13:30-14:30) pedestrians were constantly walking on it (Fig. 6.). But what needs to be highlighted that in the studied period only 2 children has walked through on the inner courtyard and in average 20 adults. The most adults between 13:45 and 14:00 hour (24 person) and the less between 14:15 and 14:30 has walked on the inner courtyard. According to the site study the low number of children was primarily due to the fact that they were still in school at this time.

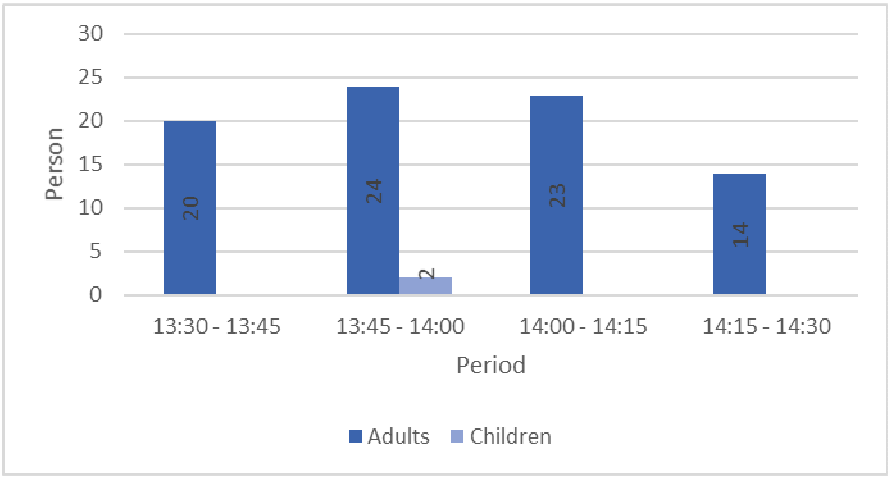

Fig. 6.: The pedestrian traffic of the inner courtyard in the Bürgergasse 5. building on April 9th

The study on 8th of April happened between 16:15 and 17:15 namely in the afternoon peak hour. However less people has walked in the courtyard as in the early afternoon period (Fig. 7.). The number of the pedestrians was almost the same besides the time period between 17:00 and 17:15. In average 17 adults and 2 children has walked through in the courtyard on the studied period. From this the most adults between 16:30 and 16:45 (19 person) and the less between 17:00 and 17:15 (13 person). The number of the children was the highest (4 person) between 16:45 and 17:00 and besides of 16:15 and 16:30 only one child has walked through in the inner courtyard.

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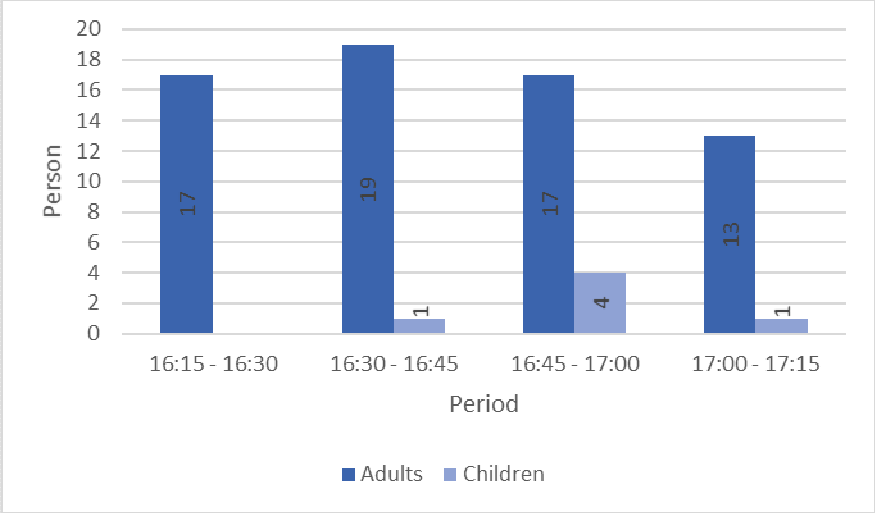

Fig. 7.: The pedestrian traffic of the inner courtyard in the Bürgergasse 5. building on April 8th

Under the Herrengasse 16. can be found building complex is located in the heart of Graz's city centre which is approximatly 100 meter from the Haputplaz. The here can be found innner courtyard's eastern entrance overlooks to the Herengasse which is the busiest pedestrian street in the city. Besides as in the previous chapter has been mentioned in this courtyard can be found the mansion, a museum, two restaurants, and many shops on the ground floor of the building complex facing to the street. The building was built between 1642 and 1644 which is one of the most beautiful Renaissance building of the city and due to among others very popular among the tourists. All of this have significant define the pedestrian traffic of the inner courtyard where only on the 9th of April were made traffic counting but unlike to the other courtyards here in two time periodes between 10:45 and 11:45 and between 12:30 and 13:30.

Fig. 8.: The inner courtyard in the Herrengasse 16. building

From the results it turns out clerly that the bulidng under the Herrengasse 16. got a relly high pedestrian traffic (Fig. 9) because looking at the two studied time period in average 42 adults and 10 children walks on it during 15 minutes. In the first studied period (between 10:45 and 11:45) the numbre of the audlts were slightly less as on the second (between 12:30 and 13:30). Looking at the numbers of the children the outstanding value between 10:45 and 11:00 (33 person) and 11:15 and 11:30 (24 person) was due to a school

group. Besides that mostly only one child walked through the courtyard from which in the forenoon only between 11:00 and 11:15 6 person and in the afternoon 5 person between 13:15 and 13:30 meant the exception. The most adults between 12:30 and 12:45 and 12:45 and 13:00 have walked through in the courtyard due to a tourist group. Besides of that except one time period (between 13:00 and 13:15) the numbers of the adults were over 30 person in the whole time.

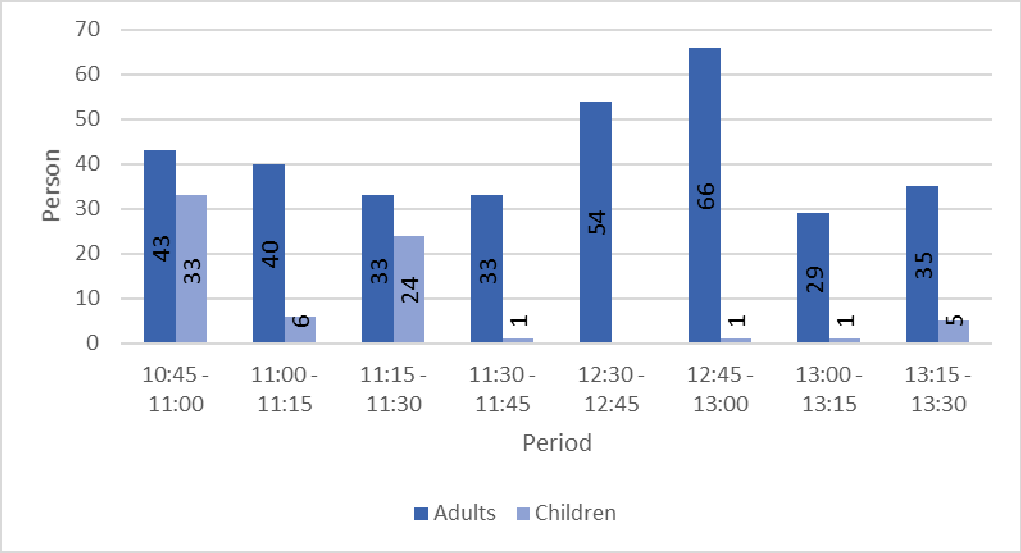

Fig. 9.: The pedestrian traffic of the inner courtyard in the Herrengasse 16. building on April 9th

6 CONCLUSION

The research in Graz has been proved that the traffic of the inner courtyards significantly determined by they location in the city and that the given courtyard what kind of shops, stores, street furnitures has. All of this has confirmed the results of my study in Győr Hungray where I have studied also three different inner courtyards (Jóna, 2018). But the biggest difference my study between Austria and Hungary that in Győr I could study such an inner courtyard which was in the heart of the city centre but dosen't got significant traffic. The reason of this was primarily due to that the courtyard doesn't get connection between two busy pedestrian street because each entraaces was open to the same street. In the case of Graz in the Prokopigasse 2. building can be found inner courtyard got the lowest pedestrian traffic. This is due to several factors such as that inner courtyard doesn't have stores, or offices, just a larger bicycle storage. And the apartments in the building are accessible from the courtyard. Therefore the features that generate pedestrian traffic were missing, even though they were located between two significant pedestrian traffic have public spaces. It is not accidental that the courtyard was primalry used by children studying at the nearby school for the reason to get to the nearby Haputplatz as soon as possible. Therefore in the Prokopigasse 2. building can be found inner courtyard's primary function is route shortening.

In the Bürgergasse 5. can be found building pedestrian traffic primarily was determined by the there living people because according to the study in the courtyard most of them were residents of the apartments. Besides of that many people visited the local gallery and training center.

As it was seen earlier under the Herrengasse 16. can be found building complex inner courtyard had the highest pedestrian traffic. The high traffic of this courtyard is prime due to that it is located in the heart of city centre, with many shops, stores, offices, coffee shops, restaurants, etc. which all have a significant impact on traffic. Besides of that the building complex which gives home to the inner courtyard is a monument is among the tourists very popular and in the courtyard can be found restaurants and a museum also has many visitors. These are the characteristics of the success of the Herrengasse 16 building's inner courtyard.

However, the disadvantage of each inner courtyard is that they do not have significant green space. The slight exception to this the inner courtyard under the Bürgergasse 5. can be found building where a "rest area" were created with smaller trees and bushes. And in the Prokopigasse 2. building can be found inner courtyard has a tree and some running plants on one of the walls. However, the size of each courtyard would allow the creation of greater green space. All of this would play significant role improving the urban climate,

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because the effects of climate change are being felt all over the world. The increasing of the green spaces in the case of Graz colud also help to remain in the future liveable and sustainable city.

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The Symptoms of the Liquid City

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1 ABSTRACT

In the large cities there is a strong trend toward the "liquid life" described by the sociologist Zygmunt Bauman. In the "liquid cities" there are no more "values" because the individual life is aimed at flexibility and searching for and benefitting from opportunities. But some evoke "authentic values" adopted in emerging cities along the New Silk Road (the project of secured roads between China and Europe supported by China). We argue that this hypothesis is not very serious. We "mobilize" the history of the Cold War and analyses made at this time, either strategic (Aron, Castoriadis), either economic (Perroux, Pisar). One does not understand why China would resume the recipes of Soviet Union, which have failed. The model recently chosen by China, consumerism, is at odds with the project of building a "block" of countries trading one with the other, only, and not with the countries outside the block.

Keywords: liquid city, model, trade, Pacific Coexistence, authentic values

2 INTRODUCTION

The main needs of cities wanting to develop are, today, Peace and safe environment. A reference to understand this need of peace is Norbert Elias. According to his works, a "Centre" (like the powerful European courts at the time of absolutism) invents norms of behavior which are diffused anywhere, triggering a progress of "civilization". Even if this process can involve some domination (for instance, in the 18th century, there were many wars) it cannot be reduced to domination. According to Elias, the Centre creates "areas of peace" (in particular in the largest capital cities in Europe, where the courts were, Paris, London, Madrid, Vienna…). Concerning the absolutist era (the 17 th century and the 18 th century) it has been called "European equilibrium". To understand how the process of civilization implies some domination but is not reduced to it, one can quote the French sociologist Maffesoli. According to him (in "La violence totalitaire", "The totalitarian violence") there is a pair of notions, puissance / pouvoir, uneasily translated in English by collective creativity / political power. Reducing the pair to collective creativity is the harmony of utopias. Reducing the pair to political power is absolutizing politics, like in the works of Carl Schmitt, according to Maffesoli. The process of civilization according to Elias involves collective creativity (inventions of norms of behavior) and power (the State). Today the Centre (we call it Global Monopoly) is located in the large metropolises: Silicon Valley, Shenzhen, New York, Tokyo, Hong Kong … The new behavior can be described: anticipation, play, good literacy in Information Technologies (handling data), system analysis, familiarity with the social networks ... The corresponding geopolitical context (the "areas of peace") is the pacific coexistence between USA and China.

Indeed one can consider four periods of progress of civilization: the absolutist monopoly described by Norbert Elias (in "The court society"), the bourgeois society (the stake being the monetary gain), the developmentism (the stake being economic growth thanks to expertise and plans) and the Global Monopoly (the stake being innovation). At each period corresponds some kind of "areas of peace". It is shown in this tableau:

Period	Areas of peace
Absolutist monopoly	European equilibrium
Bourgeois society	The 19 th century, peaceful century (in Europe)
Developmentism	"Pacific coexistence" between USA and Soviet Union
Global Monopoly	Pacific coexistence between USA and China

Table 1. Periods and areas of peace.

Concerning the cities, they are more and more an accumulation of opportunities and experiences. In a city, one searches for the connection to the good networks, given the goals one has chosen. The aim is to play, and play again. The choices made, the tastes, are always changed: one changes the quarter where one lives, or the city, one's job, one's hobbies and the consumer tastes … It is the "liquid life" (Bauman, 2013).

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Transcendence has deserted cities. Today, the prestigious places are either popular, "visible" (that is to say, branded), either notorious (the cause of prestige being a specific, acknowledged competency). The characteristics of the old city and the "liquid city" are shown in this tableau:

Old city	"Liquid city"
Image	No image
Prestige	Opportunities and experiences
Transcendence	Places "visible" or "notorious"
Mastered evolution	Flexibility

Table 2: Transition from old city to "liquid city".

In this context has appeared the Chinese project called "New Silk Road". The project is that of trade roads (terrestrial and maritime) between China and Europe, controlled by China thanks to massive investment in the countries crossed by the roads. These investments would be in transport infrastructure (harbors, railways, highways) or more generally in infrastructures (energy, or even industrial plants). The justification is to provide the tens of countries which are concerned, with an economic growth "secured" and "sustainable". It is a little blurry, but it sounds like "authentic values", by opposition to the current absence of values in the liquid society. At first glance, it is paradoxical, since China has its role in the existing Global Monopoly (for instance, Chinese firms are leaders in Information Technologies, social networks etc.). It would be the return to pacific coexistence at the time of Cold War. "Pacific coexistence" has been coined by … Lenin, used by Stalin and mainly claimed by Khrushchev. Indeed, it was hostile coexistence. There were two blocks, East and West. The Stalin's project was to attract numerous enough countries in the Eastern block to prevent the capitalist world market from working. This project has failed. For this reason, one does not understand why China, after the Den Xiao Ping 's reforms, would engage in this way. The hypothesis of many cities located on the "Belt and Road", becoming prosperous, does not seem serious.

To deepen the discussion, we shall study the topics "cities and trade roads" and "pacific coexistence" in the following chapters.

3 CITIES AND TRADE ROADS

The theorist of the strong link between cities and trade roads is certainly Marcel Poète. In his book "Introduction à l'urbanisme" ("Introduction to urbanism"), he has shown how in History, trade triggers the appearance of cities. In particular, along the Silk Road, appeared cities (Palmyra, Dura Europos …) remarkable by their plan, monuments and way of life. It was the time of Pax Romana. The kingdoms crossed by the Silk Road were interested in granting the security of the Road: the passing caravans were a source of money for them. All this is of great historical interest, but is not a recourse to deal with our topic. First, it was trade at the time of Empires. Also, the roads linking China to Europe, America and Africa already exist. They allow the prosperity of cities like New York, Tacoma, Singapore, Rotterdam, Hong Kong etc. The role of these cities is uneasily challenged: harbors are in competition, and economies of scale matter. More, the economies of rich countries are dematerialized: innovation matters more, commodities matter less. And China is no more a developing country. Of course, poor countries (for instance in Africa) could grow and new harbors could be created for them. In any case, one does not understand why China would be interested in massive investment in logistics, worldwide. The argument that these roads are threatened is not serious. The freedom of the seas is granted by navies: the US navy, of course, but also other navies. If necessary, navies are allied to thwart threatening pirates in zones like the coasts of Somalia or the strait of Malacca. Concerning the US navy which could blockade these roads, it is not a pertinent hypothesis: the rich western countries depend themselves on trade with China.

From a strategic point of view, the works of the American admiral Alfred Mahan are very interesting. He argued that for an empire to be strategically efficient three "rings" were needed. These rings are the metropolis (and its industry), the colonies and the navies (the navy and the merchant navy). There are roads between the metropolis and the colonies, followed by the merchant navy and secured by the navy. The two have complementary roles.[1] Mahan studied the "Sea Power" in History thanks to the analysis of the British

[1] A task for the navy was to make the "exclusive" respected. The "exclusive" was the obligation for the colonies (the West Indies, for instance) to import goods from the metropolis, only.

Empire. There were three roads in the British Empire: (1) that via Gibraltar, the Mediterranean Sea, the Suez canal and Indian Ocean, as far as India (2) that circumventing Africa via The Cape, then the Indian Ocean (3) a third was only prepared and never used, via the Atlantic Sea, Canada (crossed from Montreal to Vancouver thanks to the TransCanada, just built up at the time of Mahan) and Pacific Ocean. Notice that this road was terrestrial and maritime. Trade at the time of Mahan was in the context of empires or protectionism (the USA, for instance, were protectionist at the end of the 19 th century and the beginning of the 20 th century). Neither Marcel Poète neither Mahan could observe the free trade worldwide which started after the end of the second World War.

Now we can consider four "economic regimes":

- autarky for expansion (Perroux). Examples are the Nazi Third Reich and Soviet Union. A country preparing conquests does not want to depend on other countries because of trade. It chooses autarky.
- Imperial mercantilism. It is the case of the British Empire very well described by Mahan. The industry of the metropolis has its outlets in the colonies.
- Mercantilism for development. A country banks on export to be prosperous, accepting the rules of free trade.
- Consumerism/free trade. A country banks on domestic consumption to obtain economic growth and concerning export / import, accepts the rules of free trade.

One sees in this tableau that secured strategic roads worldwide corresponds to a single "economic regime":

Economic regime	Secured strategic roads worldwide
Autarky for expansion	
Imperial mercantilism	✓
Mercantilism for development	
Consumerism / free trade	

Table 3. Economic regimes and secured roads.

The Chinese project "Belt and Road Initiative" corresponds to the line 2, while China is moving from the regime of the line 3 to the regime of the line 4. It raises objections. It casts doubt on the project. It is uncertain that it will be carried out.

4 THE PACIFIC COEXISTENCE (1): STRATEGIC APPROACH (ARON, CASTORIADIS).

Raymond Aron wrote his book "La coexistence pacifique" ("The pacific coexistence") in 1953, just after the death of Stalin. The Cold War has started. At this time, in France one was scared with Soviet Union: The forces of the Warsaw Pact were stronger than those of NATO (North Atlantic Treaty Organization) present in occidental Europe. Later, when France and Great Britain will have nuclear weapons, more moderate points of view on pacific coexistence will be possible ("détente"). But Raymond Aron is sure that "pacific coexistence" is hostile coexistence. He approves the stance chosen by the USA and NATO: "containment". The strength of the book originates in his method: the author examines the communist doctrine and its evolution, besides the official speeches of the communist leaders. For him, the idea that the potential of economic reforms is so obvious that they will be adopted, the communist regimes[2] evolving, is "radically wrong". Again, later (1970) at the time of "détente" Samuel Pisar will claim that the existence of this "potential" (that he describes very well) will trigger an evolution of the communist regimes. But he recognizes the existence of "obstacles". Indeed, the CPSU (Communist Party of Soviet Union) never changed its mind. Take the example of the trade between the countries of Central Europe and occidental Europe which developed in the 70s and 80s: it was a safety valve, and there were red lines. It was the time of the Brezhnev doctrine about "limited sovereignty".

Finally, in 1989 – 1991, the communist regimes collapsed, mainly because the elites themselves (the "nomenklatura") were aware of the strategic failure.

[2] Of course, the main question was the evolution of the communist regime in Soviet Union.

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The French philosopher Castoriadis argued in "Devant la guerre" ("In front of war"), written in 1981, that Soviet Union was a "stratocracy": a country where the resources are systematically and deliberately oriented toward military projects (heavy industry, production of weapons, some technologies and of course numerous, well equipped and trained troops). The economic mechanism was the following: the sector producing consumer goods was not efficient, because there was not investment enough, but the prices were high and the level of taxes was high. So, the revenue from taxes, very large, was invested by the State in the sector which was the priority. The consumption for the populace was sacrificed. Soviet Union became an efficient arsenal, but the accumulation of weapons was useless, for political reasons. The "glacis" (the communist countries in Central Europe) was no more a resource, but a problem. At the time of Gorbachev, the Brezhnev doctrine was abandoned. Finally, the expenses for the production of weapons and arms race were wasteful. Of course, the model is not that of China, today. The "stratocracy" (Soviet Union) was engaged in hostile coexistence. China seems engaged in pacific coexistence. For instance, the proportion of the military budget in the national product is reasonable (about 2%).

5 THE "PACIFIC COEXISTENCE" (2): ECONOMPIC APPROACH (PERROUX, PISAR)

Perroux was convinced that "pacific coexistence" was hostile coexistence, by examining the institutions of Soviet Union, not the economy nor the official speeches of the political leaders. Concerning the economy, he argues that the means for development was the "development pole", in the two blocks. The development poles benefit from agglomeration effects, complementary effects and junction effects. Why were they less efficient in the East? In the communist countries, the domestic consumption was not a demand stimulating the development poles (structure, output). The plans of the communist countries (members of the COMECON, Council for Mutual Economic Assistance) were not coordinated. There was no international division of labor between them, at least on efficient basis. The international trade between these countries was not enough to trigger efficiency. The objectives of this trade could be political, or decided in a bureaucratic way. And a single currency, the convertible ruble, was available, which was managed by Soviet Union, only. The model chosen by Soviet Union, heavy industry as a priority, was imposed on the communist countries of Central Europe, even if they were not industrialized and were poor. There were political rivalries between these countries. In particular, there was a group of rich, industrialized countries (Soviet Union, Czechoslovakia and Eastern Germany) and a group of poor countries (Hungary, Romania and Bulgaria). The "driving effects" of the development poles on the other economic units were less strong (in the communist countries, than in the capitalist countries). In the developing countries which were allied, communist countries invested to create development poles. If the demand was in the communist country, this demand fluctuated for several reasons (including political choices). The local managers were disappointed. And if the demand was local, the managers of the investing country could be disappointed, the local demand being often weak (these development poles were often in heavy industry, and the local demand for their products was weak if the industrialization of the country failed). Notice that the same drawbacks could appear for China investing massively in poor countries located on the New Silk Road.

The Perroux's works allow understanding the "cuckoo's nest" phenomenon. When a Power succeeds another one, the succeeding power settles in the same places (buildings in the capital city) than the previous. At the end of the 19 th century and the beginning of the 20 th century, in Central Europe, these was some industrialization. The development poles were controlled by large banks, often in Vienna. After the end of the World War I, they were replaced by large banks of the allied countries (France, Great Britain, Belgium and USA). They invested in the industry in Czechoslovakia, the mines in Hungary, the transport infrastructures (railways, harbors …) of the region… And when, at the start of the World War II the Nazis conquered Central Europe, they were replaced by the largest German banks, after an order from Goering (Perroux, 1958). In 1945, the German banks were replaced by institutions controlled by Soviet Union (COMECON, Ministry of Foreign Trade etc.). Is it that China will control all the development poles in the countries on the New Silk Road? It seems that it is a phantasm. In the case of the countries of Central Europe, they are not so weak, since they are members of the European Union. Concerning emerging African countries, they could have recourse to the usual means of countries fearing dependency on a foreign country investing locally, diversification of the local investment. At the time of "pacific coexistence", frequently a developing country changed the alliances, passing from an ally of a block to ally of the other block, or accepted help from the two sides. Even China, at the end of the 50s, when the Soviet experts were all

powerful in this country, accepted American aid. Today, an African country could accept Chinese investments, and also those of European countries, USA, Japan…

In "The arms of peace", written in 1970, Samuel Pisar showed the potential for peace worldwide, if the trade between East and West developed. Let us give some examples of pertinent remarks in this book:

- In the communist countries, State monopolies (the Ministry of Foreign Trade, some institutions specialized in foreign trade of a kind of products…) shielded, between firms in the communist country and firms in the capitalist countries. Exchange of information on the demand, between a buyer (or a vendor) in a communist country, and a vendor (or a buyer) in a capitalist country, was uneasy. Narrow relationships between firms (one in a communist country, the other in a capitalist country) were uneasy or impossible. Common projects led during several years were difficult. Complex contracts could not be negotiated.
- Till 1965 Soviet Union refused to recognize intellectual property. In other words, they were copying the occidental technology, without paying for any royalties. But they understood that they remained backward, concerning technology, by doing so. In 1965, they decided to accept the trading of patents. They became a member of the World Intellectual Property Organization, in Geneva. In these years, for five patents bought, they sold one. Notice that today, China is the second country in the world, for international patent application.
- The trade between the East and the West was organized on the basis of bilateral arrangements. It was insufficient. It was made necessary by the lack of a convertible currency on the side of communist countries. Often the means of barter, not very efficient, was used. There was an asymmetry of information: it was easier, for the representatives of a communist country, to prospect customers or providers in a capitalist country, than for a capitalist firm, to prospect in a communist country.
- Often the communist countries used some means (dumping, barter, bilateralism, loans on the long run with commercial provisions …) which were prohibited by the GATT (General Agreement on Tariffs and Trade). The managers in communist countries negotiating with capitalist firms were competent and … honest once a contract has been signed, but the means they used (bilateralism, barter…) were expedients. Some communist countries made concessions and entered the GATT. One was not scared with communist countries causing trouble to the working of the world market, because the part of these countries in international trade was small, about 5% (Pisar, 1970). Today it is very different. The national product of China is 20% of the product of the world and its part in international trade is large. Notice that China is a member of the World Trade Organization. If China wants to "secure" commercial relationships with many countries located along the Belt and the Road, either it will be hampered by the rules of WTO, either it will be obliged to leave this organization.

In the years following the publication of "The arms of peace", this occurred:

- The discovery of oil and gas in Soviet Union was confirmed and this country became a large exporter of these products. It was good and bad. It was good since exportation allowed collecting convertible currency (dollars), to buy the occidental technology, which was needed. Bad because it was a kind of regression: the economy of Soviet Union worked like that of an underdeveloped country (selling raw materials, buying machines).
- It appeared that Jewish people in Soviet Union were persecuted and chose exile (toward Israel) more and more. The Congress of the USA decided sanctions. An informal, secret and powerful committee, the COCOM (Coordinating Committee for Multilateral Export Controls) decided restrictions on the strategic products of which export toward communist countries was authorized. Were concerned, for instance, computers for a military usage.
- Soviet Union engaged in a war (in Afghanistan) which finally was lost.
- The process of "détente" was also threatened by the crisis of the Euromissiles.

Clearly the "obstacles" (to the development of the trade between the Est and the West) remained, and the "potential" described by Samuel Pisar was not realized. The Communist Party of Soviet Union opposed the reforms which were needed. In the same years, these reforms were applied in China.

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6 CONCLUSION

One does not understand why China would resume the recipes of Soviet Union, which have failed: a glacis of narrowly controlled countries and the attempt to build a "block", with international trade inside only, not between a country in the block and a country outside.

The threats to and from China are exaggerated. Of course, there is some conflicts between occidental countries led by the USA and China. They do not agree on the definition of Human Rights. And there is a short list of "hot points".[3] The USA are more and more allied with India. Each (China and USA) wants to attract some countries (like the Philippines). Etc. But it is not comparable with the "pacific coexistence" between Soviet Union and USA (in fact a hostile coexistence). Therefore, the project of secured strategic roads between China and Europe seems without reason.

The phenomenon "cuckoo's nest" is a phantasm, today. This occurred at the time of Empires. There is no more Empire and the decolonization is over.

Finally, one should not fear the Belt and Road Initiative. The project seems uncertain. But one could fear another kind of project, concerning China: to give up environmental objectives. The fear is that because of the rivalry between the two Great Powers (USA and China), each abandons any environmental objective, to favor economic growth. Already, China has decreased its investments in renewable energies, and builds many thermal power plants (working thanks to coal). Also (but China is not the only country doing so) they buy huge quantities of land abroad, to get a large number of products, thanks to industrial agriculture (this kind of project is called "liquid Nature").

Concerning the large cities, the "liquid life" should not be threatened by "values", even "authentic". Again, these "authentic values" (fairness, sustainability …) are defined in a blurry way.

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[3] Namely the Xinjiang, Tibet, Taiwan and Hong Kong.

Wissensbasierte Stadtentwicklung in Bochum – von der Strategie zum Konzept

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1 ABSTRACT

Bildung und Forschung, Innovation und Wissen sind Schlüsselressourcen der ökonomischen und gesellschaftlichen Entwicklung im nationalen wie internationalen Wettbewerb der Städte und Regionen. Bildungseinrichtungen, insbesondere Universitäten und Hochschulen, kommt dabei als ‚Institutionen des Wissens' eine entscheidende Rolle als Standortfaktor zu.

Wie viele andere Regionen in Europa befindet sich auch die Region Ruhr in einem Transformationsprozess von der Industrie- zur urbanen Wissensgesellschaft. Hochschulen, Universitäten und Forschungseinrichtungen sind im zunehmenden Wettbewerb um Innovationen und Investitionen zentrale Standortfaktoren.

Bochum ist Universitäts- und Hochschulstadt. Das Potenzial, was daraus für Stadt und Hochschulen gemeinschaftlich entsteht, wurde in Bochum früh erkannt. Aktuell wird ein gemeinsames räumliches Konzept für einen zukunftsfähigen und urbanen Campus entwickelt, auf dem exzellent geforscht, gelehrt und gelebt werden kann.

Keywords: Wissensbasierte Stadtentwicklung, Wissen, Universitätsentwicklung, Bochum, Strategie

2 WISSEN SCHAFFT STADT – STADT SCHAFFT WISSEN

2.1 Die Wissensgesellschaft – ein Konstrukt

Humankapital, und damit Wissen, ist zentraler wirtschaftlicher Wachstums- und Produktionsfaktor des 21. Jahrhunderts, und auch über den ökonomischen Sektor hinaus Motor gesellschaftlichen und sozialen Handelns. In Zeiten, in denen Wissen überall verfügbar ist und eine Vielzahl an „Fakten" existiert, werden lokale Netzwerke und Orte des Austauschs, die Raum bieten für Interdisziplinarität, kritisches Hinterfragen, Weiterdenken und Innovation, umso wichtiger.

Im Zusammenhang mit der Bedeutungszunahme räumlicher Strukturen sind es insbesondere immer wieder die urbanen, städtischen Strukturen, die die optimalen Voraussetzungen und Rahmenbedingungen für die Entstehung und Weitergabe von Wissen aufweisen und Wissen zu einem Standortfaktor machen, sowohl in praktischen Konzepten als auch in der theoretischen wissenschaftlichen Diskussion. Die Vorteile und Potenziale können weitgehend in den Bereich der weichen Standortfaktoren sowie der Rolle von lokalen Kontexten für personengebundenes Wissen eingeordnet werden. „Städtebauliche, soziale, kulturelle, wissenschafts-kommunikative und ideelle Qualitäten und Werte" (Behr 2004: 228) sind entscheidend, geht es um die Anziehungskraft von Städten.

Diese von Matthiesen bezeichneten „sticky knowledge spaces" sind urbane und lebendige Orte. Ob bei Floridas Thesen zur Creative Class, in Landrys Faktoren zur Ausbildung einer ‚Creative City' oder der von Läpple festgestellten Innovationskraft städtischer Ökonomien sowie anderen theoretischen Beschäftigungen mit Lokal- und Regionalökonomien: städtische, urbane Räume sind ‚in' und ziehen die „klügsten Köpfe" an. (vgl. Florida 2005, Landry 2000, Matthiesen 2004)

Diese Wissensträger können tendenziell überall arbeiten – was den Konkurrenzkampf zwischen Städten deutlich verschärft a. Viele Städte haben das Potenzial vorhandener Wissensinstitutionen und -cluster für ihre Profilierung längst erkannt. Die Maßnahmen in Entwicklungskonzepten, Leitbildern oder Marketingkampagnen werden unter dem Leitkonzept der ‚Wissensbasierten Stadtentwicklung' zusammengefasst.

2.2 Wissensbasierte Stadtentwicklung

Die Aktivitäten und Elemente, die mit dem Strukturwandel zur Wissensgesellschaft verbunden sind und für Städte und Räume Herausforderungen bedeuten, stehen nicht selten unter dem Leitbild der ‚Wissensbasierten Stadtentwicklung'. Viele Städte nutzen diese Strategie, um planerische und strategische Bemühungen der Stadtentwicklungspolitik zu implizieren, und das angestrebte Gesellschaftsmodell raumzeitlich zu

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konkretisieren. Die ‚Wissensbasierte Stadtentwicklung' reiht sich als Strategie in die Zukunftsperspektiven ein, „die nicht nur die Geschichte einer Stadt erzählen, „sondern (..) immer auch (beschreiben), wie die Stadt in Zukunft aussehen soll und geben damit Aufschluss über die gesellschaftlichen Aspirationen des Verfassers. Sie geben Auskunft über (häufig implizite) Gesellschaftsmodelle und sind Ausdruck eines Kompromisses zwischen konkurrierenden Interessen der Stadt. (vgl. Rüegg 1996: 56)

Dabei wirken die Maßnahmen der wissensbasierten Stadtentwicklung einerseits physisch und schaffen das urbane Gerüst, um Netzwerken und Interaktionen Raum zu geben. Um diesen Raum zu füllen, ist die strategische Ebene von zentraler Bedeutung: Die Vernetzung von Akteuren, die Aktivierung und Nutzung unterschiedlicher Kompetenzen für die Stadtentwicklung und die „Sichtbarmachung" von Wissen in der Stadt.

Es geht also nicht um ein Nebeneinander von Stadt und elitärem Elfenbeinturm, sondern ein enges Miteinander von städtischer Verwaltung und Akteuren der Bildung und Wissenschaft, Wirtschaft, politischen Entscheidungsträgern, Statusgruppen. Bereits 1963 hat Kerr die Rolle der Universität untersucht und gefordert, Wissenseinrichtungen als ‚cities of intellect' zu begreifen. Sie sind dabei nicht nur als Institution des Wissens und wissensproduzierender Ort zu verstehen, sondern auch als Akteur, wenn es um die Bewältigung des Strukturwandels von der Industriegesellschaft zur Wissensgesellschaft, die Vernetzung unterschiedlicher Disziplinen und damit den Auftrag zur integrativen Forschung geht – eine Forschung, die nicht nur informiert und nicht nur gesellschaftlich relevante Themen aufgreift, sondern bereits im Forschungsprozess selbst gesellschaftlich-politische und wissenschaftlich-analytische Dimensionen miteinander verbindet (vgl. Kerr 2001).

2.3 Bochum – Wissen und Wandel werden gelebt

Wie viele andere Regionen in Europa befindet sich auch die Region Ruhr in einem Transformationsprozess von der Industrie- zur urbanen Wissensgesellschaft. Mit ca. 56.000 Studierenden und 21 wissenschaftlichen Einrichtungen – darunter 9 Hochschulen – ist die Stadt Bochum eine lebendige Stadt und ein nicht nur für das Ruhrgebiet wichtiger Forschungs- und Bildungsstandort. Jüngst hat sich Bochum mit der neuen Stadtmarke „Wissen.Wandel.Wir-Gefühl" klar als Wissenschaftsstadt positioniert.

In diversen Konzepten und Verfahren – angefangen mit dem Netzwerk Wissenschaft, über erste räumliche Strategien zur Verbindung von Innenstadt und dem peripheren Campus Bochum im „Masterplan Universität – Stadt" (vgl. Stadt Bochum 2009, 2014) und dem Zusammenschluss UniverCity – ist es gelungen, relevante Akteure und Vertreter von Institutionen in die Prozesse der wissensbasierten Stadtentwicklung miteinzubinden und für das gemeinsame Denken und Handeln auf der großen Maßstabsebene zu motivieren.

Räumliche Schwerpunkte zur Implementation des Stadtbausteins Wissen sind die Innenstadt Bochums, das Entwicklungsgebiet Mark 51°7 (ehemaliges Produktionsareal des Automobilunternehmens OPEL) sowie der Campus Bochum – einer Agglomeration von Hochschulen, Unternehmen und Forschungseinrichtungen in peripherer Stadtrandlage.

3 DER CAMPUS BOCHUM

Aktuell erprobt wird die räumliche Entwicklung einer „Wissenschaftsstadt im Kleinen" unter einer gemeinsamen Zielsetzung von Stadt und Wissensakteuren am Campus Bochum. Dieser erstreckt sich über ca. 5 km und umfasst neben der Ruhr-Universität die Hochschule Bochum und die Hochschule für Gesundheit sowie weitere Teilflächen.

Die Ruhr-Universität Bochumwar nach dem Zweiten Weltkrieg die erste neugegründete Universität Deutschlands. Der Gründungsbeschluss fiel 1961, bereits vier Jahre später wurde der Lehrbetrieb aufgenommen. Seitdem hat sich der Standort mit der Hochschule Bochum, der Hochschule für Gesundheit, dem Gesundheitscampus NRW/Bochum sowie weiteren Institutionen einem Wissenscluster von internationaler Bedeutung entwickelt.

3.1 Herausforderungen

Mit dem Bau der Ruhr-Universität in den späten 1960er Jahren wurde der Grundstein des Campus Bochum gelegt. Heute wird der Campus trotz der Nähe zu angrenzenden Wohnquartieren und hochwertigen Freiräumen primär von Studierenden, Forschern und Beschäftigen in den üblichen Lehrzeiten genutzt. Er ist

maßstäblich über die Jahre sehr heterogen ergänzt worden, aber funktional nach wie vor überwiegend monostrukturiert (vgl. Mecklenbrauck 2015: 180ff).

Fig. 1: Der Planungsraum Campus Bochum und seine Institutionen

Die baupolitischen Zielsetzungen auf den überwiegend im Eigentum des Landes NRW befindlichen Flächen haben über die Jahre bis heute nicht unbedingt das Bild einer „Wissenschaftsstadt“ im oben beschriebenen Typus verfolgt. Eine an die Bedürfnisse des motorisierten Individualverkehrs ausgerichtete, aber überlastete Verkehrsinfrastruktur der Gründerjahre, öffentliche Räume mit Potenzial zur Belebung, sowie die fehlende räumliche wie soziale Interaktion des Bildungsnukleus mit dem Stadtraum sind beispielhaft zu benennende Herausforderungen.

3.1.1 Handlungsfeld „Flächen“

Die mangelnde Verfügbarkeit von Bauflächen steht dem Erweiterungsbedarf der Institutionen und der erwünschten Öffnung für weitere Nutzungen entgegen. Vorhandene Freiflächen stellen aufgrund von Landschaftsschutz, topographischen Verhältnissen und der Eigentumssitutation Herausforderungen an Planung und Entwicklung.

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3.1.2 Handlungsfeld „Nutzungen“

Bedingt durch die mangelnde Verfügbarkeit von Flächen für potenzielle Erweiterungen stehen sich die Interessen auf dem Campus in Teilen entgegen: Zum einen müssen die besten Rahmenbedingungen für Forschung und Lehre geboten werden, auf der anderen Seite sollen neue Nutzungen das Campusleben bereichern.

3.1.3 Handlungsfeld „Mobilität“

Der Campus ist geprägt von einer autoorientierten Erschließung der 1960er/70er Jahre, einem großen Anteil von MIV-Pendlern und einem täglich sehr hohen Verkehrsaufkommen. Für Fußgänger und Radfahrer ist die Verbindung der Teilräume untereinander nicht optimal.

3.1.4 Handlungsfeld „Freiraum/Öffentlicher Raum“

Die unmittelbare Nähe zum hochwertigen Freiraum des Ruhrtals ist gleichzeitig Potenzial und Restriktion. Topographie und Schutzstatus der umliegenden Freiräume limitieren die Entwicklungsmöglichkeiten. Freiräumen und öffentlichen Räumen auf dem Campus mangelt es zum Teil an Aufenthaltsqualität.

3.2 Visionen für den Campus der Zukunft

3.2.1 Gemeinsame Zielsetzungen

Um den Handlungserfordernissen zu begegnen, soll mit einem „Rahmenplan Campus Bochum“ ein planerisches Gesamt- und Handlungskonzept entwickelt werden. Hierzu hat die Politik der Stadtverwaltung Bochum im Jahr 2015 einen Auftrag erteilt. Als Leitkonzept für die verbindliche Planung soll dieser Rahmenplan räumliche und städtebauliche Maßnahmen beschreiben und damit die Leitlinien für den weiterhin zu erwartenden Wachstumsprozess am Campus Bochum setzen.

Eine wichtige Prämisse für die Entwicklung des Campus Bochum ist die Sicherstellung der exzellenten Forschung und Lehre und die Optimierung notwendiger Rahmenbedingungen. Um die Bedarfe der Akteure und Institutionen frühzeitig zu berücksichtigen und ihre Interessen abzuwägen, sind diese von Beginn an in den Prozess eingebunden. Neben der Stadt Bochum, vertreten durch das Amt für Stadtplanung und Wohnen, dem die Projektsteuerung obliegt, gehören das Land NRW, vertreten durch den Bau- und Liegenschaftsbetrieb, die Wirtschaftsentwicklungsgesellschaft mbH Bochum sowie die am Campus ansässigen Institutionen – Ruhr-Universität Bochum, Hochschule Bochum und Hochschule für Gesundheit – zum Akteurskreis. Weiterhin sind das Akademische Förderungswerk und die städtische Wohnungsgesellschaft VBW Bauen und Wohnen eingebunden. Der „Lenkungskreis Campus Bochum“ ist Entscheidungsorgan für alle inhaltlichen und organisatorischen Verfahrensbelange des Planungsprozesses. Er setzt sich aus Vertreterinnen und Vertretern von Verwaltungsspitzen, Dezernaten und Präsidien und Geschäftsführungen zusammen. Vorbereitendes und monatlich tagendes Gremium ist der „Arbeitskreis Campus Bochum“.

3.2.2 Offener Planungsdiskurs

Aufgrund der komplexen Anforderungen der involvierten Akteure und Institutionen, der vielfältigen teilräumlichen und fachplanerischen Herausforderungen sowie der daraus resultierenden anspruchsvollen Planungsaufgabe wurde der Bedarf nach einem mehrstufigen Planungsvorgehen deutlich.

Im Rahmen einer Mehrfachbeauftragung wurden im Oktober 2018 vier Planungsteams mit der Erstellung von Machbarkeitsstudien beauftragt, um erste Ideen für den Campus Bochum zu entwickeln. Durch einen intensiven Austausch mit den Teams während der Planungsphase erfolgten eine schrittweise Annäherung an die räumlichen und inhaltlichen Herausforderungen und eine Rückkoppelung von planerischen Ideen mit allen beteiligten Akteuren in mehreren Kolloquien.

Diese erste Planungsstufe hatte somit die Auseinandersetzung mit dem Raum und seinen Herausforderungen zur Aufgabe und diente der planerischen Ideenfindung zur inhaltlichen und räumlichen Weiterentwicklung des Gesamtraums. Die Ergebnisse einer Mehrfachbeauftragung wurden durch ein Empfehlungsgremium beurteilt und ein Konzept zur Vertiefung ausgewählt. Sowohl die politischen Gremien der Stadt Bochum als auch die Gremien der beteiligten Institutionen haben den involvierten Akteuren den Auftrag erteilt, diese

Konzeptideen im Rahmen einer 2. Prozessphase als Grundlage für verbindliche Planungsschritte im Rahmen einer 2. Prozessphase zu prüfen und zu vertiefen.

Ziele dieser 2. Phase sind konkret die Erarbeitung eines städtebaulichen Rahmenplans für den Gesamtraum Campus Bochum als räumliche und strategische Vorstufe zur Baurechtschaffung und Vorbereitung von öffentlichen und privaten Investitionen und die Prüfung der Machbarkeit verbundener städtebaulicher, verkehrlicher und freiraumplanerischer Konzeptaussagen. Der diskursive Prozess soll weitergeführt und um die Beteiligung weiterer Statusgruppen ergänzt werden.

4 SCHLUSSFOLGERUNGEN UND AUSBLICK

Das Projekt „Campus Bochum“ ist noch nicht abgeschlossen. Aus dem bisherigen diskursiven und offenen Planungsverfahren lassen sich bereits konkret folgende Schlussfolgerungen ziehen.

Die theoretischen Ansprüche an die wissensbasierte Stadtentwicklung werden in Bochum gelebt. Inwieweit sie sich auch räumlich implementieren, insbesondere vor dem Hintergrund der involvierten Akteure und möglicher Einzelinteressent trotz Gesamtkonzept kann heute nicht vorausgesagt werden. Aber: die Rahmenbedingungen für ein erfolgreiches Projekt stehen gut, geht man in Bochum den Weg der gemeinsamen Planungsvision bereits seit einigen Jahren gemeinsam. Es bleibt jedoch abzuwarten, in wie weit Drittnutzungen – insbesondere diejenigen, die zur Steigerung von Urbanität und Leben auf dem Campus jenseits der üblichen Lehr- und Forschungszeiten beitragen – auf Landesflächen, die nicht primär dem Zweck der „Sondernutzung Hochschule“ dienen, realisiert werden können oder wollen. Mit Blick auf planerische Instrumente und unterschiedliche Ansprüche involvierter Akteure wwerden sich die Möglichkeiten und Chancen, aber vielleicht auch Grenzen der wissensbasierten Stadtentwicklung zeigen.

Die Frage nach der Bedeutung von Raum in einer immer digital und global agierdenen Gesellschaft wird zurecht theoretisch, auch und gerade in der Diskussion um die Wissensgesellschaft, kontrovers geführt. Der Raum hat für die Erzeugung von Wissen große Bedeutung - durch Nähe, die Ausbildung von Wissensmilieurs, Clustern oder ‚local buzz‘ werden Strukturen geschaffen, die als Urbanisationsvorteile den Wissensaustausch fördern. Die große Bedeutung städtischer Strukturen zur Wissensgenerierung liegt darin begründet, dass Nähe, Agglomerationsvorteile und physische wie soziale Netzwerke die Entstehung und Wiedergabe von Wissen unterstützen und als Nährboden für Wissen gelten (vgl. Brake 2011: 80-81). Hierfür werden auch in Bochum die räumlichen Voraussetzungen geschaffen.

In der Entwicklung hin zur Wissensgesellschaft und zur damit verbundenen Technisierung sehen Vertreter, eine Verstärkung eines völlig raumunabhängigen und überall verfügbaren Wissens. Diese Ansicht der „Enträumlichungs- und Vergleichszeitigungsprozesse durch globale hochtechnologische Kommunikationsnetze“ (Matthiesen 2008: 95) wird verschiedentlich untermauert. So sieht auch Meusburger die Entwicklung, dass große Gruppen in der Forschung und Wissenschaft vor einigen Jahren noch davon ausgegangen sind, dass Wissen und Raum getrennt voneinander betrachtet werden können, da Wissen universell verfügbar, abrufbar und transferierbar sei (vgl. Meusburger 2006: 269). Die Gründe für dieses Wissensverständnis liegen darin, dass Daten, Informationen und Wissen nicht getrennt, sondern als Einheit betrachtet wurden. Matthiesen sieht die Gründe für diese planerische, politische und gedankliche Position auch in einer „Skepsis gegenüber der Rolle von Standorten in der Wissensproduktion, (die) sich dabei auf ältere Zweifel, ob physisch-materielle Infrastrukturen überhaupt Einfluss auf geistige Tätigkeiten und Kreativität haben, (stützt)“ (Matthiesen 2008: 95) . Dies betrifft also nicht nur den konkreten Ortsbezug innerhalb einer Stadt, sondern auch die globale Ebene.

Spezialisierung und Differenzierung werden auch in Zukunft immer noch anwachsen. Dies bedeutet jedoch nicht, dass auch weiterhin autarke Einheiten, auch räumlich betrachtet, entstehen (vgl. Nowotny 2006: 26). Im Gegenteil: Während die Gesellschaft der Zukunft in ihren technischen Prozessen noch stärker spezialisiert sein wird, ist dennoch die räumliche Nähe entscheidend (vgl. Hübner 2006: 14). „Entgegen weit verbreiteter Auffassungen brachten die IuKT (Informations- und Kommunikationstechnologien, Anm. der Verf.) keineswegs den ‚Tod der Distanz‘. Das Gegenteil ist wahr: IuKT sind wissensgetriebene Innovationen, die die räumliche Nähe von Innovationsakteuren geradezu erfordern. Richtig ist: IuKT transportieren Informationen schneller und billiger denn je über den Globus, Wissen, anders als Information, aber ist nach wie vor in starkem Maße menschengebunden und deshalb räumlich fixiert“ (Hübner 2006: 14).

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Jenseits raumwissenschaftlicher Diskussionen wird im Bochumer Prozess „glokal“ gedacht. Die lokalen Akteure denken gemeinsam visionär: sei es im Falle der Hochschulen die Verfolgung höchster Ansprüche an Lehre und Forschung und die globale Positionierung in der Wissenslandschaft; sei es in der bestmöglichen Schaffung rechtlich-planerischer Voraussetzungen, die diese Zielsetzungen ermöglichen. Die Basis dafür ist in Bochum vorhanden.

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Greenery in Cities and Controlling the Reasons of Urban Heat Islands – a Sustainable Approach for the Spaces of the Future in Controlling Urban Heat Islands

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1 ABSTRACT

Amid the current global climate change, countries are facing a critical challenge in consideration of dealing with its consequences. In Bahrain, the urbanization process has been of grave consequences upon the urban open spaces quality. Therefore, a low percentage of vegetation and "CONCRETE FORESTS" occurred, which acts as heat absorbents towards the building' inner spaces. Consequently, overpriced monthly electrical bills were resulted due to the excessive energy consumption in cooling the building. Furthermore, these cement blocks emit heat towards the surrounding urban spaces, deteriorating the urban quality of the city. Lamentably, these factors have released socio-economic and environmentally unsustainable perception of cities in Bahrain.

In the old part of Manama city, the capital of Bahrain, we find this problem very clear. According to the field survey, most of these buildings' facades either have no or minor climatic treatments. Paints and lesser types of thermal insulation; as well as; using natural materials in building blocks is the existing treatment-seeking least insulation impacts. The research presents the green walls upon buildings' facades as a cooling method of the interior spaces during summer and for a thermal insulation technique as well. This technique will add value in controlling the reasons of the Urban Heat Island (UHI) and overcoming as well in Bahrain.

Keywords: Concrete forests, Living green walls, Sustainability, Urban heat island (UHI), Urbanization.

2 INTRODUCTION

Most of the cities in the Middle East and North Africa (MENA cities) in general and Gulf cities in particular, the cap face a dramatic increase in the grave consequences of climate changes problems. (Guzmán et al., 2009). Urban designers, landscape architects, and architects have their responsibility towards creating different solutions in overcoming these dramatic climate changes problems. Unfortunately, there is a lack of coordination and integration between the work of the specialists and the professional discipliners primitively in mainstream climate change problems in the local, regional and international levels. UHI is one of the results of these miss coordination between the urbanists as well.

The old urban areas of the kingdom of Bahrain' suffer from the rapid changing in the urban pattern and its characteristics, which occurred in conjunction way with a shortage of open spaces and greenery. Some urban ideas moved toward adopting vertical urban expansion (Figure 1) (El-Ghonaimy and Javed, 2018). In the same issues, Unfortunately, most of the facades of the existing building in the old part of Manama city are vulnerable to heat, warming, and traversing heat towards inner spaces with minor thermal treatments. Moreover, it is challenging to deal with the existing building facades in term of insulation systems. Therefore, the installing of the Green vertical wall is suitable, as an envelope for existing old buildings that is does not need to change the wall; it is just adding layers with proper fixing.

From the planning point of view, many infrastructure plants that generate energy and electricity that suites the urbanisation needs were constructed. Also, water and sewer treatments plants were rapidly built to support urbanization progress. It should be noted that Bahrain depends on the use of the country non-renewable-resources such as the fuel fuels in generating energy, which mainly directing towards use in Cooling buildings, especially during the summertime. All the previous conditions rose the reasons for happening the urban heat islands (UHI), where the urban settlement demonstrates a higher temperature in some places than the surrounding area (Nuruzzaman, 2015). Moreover, a pilot field study by the researchers indicated the happing of the UHI in Manama city, the capital of Bahrain. Since UHI phenomena threaten Bahrain, a critical question appeared as the focal point of the research, which is: how can Bahrain control and limit the accruing of UHI? Answering this question will be the scenario of this research. Therefore, the research focuses on presenting one of the useful and practical technical solutions that will help in controlling this phenomenon in the Kingdom of Bahrain.

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Fig. 1 (left(: Bahrain is an island, has limitations of land for horizontal urban growth (Al Aali, 2008). Fig. 2 (right): High-rise building (concrete forest) with a low solid/void land uses ratio within the Manama City urban' pattern (researcher, 2019).

Thus, research illustrates the concept is to have greenery upon wall functioning as an environmental temperature insulation layer, preventing the summer burning heat from affecting the exterior structure of the building, and trespassing them their interior spaces; as applied in many Gulf Cooperation Council (GCC) cities such as Dubai and Abu-Dhabi. Also, this technique serves the ongoing economic growth and nurture the national income by creating many job opportunities for the unemployed. Furthermore, the ripe unique collection of plants could be either sold for a decent monetary value or get locally utilized for nutrition security and self-sufficiency purposes. Mainly, concerning this system is recommended, especially in case the difficulty in doing indoor thermal treatments (planters, 2018).

In sequance, the research methodology was divided into the following parts:

- Literature review: about UHI
- UHI in Manama city and its locations.
- Analyzing the urban pattern and building facades.
- Proposing the method for controlling UHI in old Manama.

3 THE PHENOMENON OF UHI

UHI is an area that is hotter than the surrounding because of a climate phenomenon. In other words, UHI is a climate phenomenon that results in increased air temperature in cities, when compared to their rural surroundings. (Sobstyl et al., 2018). Due to the rapid urban growth in cities, energy consumption is in the continuous increase, to match the accelerated needs for the metropolitan requirements. Accommodating the massive influx of people, cities will have to get smarter concerning sustainability and for the technical solutions towards energy preservation by scrutinizing every architecture detail (Martin, 2019).

Scientists have studied UHI effects for decades and the significant reasons for increasing this phenomenon in cities. Generally, these urbanisation progresses increased the demand for urban services and infrastructure plants. Moreover, it increases the urban problems within the city neighborhood districts in term deteriorating the urban pattern, neighborhood quality of life, and increase the environmental problems. The losing open spaces, high rise buildings, inappropriate insulation material or the absence of thermal treatments for building facades increase the temperature within the premises as well. Consequently, the demand upon using artificial air-conditions has accelerating, which increases the energy consumption within these areas (Elghonaimy and Elghonaimy, 2017). Therein, the UHI effects can also experience the increase of heatwaves, heat-related illness, air pollution and an upsurge in energy use (Henninger et al., 2015).

Furthermore, in ISESCO Journal for Science and Technology, has cited that the GCC countries are struggling on the horns of the dilemma; high-energy consumption out of the rapid population increase and its subsequent environmental threats, thanks to the high wave of modernization and astounding economic

growth. Logically speaking, the witnessed GCC renaissance has scored the top six CO2 emission rates all over the world, resulting in drastic climatic changes (Darwish, 2016)

4 REASONS OF THE PHENOMENON OF UHI

In recent years, the subject of the impacts of the "Climate Change" and the Phenomenon of UHI has been one of the critical issues on international political agendas, with significant economic consequences. Many scientific projects, research projects and academic reports, searched about UHI phenomenon. The drastic economic changes that occurred in Bahrain had a significant influence on the urban pattern and the architecture of the Island. The changing in the urban settlement can be noticed by the dramatical increase of the urban encroachment from 1990 to 2013. The growth did not occur in uniformity, and most of were focused on Manama (Wolfinbarger et al., 2014). In 2018, the land area for Bahrain was 778 sq. Km. It increased from 690 sq. Km in 1969 to 778 sq. Km. In 2018, the growth was at an average annual rate of 0.25%. The Agricultural land area was 86 sq. Km and Forest, which were about 11.1% and 0/8% of the share of land area (knoema, 2018b). Manama in Figures 3a shows that the original urban area was greeneries years ago. The roads were conforming to the direction of the sea breeze. Meanwhile, it went fewer greeneries farther from the Seaside. However, the new planning scheme complies with the city and its organic nature, which has changed to the more organized and modern. In the past, houses were fewer numbers in the urban context. The street network paved by natural stones (not asphalt) also the orientation of buildings was to take advantage of the wind movement, avoiding the direct exposure to the sunrays. Therefore, it created a comfortable environment for inhabitants to perform their daily activities. In contradict in figure 3b; recently, the city has rapid population increases and change in the urban pattern (Figure 4) due to the appearing of concrete forests, which became the domain. Streets became wider and paved with asphalt (heat reservoir) as well re-using the vacant lands and the open spaces towards buildings, which decrease the ratio of the vegetation in the area and led to deteriorating the quality of life for inhabitants.

Fig. 3 (left): Urbanization developing in the study area 1990–2013 (Wolfinbarger et al., 2014). Fig. 4 (right): The Changing in streets pavements characteristics in Bahrain: In old district: the use of traditional and natural pavements materials (researcher).

4.1 Developing projects and the increase of CO2 emissions

Massive, developing projects have been constructed to satisfy the population needs. These developing projects need more energy, especially for cooling in hot, humid days, which annually extend from the beginning of April to end of October. It is considered that more than 70% of year time, it is expecting to need for the massive amount of fossil fuels, to cool these buildings, by operating the power plants to generate the required electricity. The Carbon Dioxide Information Analysis Center “indexmundi” (2018) measurements show that the value for CO2 emissions from gaseous fuel consumption (kt) in Bahrain was 28,375.25 as of 2014. As the graph below shows, over the past 54 years, this indicator reached a maximum value of 28,375.25 in 2014 and a minimum amount of 0.00 in 1960 (Figure 5).

According to IEA Statistics (OECD/IEA 2014), it was calculated that the CO2 emissions from the different types of buildings (residential buildings, commercial ...etc.) and public services (% of total fuel combustion) in Bahrain were 0.84% as of 2014. The highest value over the past 43 years was 2.08% in 1998, while its lowest cost was 0.79% in 1974. The CO2 emissions from residential buildings and commercial and public services contain all emissions from fuel combustion in households (knoema, 2018c) (Figure 6).

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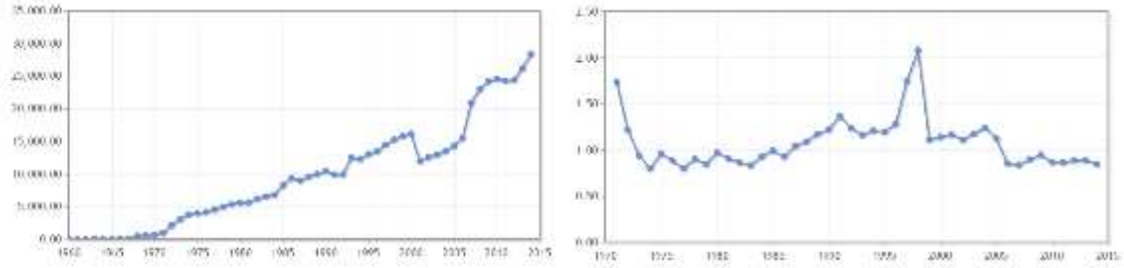

Fig. 5 (left): CO2 emissions from gaseous fuel consumption (kt) between 1960 and 2015 (indexmundi, 2018). Fig. 6 (right): CO2 emissions from residential buildings and commercial and public services (% of total fuel combustion) (indexmundi, 2018)

Indexmundi (2018) shows in a study in Bahrain, CO2 emissions increased from 14,658.3 kt in 1997 to 24,458.4 kt in 2016, growing at an average annual rate of 2.92 %. Moreover, the low greenery rate deteriorates urban quality in Bahrain. Consequently, the resulted problems from the UHI phenomenon are in increasing in old neighborhoods in Bahrain. Moreover, it should be noted there is increasing in the activities of the potable water plants (treatment – desalination) for supplying the urbanization projects must cope with such services, especially in cooling of buildings.

5 BAHRAIN NATIONAL STRATEGY 2030 AND UHI PHENOMENON

Statistic by Carbon Dioxide Information Analysis Center showed that Bahrain has the position of 42 levels between 117 countries with Value of 28,375.25 kt. It indicates the hazard level of CO2. (indexmundi, 2018). Unfortunately, the Strategy of Bahrain 2030 did not take serious actions in consideration the warning of the CO2 threshold. Nonetheless, the main aims of the strategy mentioned to re-establish the Bahraini Kingdom as an ideal island of living to the diversity of groups (SOM Consultancy Project for Bahrain, 2007).

5.1 Urban solid and void in old Manama

Elghonaimy and Mohamed (2019), in a research project about solid and void in urban of Manama Governorate, the considerable difference ratio between the built-up areas related to the vacant spaces have been revealed. The research has unearthed the concentration of huge buildings "Concrete Forest" with an apparent shortage of greenery inside the residential areas. The conducted practical survey and analysis in this research concerning Manama (Figure 8a) has concluded that the city suffers from the absence of appropriate urban open spaces and foliage in various areas of the city.

a. Pilot study map

b.Land surface temperature (LST) over Manama City in the Winter of 2017.

c. LST over Manama City in the summer of 2018

Fig. 7: Pilot study, UHI in Old Manama location in Capital Governorate, Bahrain in 2018 (researcher).

Most of the urban pattern has turned in to “Concrete Forest” with a shortage of greenery. This leads to the accelerating emergence of UHI phenomenon. Figure (8 b and c) shows the UHI in the old part of Manama city and the prevalence of UHI, out of the shortage of open spaces and greenery in these areas. In the same sequence, the CO2 emissions increased from 14,658.3 kt in 1997 to 24,458.4 kt in 2016, growing at an average annual rate of 2.92 % as shown in indexmundi (2018). In Bahrain, Moreover, the low greenery rate deteriorates urban quality in Bahrain. Consequently, the resulted problems from UHI phenomenon are in increasing in Bahrain. Moreover, it should be noted there is increasing in the activities of the potable water plants (treatment – desalination) for supplying the urbanization projects must cope with such services especially in cooling of buildings

5.2 Facade conditions in the Building

Infringing the stipulated urban rules of thermal insulation, in particular, ends up in an economic burden on the environment. Likewise, the number of heat reflecting facades and human activities are affected. Moreover, the lack of open spaces, large concrete forest areas and adapted facades types are cardinal factors in the mutual problem in the old districts in these cities. etc., causing the spread of the UHI. From the site inventory and analyzing the urban changes in Bahrain, it was noted that after the wave of modernization, the urban pattern had undergone several transitional phases. In the traditional city of Manama, one can notice in the old neighborhoods low-rise buildings, whereas, in other areas, they are modernly styled mid-rise buildings. Moreover, the city also contains high-rise towers of modernized glass facade in the eastern part. Additionally, most of the facades had a low level of thermal insulation for a long time. The governmental housing projects, which scattered in Bahrain, missed the prober thermal insulation and influenced the increase of the energy for buildings' cooling, which will explain in the next section. (Figure 9).

5.3 The resulted accelerating of Energy consumption in Bahrain

Unfortunately, the implementing process of the urbanization projects has no comprehensive defensive strategies against the UHI phenomenon. Therefore, there is a vast wasting of energy in services; such as cooling, supplying potable water and electricity. Bahrain can partly provide itself with self-produced energy. The most critical measurement is the total consumption of 26.09 billion kWh of electric power/year. Per capita, this is an average of 17,480 kWh. The production is 17 bn kWh from all-electric energy-producing facilities. That is 65% of Bahrain own usage. The rest of the needed power is imported from the surrounding countries in the Gulf region. The different energy sources, such as natural gas or crude oil, are also used (Table 1).

Electricity	**Total**	**Bahrain (per capita)**
Own consumption	26.09 bn kWh	17,479.75 kWh
Production	17.07 bn kWh	11,436.54 kWh
Import	205.00 m kWh	137.35 kWh
Export	213.00 m kWh	142.71 kWh
Crude Oil	**Barrel**	**Bahrain (per capita)**
Production	44,240.00 bbl	0.030 bbl
Import	223,900.00 bbl	0.150 bbl
Export	225,000.00 bbl	0.151 bbl
Natural Gas	**Cubic meters**	**Bahrain (per capita)**
Own consumption	15.50 bn m³	10,384.68 m³
Production	21.07 bn m³	14,116.46 m³

Table 1: Energy Balance. Source: https://www.worlddata.info/asia/bahrain/energy-consumption.php.

6 GREEN WALL SIGNIFICANT

Green walls, it is not the latest design fad. The concept dates back to the 1930s, and they are science fiction made fact. Many of the architectural companies trying to win design awards, of all sizes looking to improve their green credentials. Therefore, it is important to define the term of "green walls" which are panels of plants, grown vertically using hydroponics, on structures that can be either free-standing or attached to walls. Living green walls are also referred to as vertical gardens, living green wall, green walls, living walls or eco walls (Ambius, 2019). It is partially or wholly covered with vegetation and, in some cases, soil or an inorganic growing medium (Figure 11). The succession of the green wall is due to proper insulating, lightweight; choosing locally sourced plants would flourish all year round moreover it should be low maintenance as well as having internal irrigation system, which should be particularly beneficial as local staff can easily look after walls (Ansglobal, 2019).

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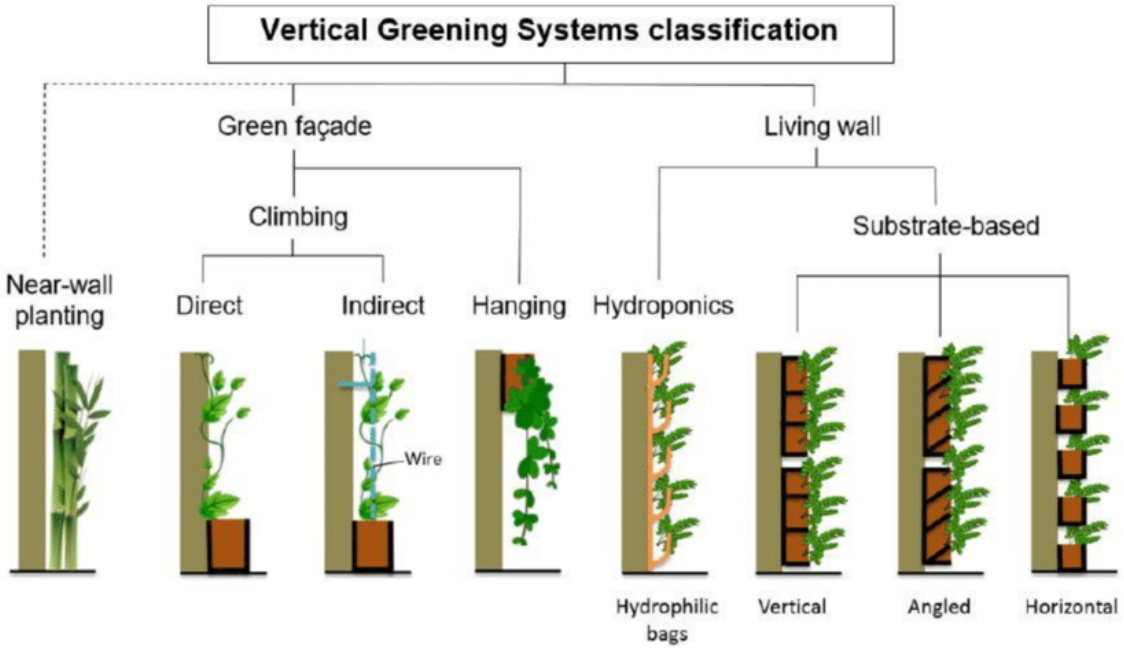


Figure 9: Vertical Greenery Systems classification. (Ottelle, 2011)

Discussing the significance of green wall in controlling UHI will be illustrated based on the fieldwork and the researches, as follows:

6.1 Energy impact of using green wall

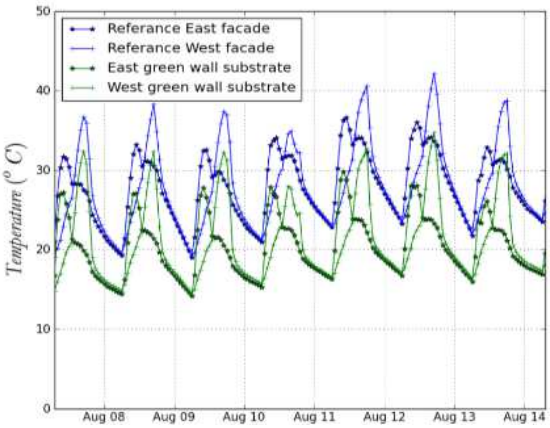
6.1.1 Energy saving

Green walls improve building energy efficiency by reducing energy cost. It enhances the building's thermal insulation by adding a protective layer of plants as well as the shading, and the evapotranspiration of the plants contribute to lower surface temperatures, and thus to reduce heat gains through the facades, which are also moderated by the large heat capacity of the plants (Henninger et al., 2015). Abdelsalam in his study, he concluded that comparing greenery in building upon facades to the standard walls, shows that the energy-saving up to 15%-32% depending on the thickness and thermal conductivity of the green wall composition (Abdelsalam, 2012).

Region	Season	Observation
Tehran, Iran	Dry-summer subtropical	Average air temperature above the green roof was 3.06–3.7°C cooler than that of the reference roof (Moghbel and Erfanian Salim, 2017)
Singapore	Hot-humid	Large urban parks significantly mitigated the UHI effect (Forsyth et al., 2005)
Florida, United States	Humid-subtropical	Lower air temperature under the shade of the trees compared to the surrounding areas (Sonne and Vieira, 2000)

Table 2: The effect of greenery on cites with similar climates to Bahrain.

A study by Djedjig et al. investigated the impact of the green wall on buildings energy demand as the more heat the building isolates the less energy it would require cooling itself. Two identical three-story buildings were covered by green wall on the east and west facade. One building is on La Rochelle, where the climate is similar to Bahrain. Building' walls were made of 20 cm cinder block and the roof made of 12 cm concrete. The green walls substrate depth is 12 cm, and its saturation ratio is fixed 60%. The vegetation coverage was kept constant. The results show that green walls reduced the temperature up to 10 degrees Celsius.



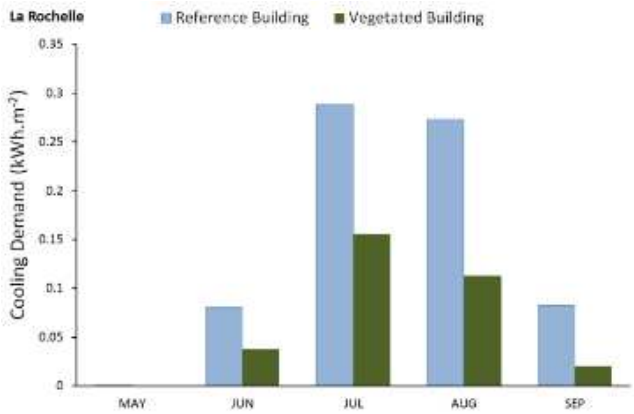


Fig. 10 (left): A diagram showing the temperature with and without a green wall (Djedjig et al.). Fig. 11 (right): A diagram showing the cooling demand with and without a green wall for La Rochelle (USA)

Furthermore, the vegetated buildings have less than half the cooling load of the reference building' Green walls reduce the temperature of a building by decreasing the U-value of the building envelope. Furthermore, the shading and evapotranspiration process lower the external temperature. (Djedjig et al.) Figures 12&13 show the results of the studies.

6.1.2 Energy cost reduction

It is propitious in saving energy up to 33% in countries with hot, humid climate; such as Bahrain (Payne et al., 2007). Consequently, it will reduce the budget of cooling buildings consumption and accordingly the annual amount of fossil fuels in operating the electrical, desalination water plants, which would end up in positive results regarding the energy cost reduction by reducing the consumption of energy in running artificial air conditions. Moreover, Al-Nuaimi and Khamis (2014) in a study on obtaining the advantage of the age of foliage in different places in some buildings in Bahrain, it was deduced that up to 68KWH of the annual energy consumption is reduced, saving about 150,321.6 BD.

6.1.3 Decrease the load from the power station

The governmental power station will not be loaded; especially in the summertime with the increase of building cooling purposes.

- Sound reduction

A study by Wong et al. (2010) was conducted to determine the noise absorption rate when green walls are used. Ferns were used for the green wall. Three sample green walls were obtained, one covering only 43% of the wall, the other covering 71% of the wall and the last one covering 100% of the wall. The results show that the thicker the green wall, the more sound it isolates. We can see that for sound frequencies less than 800 Hz even limited coverage of vegetation equally help with noise isolation. (Figure 14) (Wong et al. 2010)

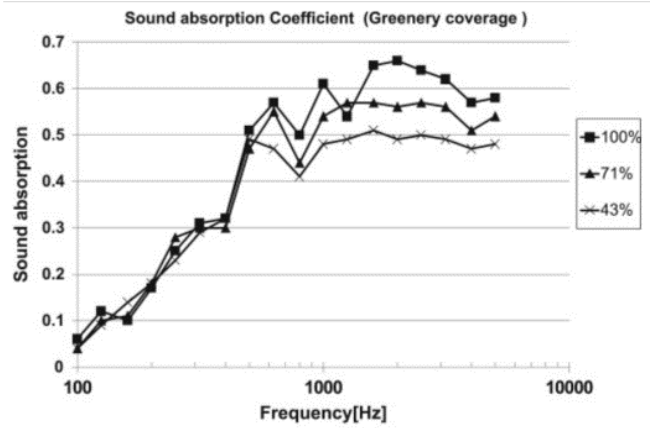


Figure 12: The amount of sound absorption in respect to the amount of plant coverage of the green wall and sound frequency.

- Marketing potential and Tenants' Economic Resources

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Green walls are innovative design technique. The attractive appeal of living walls fascinates people, bestowing uniqueness to these buildings to be a distinguishing factor for marketing initiative (and romeda district, 2007). This would result in the tenants' financial welfare, for their owned buildings would be a productive environment with fruits, vegetables or flowers.

6.1.4 Nutrition security suppliers

Being a productive environment implies being a nutrition supplier to secure the residents' needs.

6.1.5 Psychological sequels

Bahraini citizens sanctify their privacy rights. It is represented in craving for separate independent housing units. Yet, they have a soft spot for gardens. The traditional Bahraini architecture has been a typical incarnation of this keenness, as in courtyards, for it has been a definitive component of its housing scheme. Recently, this component; likewise; any façade greenery have vanished from the field. Therefore, recalling the greenery of building facades realize the User's appreciation that the Greenery upon the walls of the housing units is expected to meet unanimous agreement and gratitude by the Bahraini citizens. This would act as an alternative construction strategy to courtyards, by providing greenery on buildings' facades substituting gardens and social interactions (Henninger et al., 2015).

- Horticulture therapy interaction

Horticulture therapy affirms that greenery acquainted people are apt to master the stress management, controlling the panic attacks and blood pressure swings, thanks to their homing relaxing spaces (Shiah, 2011). The green view can be regarded as a natural driving force to:

(1) Encourage public participation in enhancing the urban quality of the participants' neighbourhood and getting over self-consciousness. Having such competitions is to be perfect for introducing the best performers to be awarded. This would probably help their self-esteem (Henninger et al., 2015).

(2) Having greenery upon building facades will motivate pedestrians. Also, it will encourage residents to beautify their sheltering urban environment, which is undoubtedly an indispensable social advantage of open spaces. It will impact positively in the social interaction thrives in communal areas; especially in pleasant environments. (Henninger et al., 2015).

- Aesthetic appeal

Visual quality by alluring treatment and decorative elements are substantial beatification factors for eye-catching green view buildings in a world stitched up with concrete and brick blocks. Another advantage that it makes up for the embarrassing mistakes in building with derogatory and inferior materials, letting them go unnoticed by increasing greenery in the targeted areas (urban-greening, 2017). Here, it will re-form the image of the city positivly, and decrease aesthetic pollution, which positively shows on social life.

7 PLANTS THAT ARE SUITABLE FOR DRY AND HOT CLIMATES

The researchers collected data by acting a survey, site studies in many nurseries in Bahrain, which was followed by comparative analysis for the types of the plants' species that could be used in the green wall in hot climate environment such as most areas of Bahrain. The significant plants' types are (Table 2):

(1) groundcovers, ferns, low shrubs, perennial

(2) flowers and edible plants

(3) pre-vegetated living walls offer an instant green wall for immediate impact.

8 TECHNICAL AND METHOD OF INSTALLATION:

There are several ways to install green walls, including:

(1) Using moulds: open tray plug (Figure 18) cohesive soil is used in the formwork with the seeds or small plants, and then they put on them the net that the young plants can pass through and at the same time prevent the soil from falling. Then it is hung on the wall through a wall-mounted structure, often made of steel, to withstand heavyweights. The irrigation process is done through water sprays or water channels (distillation).

Images	Name	Type Description
	Bahraini jasmine	outdoor plant (Climber) A plant that blooms in summer and spring. Its flower is white and smells strong and fragrant
	Allamanda	outdoor plant (Climber) Season: all seasons, it flowers are yellow, appearing in the summer. Use: for decoration. Very fast to grow
	Jacquemontia	outdoor plant (Climber) Season: all seasons, it flowers are purple, appearing in the winter. Use: for decoration.
	Silver queen	indoor plant Season: all seasons Use: for decoration.
	Money Plants (Epipremnum aureum)	indoor plant (Climber) Season: all seasons Use: for decoration.
	Dracaena	indoor plant Season: all seasons Use: for decoration

Table 3: Plants that are suitable for green walls in Bahrain

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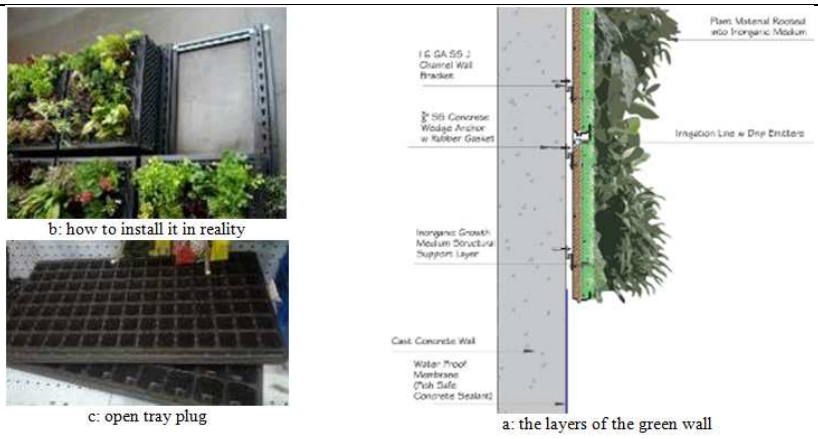

Fig. 13: Using molds open tray plug.

(2) Climbing plants: Climbing plants: They are placed or cultivated on the ground at the bottom of the wall, above the wall, or even in the middle of the wall, and then bamboo sticks or a grid structure of any materials are placed and installed on the wall, after that the plants grow on the net or sticks to be a green wall. Irrigation is usually done by spraying water. Applying this method is the easiest that it is the most common as well in Bahrain.(distillation).

Figure 14: Using climbing plants for green wall.

(3) Garden Spot: Pixel Garden is a unique system used in constructing vertical gardens, popularly known as Green Walls. Pixel Garden is setting new standards in buildings design, with the use of living flowers, which implement freshness, aroma and colours in its surroundings (figure 20). Each set consists of a box with two flower pots planted inside it. The system is designed in a way which enables the construction of a full flower wall with an innovative irrigation system.

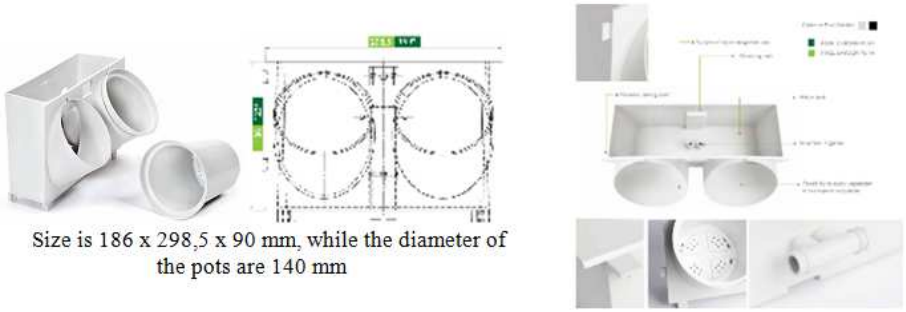

Figure 15: pots dimensions, which will produce the grids pattern of the facades

The Pixel Garden System offers enormous design possibilities and arrangements. Various colourful flowers in each pot can be used to create colourful pictures with diverse colour variations, blooming mosaics, floral inscriptions and sophisticated patterns with spectacular visual effects. The Pixel Garden's vertical gardens offer enormous possibilities of arrangement. Flowers in small pots, like pixels, create colourful pictures. The system is not only used as decorative nature. It has a multi-functional usagesuch as Traditional Vertical Gardens, Sound Barriers, Fences or hoardings and Partition Walls

9 FINDINGS AND CONCLUSION

After doing a market survey in Bahraini market, it was found that in general, the concept of dealing with greenery upon building walls is to use the lightweight system to make it possible and up to 25 m high, can be extremely dramatic visually, as well as softening what may be seen as hard surfaces. These green walls made of parts to enable the arrangement in attractive shape with a significant degree of self-efficiency. It allows a large number of plants species to grow on a vertical surface – allowing the designer to use it in artistic freedom in their work. Climbing plants have traditionally been seen as 'add-ons' to buildings. They are using living material, which could be installed, in different positions above the building facades. For the present case of the buildings in the old part of Manama, climbers can be used on freestanding structures such as giant 'pergolas' or poles. While discussing the panel typology of vertical green walls, there are major four types of boards, which are:

(1) Panel systems: Benefits of a panel system:

(2) Tray systems; Benefits of green wall tray systems:

(3) Freestanding systems; Benefits of a freestanding system: Moss walls

In conclusion, having Vertical Greenery upon buildings facades play as isolation envelop for buildings facades and will adjust CO2 emission rates, which by turn enhances air quality and comfort. No question, it will improve using lighting, controlling temperature, humidity and develop ventilation for the building (interior and exterior spaces), to reach out for the aspired comfort level. Undoubtedly, introducing Vertical Greenery upon buildings facades to counter the UHI impacts is one of the leading vital solutions, is a sustainable solution to improve the environment and minimize the actual risk of UHI. Therefore, applying this idea is a priority for the desiners in terms of achieving sustainable city because of the following points:

- Economic: It can optimize a natural cooling process, which functions by breaking the vertical flow, to cool the surrounding air as the vertical circulation slows down. Furthermore, It will reduce the consumption of energy in cooling, which will reduce the Co2 that is resulting from using the fusel fuel in running the energy plants. Moreover, it will have positive impacts on the national economy by using productive types of plants, as explained earlier, which will become economic resources for the Bahraini family. Moreover, it will integrate the community with farming using and benefiting from developing the idea by having "Vertical farms" as well.
- Environmental: In energy curtailment of the buildings, it has thermally beneficial for hot, humid countries, benefiting from adding the thermal and sound insulation techniques by modifying the thermo-conductivity. That will help Bahrain to be self-sustainable in terms of reducing the UHI phenomenon, reducing the energy consumption in cooling; as well as; producing local nutrition and air filtering. Moreover, it is possible to realize better urban spaces by reducing glare.
- Technically: From the construction point of view, the existing buildings in Manama are old enough to make the insulation of thermal insulation is difficult. Applying the vertical green is simpler to do thermal insulation upon buildings' structures. Moreover, installing the concept of "ECO" technology to Vertical Green facades is essential to deal with the buildings that are difficult to add thermal insulation.
- Social: It binds nature to its urban environment, to foster the social interaction, economic growth, educational status and environmental conditions. Moreover, vertical greens provide shading and protection to the surface of the building to absorb less heat, which influences positively for the social activities inside and outside buildings.

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Industrial Brownfields as Restorative Environments: the Possibility of Transformation and Reactivation of the Abandoned Industrial Heritage

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1 ABSTRACT

Changes in the needs of modern society, as well as technical and technological developments, have led to an increase in the number of abandoned industrial buildings in cities, thereby disrupting existing urban areas. Although in recent decades the well-known practice of urban revitalization of abandoned industrial heritage buildings has been recognized as a successful method for urban revival, these types of properties in Serbia, although being the former symbols of prosperity and the power of the state, have been left to physical decay.

Restorative environments, unlike industrial heritage buildings, are designed to contribute to the health and well-being of people, especially by alleviating mental fatigue and stress, through the people's contact with nature. As restorative environments are predominantly tied to open spaces and natural settings, it is important to consider the possibility of applying this concept to indoor environments.

The aim of this paper is to research the possibility of applying the principles of restorative environments in the processes of transformation and reactivation of abandoned industrial heritage buildings, which have been placed under state protection as cultural monuments.

Through an extensive literature review, including different theoretical concepts and analysis of good practices, this paper examines the possibilities of transformation and reactivation of the abandoned industrial heritage on the territory of Belgrade such as Sugar Plant, the Milan Vapa's Paper Mill and the Power and Thermal Power Station "Power and Light", through the implementation of the concept of restorative environments.

The aim of this paper is to examine the possibility of transforming abandoned industrial heritage into healthy environments while adding cultural, social, and economic value. Application of this concept could lead to the formation of new potential for increasing public health within the urban tissue, as a new form of a public good, as well as to consider the possibility of wider use of restorative environments.

Keywords: urban renewal, industrial heritage, reactivation, restorative environments, Belgrade

2 INTRODUCTION

The transition of society from industrial to post-industrial and the accelerated urbanization that led to the expansion of cities, influenced the change in the character of industrial locations that were once planned on the peripheral parts of the cities, along with strategic traffic routes. These locations have become abandoned parts of the wider central zone of cities, occupying significant areas of building land intended for construction. Considering the importance of industrial buildings and complexes in general, both through their cultural and historical value, bearing in mind that they represent a testimony to the development of society not only through the construction of industrial buildings but also through the construction of supporting infrastructure systems and are part of society's collective memory, many industrial buildings and complexes have been revitalized in Europe in recent decades.

Due to the current underdeveloped practice of including such buildings in the socio-economic development of society, the topic of the revitalization of industrial heritage in Serbia is of particular importance. Numerous industrial buildings in Serbia have been left to decay, which has neglected their cultural and historical significance. Belgrade has significant and numerous industrial buildings with recorded cultural and historical value and their position and character represent a good basis for the development of various purposes. Many of these industrial buildings and complexes are positioned in locations that are intended for the development of commercial activities, and therefore, their valorization and preservation are under great pressure from potential investors.

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Taking into account the challenges that cities face today and that the issue of sustainability and improving the health of people in cities is one of the most important issues for all professions, not just for urban planners, finding the new ways to plan restorative environments could contribute to better understanding and improving public health in cities.

Unlike industrial buildings, which are most often associated with impaired human health, restorative environments are spaces that contribute to the health and well-being of people. The contribution of restorative environments to human health and well-being is reflected especially through the alleviation of mental fatigue and stress, through people's contact with nature. Exposure to the natural environment reduces negative behaviors and conditions such as aggression, anxiety, depression, or other types of illness, and increases the positive aspects such as health, cognitive abilities, etc. (Mayer, Frantz, Bruehlman-Senecal & Dolliver, 2009). The visual presence of plants can be one of the stress-reducing factors, considering that affective responses to aesthetic visual stimuli can reduce tension levels in humans (Grinde & Patil, 2009).

In addition to natural environments, built environments may have certain characteristics of restorative environments (Kaplan & Kaplan, 1989). However, the degree of restorativeness can be increased by including nature in the context of the built environment. Place attachments also could lead to positive emotional changes (Korpela, 1989), which increase the level of restorative experiences.

Having in mind the stated characteristics of industrial buildings and complexes, but also the characteristics of restorative environments, this paper examines the possibilities of applying the characteristics of restorative environments in the processes of transformation and reactivation of abandoned industrial heritage buildings on the territory of Belgrade. The criteria for the selection of industrial buildings and complexes discussed in the paper are that: these buildings are under state protection as cultural monuments, and thus part of the collective memory, which indicates their importance and increases the propensity of people to these buildings and complexes; they are intended for commercial activities by urban planning documents, and thus their preservation is under great pressure, which requires finding sustainable and cost-effective solutions; and that these buildings are parts of the significant natural environments, which would potentially increase the restorative effects. Also, a common feature of all selected objects of industrial heritage is that their locations, by their nature, are in close proximity to natural environments (rivers and other natural environments that have special significance, quality, and potential for creating restorative environments) but are not directly related to them, which especially points to the problem of connection and the need to create new unique units.

By researching the application of restorative principles on the abandoned industrial heritage such as Sugar Plant, the Milan Vapa's Paper Mill and the Power and Thermal Power Station "Power and Light", the aim of this paper is to examine the possibility of transforming abandoned industrial heritage into healthy environments with cultural, social, and economic value.

3 THE CONCEPT AND SIGNIFICANCE OF THE RESTORATIVE ENVIRONMENTS

3.1 Restorative environments and importance of nature

Restorative environments refer to the ability of nature to induce the improvement of cognitive abilities and the reduction of stress caused by people's daily activities and exposure to stressful environmental influences, explained by the Attention Restoration Theory (Kaplan & Kaplan, 1989) and the Stress Reduction Theory (Ulrich, 1983).

By researching and evaluating people's preferences for different types of landscapes, it has been found that people are much more inclined to build environments with natural elements such as plants, water, etc. than environments without these natural elements (Kaplan & Kaplan, 1989). This preference is explained by the biophilia hypothesis. Biophilia (Wilson, 1984) is defined as a genetically-based human need and propensity of humans to connect with nature and natural processes.

The relationship between nature and man usually involves direct contact with natural elements such as daylight, fresh air, plants, etc. (Ramzy, 2015). People's connection with nature, both direct or indirect, have a significant impact on human health (Kahn, Severson & Ruckert, 2009; Mayer et al., 2009; Maas, Verheij, Groenewegen, de Vries & Spreeuwenberg, 2006; de Vries, Verheij, Groenewegen & Spreeuwenberg, 2003; Wendelboe-Nelson, Kelly, Kennedy & Cherrie, 2019). The visual presence of plants may be one of the

stress-reducing factors because affective responses to aesthetic visual stimuli can reduce tension levels in humans (Grinde & Patil, 2009). Taking into account the positive effects they cause in humans, which is primarily related to reducing stress, improving mental engagement and attention (Biederman & Vessel, 2006), as well as emotions, moods, and attitudes (Barton & Pretty, 2010), natural environments can be good platforms in environmental strategies for creating restorative environments or environments without stress.

3.2 Restorative environments as built and interior environments

Kaplan and Kaplan (1989) indicate that nature and natural elements cannot be clearly defined and that places or things that are natural are the ones which we have experienced. Keeping this in mind, restorative environments do not necessarily relate to a single typology of environments, in this case, nature, but also build environments (Scopelliti, Carrus & Bonaiuto, 2019). If the specific properties of the natural environment make such an environment restorative, then built environments with similar or the same properties could contribute to people as a kind of restorative environments (Scopelliti et al., 2019).

As the Scopelliti et al. (2019) states, conducted studies dealing with the research of restorative built environments exist in small numbers, and according to the character of the objects, they usually include objects that have a certain artistic or historical value. This can be specifically connected to the aspect of collective memory and the sense of belonging and connection that an individual has towards a certain object or built environment in general.

As visual perception plays an important role in the processes of restorativeness, it is important to consider the ways and mechanisms to contribute to people's health in a built environment in the same way that nature contributes. People react very similarly to the natural environment, whether it is real or virtual (Benjamin, 2013). Simulation of nature, through the artistic representation of nature, virtual reality, and other illusions, can be as important as real nature, primarily due to the visual aspect, which positively affects human health. Therefore, it is important to consider the manner of application of digital nature in built environments or in the interior of buildings, especially through the processes of the revitalization of existing buildings. Downton, Jones, Zeunert and Roös (2017) pointed out that generating a virtual experience, in places where it is not possible to make real contact with nature, can have a positive impact on people's mental health and well-being. Making contact with digital nature can be categorized as an advantage when it is impossible to make real contact with nature.

Kahn et al. (2009) point out that, even with comprehensive technological progress, the identity of digital nature and real nature, from the aspect of their positive effects on humans, is the subject of various researches and debates. Human exposure to digital nature provides some but not all of the pleasures and benefits as contact with real nature does (Kahn et al., 2009), so digital nature should thus be treated as a significant element that could improve human health when exposure to real nature is not possible or when it is minimized.

4 INDUSTRIAL BROWNFIELDS AS RESTORATIVE ENVIRONMENTS

4.1 Transformation and reactivation of abandoned industrial heritage buildings

As the restoration processes are a consequence of the comprehensive experience of space and the connection that people make with that space, the purpose of the space and the activities that take place in it plays an important role. Having in mind the cultural and historical significance of industrial heritage buildings and an important position in the modern urban fabric, the revitalization of these buildings is a significant strategic commitment that could meet the modern needs of society but also adequately protect industrial heritage. Revitalization of industrial heritage buildings should include a modern context and development trends and thus integrate modern functions. This can lead to the connection of modern society with revitalized industrial heritage as their favorite place, which would also lead to an increase of the restorative potentials of the space.

The social component is especially important, so environments that increase social interaction are more important from the aspect of the feeling of security, accelerating the processes of restorativeness (Staats & Hartig, 2004). Social relations can be constituted through space, constrained by space, or mediated by space (Dear & Wolch, 1989). Human behavior is related to situations or contexts that are not only part of physical settings, but also perceptual, cultural, and social (Carmona, Tiesdell, Heath & Oc, 2003).

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Due to the complexity of all the above characteristics that define space and affect a person in a way that improves his health, during revitalization, it is desirable to take into account all the complex relationships. Therefore, the formation of such spaces could provide continuous development of the intervention area, as well as the possibility for constant use of facilities by different social groups. Such spaces, by their multifunctional character, should correspond to the character of the narrower and wider context in which they are located, which would achieve a balance between the needs of different actors in the revitalization processes. Also, the specificity of the content itself plays an important role in attracting users.

Scopelliti et al. (2019) pointed out studies (Scopelliti et al., 2016; Carrus et al., 2017; Amicone et al., 2018) which explore the restorative potentials of places through on-site experiences in urban parks, botanical gardens and educational settings. As natural environments in themselves are not a sufficient factor for achieving economic profitability and sustainability of revitalization of industrial heritage, it is important to fit them into other contents, creating a mixed-use. In order to achieve the socio-cultural revitalization of industrial heritage, it is necessary to implement a strategic approach that would achieve an attractive and modern redesign of buildings, but also locate recreational, cultural and educational content, and create spaces potentially intended for various events and tourism presentation. Combining spaces dedicated to social interaction and creative production could have positive effects on the development of social and economic capital.

The revitalization of the presented objects of industrial heritage should be adjusted to the cultural, historical, but also social and political circumstances of the environment. Although recreational, cultural, scientific and artistic activities that bring together different social categories of people, increasing the degree of socialization, can increase opportunities for creating a restorative environment, revitalization of these facilities significantly depends on economic stability and sustainability of all projects and planned facilities.

4.2 The Sugar Plant

The complex of the Sugar Plant, as the first of that kind in Belgrade, was built in 1899-1901. The factory complex contained not only buildings intended for production processes but also housing buildings intended for employees (Dimitrijević-Marković & Sretenović, 2008). Various reconstructions that were carried out within the factory complex, and which took place most intensively between 1923 and 1946, led to the creation of a mixed architectural and functional value of buildings within the complex (Dimitrijević-Marković & Sretenović, 2008). At the moment, the Sugar Plant complex is mostly a devastated and abandoned area, with a minimal functional degree of activity. Dimitrijević-Marković and Sretenović (2008) state that, except for the machine-room in which the KPGT theater is located, the common characteristic of all buildings in the complex is that they have purposes that are not adequate, accompanied by general lack of maintenance and thus deterioration of buildings.

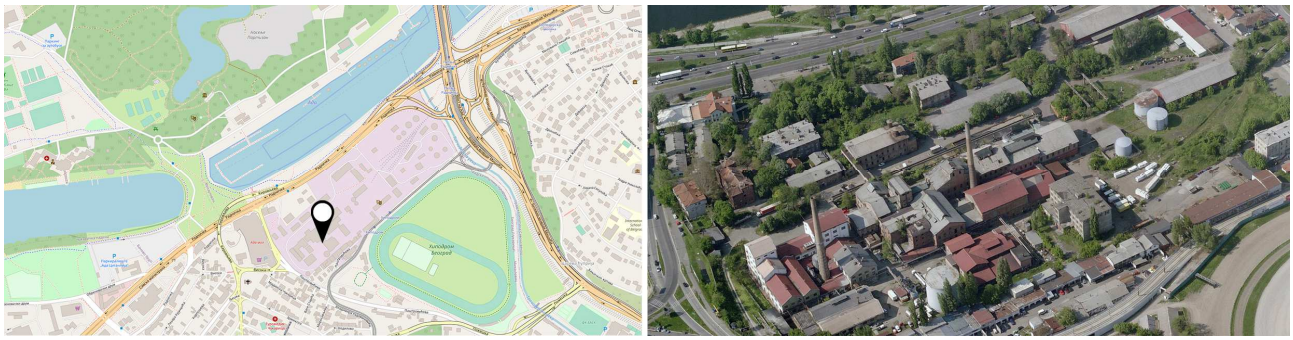

Fig. 1: The position of the Sugar Plant in relation to the immediate environment (left) and the aerial view (right).

A machine-room, drying-room, employee quarters and a house for the workers and the building of the directorate, as the oldest buildings and buildings of exceptional architectural and cultural-historical value, are standard examples of industrial architecture from the end of the 19th century in northern and central Europe (Dimitrijević-Marković & Sretenović, 2008). The residential building for workers stood out for its stylistic characteristics in relation to the other listed buildings, with its monumentality but also the absence of facade decoration, and today its authenticity has been degraded by various changes in both interior and exterior (Dimitrijević-Marković & Sretenović, 2008). Due to its dimensions and extremely high chimney, the spatial dominant of the complex is the machine-room.

The complex of the Sugar Plant is located along the banks of the Sava River, near the urbanized Ada Ciganlija and the protected Ada Medjica, important components of the natural core of Belgrade, which have natural values important for preserving the quality of the environment and recreational areas of the city. In addition to the above, the complex of the Sugar Plant is located in the immediate vicinity of the natural monument "Topčiderski Park", which has been placed under state protection due to its natural, cultural-historical and landscape values. Although the complex of the Sugar Plant is located next to extremely important natural environments, their connection is not adequately spatially defined and realized. With the river Sava, Ada Ciganlija and Ada Medjica the complex of the Sugar Plant is separated by Radnička Street, a road with high traffic intensity, while the tram line, which is spatially defined so that it passes directly along the southern border of the complex, separates it from Topčider Park. In the immediate vicinity of the Sugar Plant complex, there are locations intended for commercial facilities. One of them is the location on the northeast side of the Sugar Plant complex, planned for the commercial activities and city centers. Along the western border of the Sugar Plant is the newly built Ada mall. The complex of the Sugar Plant is also in the immediate vicinity of the Belgrade Fair - a meeting place for actors belonging to different areas and industries, through events of international and regional character. The diversity of content in the immediate vicinity of the Sugar Factory complex, which attracts various members of socio-economic groups, makes this location an additional attractive and potential place that, with adequate revitalization, could become a gathering place for these actors.

4.3 The Milan Vapa's Paper Mill

The Milan Vapa's Paper Mill was designed by architect Karl Hanisch and built-in 1921–24. The development of the Serbian economy in this period was significantly contributed by the construction of this factory, which at that time belonged to the category of large and modern industrial companies that can compete with factories of this type located in developed European countries (Mihajlov, 2010). Due to its cultural, historical, architectural, and urban values, the Milan Vapa's Paper Mill has the status of a cultural monument. Mihajlov (2010) states that The Milan Vapa's Paper Mill from the urban aspect testifies to the existence of one of the first extremely important zones intended for the industry in Belgrade, while its representativeness indicates the importance of an architectural design of industrial buildings in that period. After the cessation of paper production during the 1950s and the relocation of the factory to another location, the factory building was converted into a business facility.

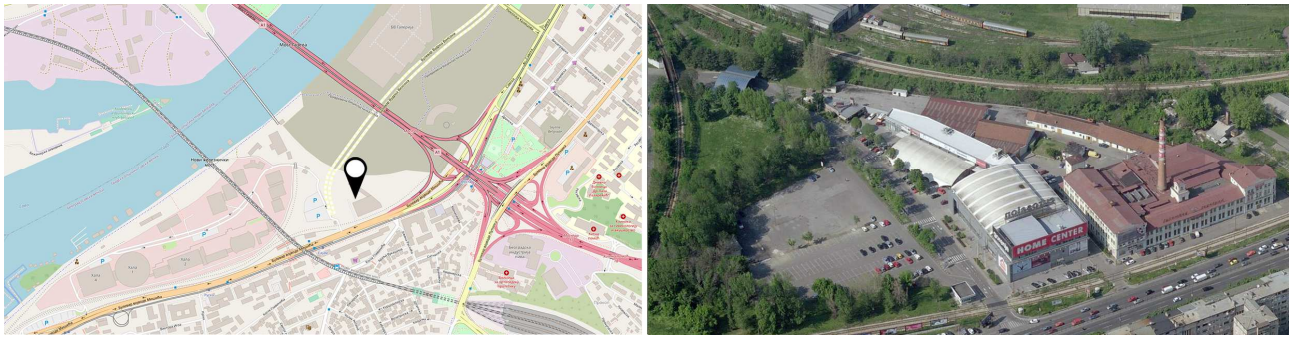

Fig. 2: The position of the Milan Vapa's Paper Mill in relation to the immediate environment (left) and the aerial view (right).

It had its own industrial railway and a quay for berths for ships and barges on the banks of the Sava. The Milan Vapa's Paper Mill is architecturally shaped in the spirit of academism modified according to the function of the building itself, and its interior is designed according to the technical and technological requirements of production processes on an area of about 3,600 square meters (Mihajlov, 2010). Special importance in the design of the building has a chimney, which is the dominant element of the building.

The Milan Vapa's Paper Mill is located next to several important hubs of a different character. The factory complex is located along the Sava River, in the immediate vicinity of Ada Ciganlija and Ada Medjica, a dynamic and unique ecosystem and the central natural core of Belgrade. Although it is located in the immediate vicinity of the river, the factory complex does not have a completely clearly defined connection with it. The Milan Vapa's Paper Mill borders the Belgrade Fair complex on the west side. Within the Belgrade Fair, numerous state, regional and international events are organized, but also other events that attract a large number of participants, which is one of the potentials for the development and reactivation of

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the factory complex. In the immediate vicinity of the Milan Vapa's Paper Mill is also the building of the Belgrade Publishing Institute (BIGZ), a significant architectural achievement of Yugoslav modernity and a reference point of space. It was built between 1934 and 1941 and is under state protection as a cultural monument. Although BIGZ has lost its original purpose, in the last few years a large number of young artists, designers, architects, musicians, but also several companies have moved into the building. The location is bordered by important traffic routes and facilities (Prokop railway station). All these characteristics, but also the contents of the immediate environment, represent an important potential for the development of the factory itself.

4.4 The Power and Thermal Power Station "Power and Light"

The complex of the Thermal Power Station "Power and Light" was built between 1930 and 1932, by the Swiss Basel-based Electrification and Transport Society. The Thermal Power Station complex consists of several buildings: the main cubic power station building, the portal crane, the pumping station, and the water filtering plant. The main building has three functional units, which are visible in terms of construction and design: the boiler room, machine hall, and control room (Mihajlov, 2011). The Thermal Power Station has been out of function since 1969. Due to its cultural and historical values, but also values in the architectural and urban sense, the Thermal Power Station "Power and Light" has the status of a cultural monument.

Fig. 3: The position of the Thermal Power Station in relation to the immediate environment (left) and the aerial view (right).

The significance that the Thermal Power Station building had in the period of its creation can be seen through the architectural, technical, but also an economic aspect. Evidence of the rise of society, through all the above aspects, makes the Thermal Power Station significant in the modern context also. At the time of construction, the Thermal Power Station was the largest facility of its kind in Belgrade (Mihajlov, 2011).

The building of the Thermal Power Station is designed according to the properties and principles of modern architecture and is characterized by its simplicity of form, and also the rationality of spatial organization. As Knežević (2007) states, social norms related to the creation of humane working conditions, through the establishment of a more pleasant working environment, were achieved by opening the building to the outside, using large glass surfaces, which not only struck a balance in the massiveness and monotony of the building but also in a way abolished the boundary between the interior and exterior of the building.

The Thermal Power Station is located in an urban location along the Danube, in the immediate vicinity of the Marina "Dorcol". Although it is insufficiently arranged at the moment, the location of the Thermal Power Station building has great urban potential. The proximity of the location in relation to the planned metro route, but also the fact that it belongs to the scope of the detailed regulation plan for the construction of the line park, make this location even more attractive. The line park, which includes the Thermal Power Station complex, is planned in the length of 4600 m, connecting the Concrete Hall and the Pancevo Bridge. These development and urban potentials of the location, as well as the planned capital city projects in its immediate surroundings, represent the backbone of the development of the location itself, but also a challenge for its preservation and reactivation. The environment of the Thermal Power Station consists of numerous other industrial buildings, which should be activated, as well as the building of the Thermal Power Station. Current activities and attractions of the city population in this area are based on holding various cultural events. Therefore, the revitalization of the Thermal Power Station itself should be viewed through the creation of a hybrid model, which would reuse its potentials for artistic, scientific, and cultural purposes (Kneževic, 2007).

5 CONCLUSION

The industrial development of Belgrade influenced the spatial and urban development of the city. As the industry progressed with constant technological changes, so did the needs of certain factories, and certain plants even shut down completely. With the development and expansion of the city, but also with the abolition or relocation of production processes of certain factories, once developed industrial zones, formed on the peripheral parts of cities, became devastated and abandoned places within the wider central core. Insufficient utilization of architectural and urban potentials of these locations has the consequence of their separation from the spatial context in which they are located. The objects of industrial heritage have an exceptional cultural-historical and monumental value and are a testimony to the development of the city and the aspirations towards the economic progress of both Belgrade and the entire country. For these reasons, the protection of these buildings is very important.

At the end of the 20th and the beginning of the 21st century, the trend of the revitalization of industrial facilities began, which were reactivated by the introduction of new contents of educational, cultural, or artistic character. Ideas about industrial facilities and complexes are most often related to the economic progress of the country, but also to the negative attitude towards the natural environment. As the objects of industrial heritage are not in function, their revitalization through the creation of a connection with nature, but also the shaping and rectification through the principles of restorativeness, could have a positive impact on the improvement of public health. In that case, the objects of industrial heritage would be restorative points or points that encourage the improvement of psychophysical and social health in cities.

Restorative potentials of space can be related to natural environments, but also to the restorative potentials of the built environment as a whole, although through the literature this topic is still insufficiently researched. The restorativeness of the built environment is related to its various characteristics. Spaces that are part of the collective memory, such as buildings that have significant artistic and cultural-historical value, have special restorative potentials. These objects are significant because of the sense of belonging that individuals have in relation to these objects. The restorativeness of the space also depends on the visual perception of the user, so it is of great importance to design these spaces in a way that provides a sense of security and comfort for the users. When it comes to visual perception and nature in the built environment, in places where it is not possible to introduce natural elements or make real contact with nature, it is possible to use digital representations of nature, bearing in mind that they have the same or similar positive effects on human health. as well as contact with real nature. Therefore, it is important to consider the use of modern digital technologies in the processes of the revitalization of industrial heritage, which would simulate natural processes and elements. Also, a particularly important aspect in the revitalization of industrial heritage is the creation of places that encourage social interaction of people, through the introduction of attractive content, attracting different socio-economic groups and enabling the use of space in different periods on a daily, monthly and annual basis.

All three industrial heritage complexes have significant architectural, urban, and cultural-historical value. They are located next to significant natural cores in the city, but due to spatial limitations, they are not clearly connected with the natural environment. Having in mind the importance of nature for the psychophysical and social health of people, connecting the complex of industrial heritage with the natural context in which they are is recognized as important and necessary. Also, these facilities have great potential for creating new hubs for gathering different social groups, bearing in mind that they are located in the immediate vicinity of various recreational, commercial, and business zones.

Revitalization of these industrial heritage buildings should include a modern context and development trends, and it should be adjusted to the cultural, historical, social, and political circumstances of the environment also. They should have economic value and cost-effectiveness, not only recreational, cultural, scientific and artistic activities that bring together different social categories of people, and to achieve a balance between the needs of different actors in the revitalization processes.

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7 ILLUSTRATIONS

Fig. 1: The position of the Sugar Plant in relation to the immediate environment (left) and the aerial view (right). Retrieved June 08, 2020, from www.openstreetmap.org (left) and www.bing.com (right).

Fig. 2: The position of the Milan Vapa's Paper Mill in relation to the immediate environment (left) and the aerial view (right). Retrieved June 08, 2020, from www.openstreetmap.org (left) and www.bing.com (right).

Fig. 3: The position of the Thermal Power Station in relation to the immediate environment (left) and the aerial view (right). Retrieved June 08, 2020, from www.openstreetmap.org (left) and www.bing.com (right).

🏆 *reviewed paper*

In Greensight: Healthier Futures for Urban Cores in Transition

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1 ABSTRACT

This paper develops new perspectives of cross-disciplinary methods combining futures studies and urban planning to help imagine healthier futures for compact urban cores. Our empirical basis lies in research-based collaboration between 2016 and 2019 with the City of Turku, the former capital of Finland. The goal was the creation of an ambitious but realistic vision and strategic plan focused on liveability and wellbeing and addressing challenges posed by spatial fragmentation and lack of cohesion. Through the process, it was concluded that to create a positive transition, planning requires the adoption of a 'greensight' perspective as a point of departure. The basic argument was that in order to reach a new level of human-centredness and interconnectedness, urban cores need to act as the strong support system for the healthier urban societies of the future. In this paper, we explain the lessons learned and provide an analysis of green areas in the context of Turku. We share wisdom on two key aspects: 1) the growing importance of human health for a more future-oriented approach to the planning of green areas and 2) the rising levels of urban complexity that make adequate distribution of green areas hard to achieve.

Keywords: wellbeing, urban green, future studies, transformation, urban cores

2 INTRODUCTION

One significant trend in urban development across European cities and elsewhere is the growing consensus that life in urban centres needs systemic integration of green areas and more understanding of how to reconnect with nature for human and planetary wellbeing. To explore this field of knowledge and for the purpose of this paper, we have used the term 'greensight' to refer to trends and systemic viewpoints that bring focus to the importance of green areas and the considerations needed for their integration with the built environment. Calling attention to a series of viewpoints, the perspectives below support the theoretical rationale of this paper; they explain why a focus on green areas is crucial:

(a) Green Spaces for Human Health: An extensive body of research in the field of environmental science has already demonstrated how exposure to a diverse range of nature areas has a positive cognitive, emotional, physical and mental impact on people living in cities (Bertram and Rehdan 2015, Ode Sang et al. 2016, Van den Berg et al. 2017, Akpinar 2017). In his book Everything in Its Place, the physician and pro-fessor of neurology Oliver Sacks explained 'why we need gardens.'(Sacks 2019) According to his observations, gardens are essential to the creative process. He went on to refer to them as a type of 'non-pharmaceutical "therapy"' of vital importance for improving positive physiological states:

I have a number of patients with very advanced dementia or Alzheimer's disease, who may have very little sense of orientation to their surroundings. They have forgotten, or cannot access, how to tie their shoes or handle cooking implements. But put them in front of a flower bed with some seedlings, and they will know exactly what to do—I have never seen such a patient plant something upside down (Sacks 2019, p. 245).

Dr. Sacks found that gardens and nature were more powerful than medication – a key aspect when we consider the health benefits nature provides for human development and for supporting more resilient societies. The observations by Sacks on the positive effects of gardens on physiological states underscore the innate human restorative and healing powers that can be assisted by nature and the vital role they play in mental healing. Indeed, research in the field of urban psychology has already called attention to the relationship between the human mind and the physical environment. Studies have, for example, found a correlation between urban living and poor mental health. In his book The Psychology & the City: The Hidden Dimension, Charles Landry mentioned how urban populations are twice as likely to experience schizophrenia and almost three times as likely to experience depression than populations in rural areas (Landry and Murray 2017). Also, it is worth noting the growing traction of mental well-being in the global development agenda and its integration with mental health in Goal 3 of the Sustainable Development Goals (SDGs).

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(b) Changing narratives, from linear to circular: Beyond human health, nature is essential for biodiversity and planetary well-being. Our natural environment is composed of a compact dynamic network working on a closed and efficient cycle that is highly interdependent and collaborative (Siegel 2018). Even if the tendency in our physical environment is towards a more individualistic, hierarchical and man-dominated society, the truth is that the natural world works in the opposite direction. The laws governing the natural world are known to be non-hierarchical and non-linear. Contrasting to this are linear models which have been defined as characteristic of terminal cultures (Johnson 1991). The way urban systems operate today shows that natural and material cycles lack the capacity to restore creating inefficiencies, the extinction of species and generating excessive waste. This only indicates that our current model for development is unsustainable, something that becomes apparent every time we choose to replace nature's functionality and intelligence with the purely economically-driven expressions of our past industrial societies. So, what we see now is a society that has purposely sought to break away from nature and its environment both to its own detriment and to that of future societies. We have essentially created a broken link within our total ecosystem.

(c) Nature biodiversity for urban resilience: Nature networks are multipurpose. The specific role played by any living organism in the effective functioning of ecological networks is pivotal for both evolutionary processes and for building intelligent and resilient environments. In fact, many cities such as Bogota or Los Angeles, to name only a few, have evolved in some of the most fertile and biodiversity-rich landscapes and regions. Biodiversity in this context means diversity of life. Los Angeles is known to be part of a biodiversity hotspot called the California Floristic Province – one of thirty-six biodiversity hotspots in the world (Higgins et al. 2019). Cities located in close proximity to these hotspots are also required to implement urban conservation measures that preserve a habitat in which native and foreign species can thrive and sustain. Conservation also provides opportunities to integrate biodiversity in a wider programme for human health. Cities and citizens depend on the healthy regulating effects of natural cycles for a number of functions, like the provision of clean air and clean water, local climate regulation and education, For these reasons, green areas like parks act as hotspots for biodiversity; they create the necessary conditions for species to thrive and for people to experience nature's healing benefits.

d) A futures approach to urban transitions: Some people would argue that the word 'nature' did not exist in previous ancestral interconnected cultures when humans and nature were part of an integrated system that did not differentiate between the two. This implies that differentiation between the human and the natural was indeed created by man himself. Futures research has been particularly concerned with the sustainable evolution of our natural world. The Finnish futurist Pentti Malaska contended that humans were being gradually separated from nature (Pouru et al. 2017). He reflected upon 'the stage of ecosystem predominance' and how human material existence was from the beginning controlled not only by the same invariant laws of nature as the rest of the ecosystem, but also by the initial cosmic boundary conditions prevailing within it. But how far have we gone from our innate connection with our biological systems? And what are the tools that will help transform our environment and present alternatives for a different type of connection with nature? One possibility is a futures thinking approach. Foresight and futures studies essentially make two contributions to urban development: a) a vision of the future exploring alternative (ideal) scenarios not visible in the present time and b) the tools to enhance participation and to have a positive impact on the future. In essence, a futures approach contemplates alternative pathways that can assist transformative processes towards more informed and diverse solutions.

(e) Systems complexity and transformative processes: Complexity theory is part of futures research. Within the field of complexity theory, and the way in which it is applied to urban systems and ecological transformations, the imbalances in existing systems and frameworks constitute a recurrent theme (Alvarez-Pereira 2016). This is manifested directly in the fragmented landscapes of city cores and the minor role that nature usually plays in them. Across city planning, there is a tendency to work in silos. Small independent patches of green do not contribute a sense of the complex and interconnected whole and do not provide impetus for inspirational experience. The essential benefits of nature are indeed invaluable. Yet it has been difficult to put a price on the intrinsic value of nature for our human and planetary existence – something that has contributed to the undervaluation of nature areas and their ecosystems for human well-being. We could say that our model for development has led to nature being poorly understood, grossly undervalued and ineffectively managed.

(e) Urbanisation and compaction: Population growth is a key driver of urban change. According to the World Health Organization (WHO), more people live in urban areas than in rural areas (2018). In the 1950s, 30% of the world's population was urban. Today it is estimated that by 2050, the urban population will account for 68% of the global population. Population growth and unregulated development are to be blamed for urban inequalities. Inequalities in cities have followed an invasive model of urbanisation – car-driven development with buildings and other urban infrastructure detached from natural cycles. The absence of a systems level has resulted in a parasitic relationship between nature and the built environment. The history of urbanisation goes back thousands of years. According to Landry and Murray (2017), 'modern humans have been around for 200,000 years but cities only for 6,000 to 8,000 years'. Success cases have been based directly on access to land and natural resources like the water and soil needed to sustain the biological and artificial constructs of cities. The compaction of urban areas is a driving factor for change in the urban landscape and planning structure. The current trends in urban cores with urban-tech and the flood of large companies, millennials and other groups gravitating towards centres poses a challenge for maintaining access to nature resources and urban equality.

So, what is having a greensight view mean against this background? It means resourcing to alternative mechanisms that can facilitate new types of governance, planning structures and very importantly, a change in narrative. It also means promoting the emergence of a constructive dialogue centred round the interrelated capacities of circular systems – network design, organisms and urban systems. Current urban transitions require methods that challenge our preconceived notion of linearity and individuality. We need to learn from nature to come back to the sense that we are part of a whole, that alone we are unable to go far let alone sustain.

Increasing awareness and understanding of the effect green areas have on human health is crucial for transforming cities into environments that breathe life. In the following section, the City of Turku, the old capital and one of the biggest cities in Finland, is introduced to share experiences and lessons learned on previous work where futures foresight methods were used as part of an urban analysis of green areas. In addressing challenges, the study also explored the potential of green areas to help tackle urban challenges of urban fragmentation, lack of cohesion, and liveability. Back in 2017, the City of Turku launched its City Centre Vision 2050, which was drafted by a Vision Committee led by Markku Wilenius (Turku City Center Vision, 2050). Through the use of foresight, a new agenda for the city centre aimed to invite a more accessible, liveable and healthier Turku. The vision led to a critical analysis of the city centre landscape and subsequently to development of the sub-project Green-In Turku: Towards Greener Urban Futures. The aim of the sub-project was to study Turku's network of green areas and their hidden potential. Key observations were made primarily on how to improve access to and adequate distribution of multifunctional green areas. Another aspect highlighted during the vision process was the lack of systemic thinking and the importance of foresight as a useful tool to anticipate challenges and opportunities and to open up the possibilities for having a positive impact on the future

3 A GREENING VISION FOR URBAN CORES 1

Green areas are important sources of information and wellbeing. Nature is in itself a diverse, collaborative and intelligent system. In contemporary urban settings, green areas are spots where nature has the possibility to flourish; yet, green areas are often overtaken by grey development based highly on economic targets inherited from a culture of the past that believes in endless economic growth. A greening vision for urban cores looks to promote a change of direction to break away from that past to inspire new ideas in search of a more promising future, no longer based purely on capitalistic, financial or economic values, but focused instead on the health and wellbeing of people and communities and on resolving the most pressing societal challenges of our time to benefit those who live, work and participate in urban life.

Green areas are the lungs of every city. In studying the dynamic flows of urban centres, analyses with spatial quality criteria, geographical and demographical data demonstrated the need for more research in the field of green space planning and networks to understand who are the users and what are the specific needs that we need to respond to. Ecologically, urban planners will need to expand their understanding of the nature of services and disservices generated by green areas and their regulating, supporting, and provisioning capabilities. In the face of an increasingly urban population, concentrated mainly in compact built-up areas,

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green spaces and biodiversity hotspots will become of strategic importance as areas with the highest potential for making a positive impact.

3.1 Greening Turku City Centre: Key Messages and Lessons Learned

This paper draws from close collaboration between the Finland Futures Research Centre and the City of Turku that took place between 2016 and 2019. The collaboration was an exploration into the possible futures for the city centre of Turku, formulated in the Vision and strategic plan 2050 for a more liveable and human-centred city. In an attempt to tackle challenges of spatial fragmentation, lack of cohesion and urban attractiveness, research was carried out on the state of Turku's green areas to identify points where the quality, distribution and access to existing green areas could be improved and also to explore new potential looking beyond marginal planning. The project combined a series of foresight methods and analysis of patterns in urban-core development. In addition, site observations, interviews and surveys complemented the analysis. The outcomes were presented to Turku's city officials as a set of 13 recommendations for how to improve the urban green layer of the city and its liveability profile (Jones and Wilenius 2018b).

The City of Turku is a medium-size, 800-year old city located in Southwest Finland (See Figure 1). The total area of Turku is 306.4 km2 with land accounting for approximately 245.7 km . Turku is located in an

archipelago region of 20,000 islands and is a port of entry for trade between Europe and Scandinavia. In 2017, the total population of Turku was 189,669 people of which some 56,000 lived in the city centre. The city centre population in 2018 was predominately divided between young and middle-aged groups. The largest age groups living in the city centre in 2018 were between 20 and 59; they accounted for more than half of the total residents of the city centre or 35,380 people, thus indicating the predominance of a relatively young community. The following paragraphs explain a series of key messages and shortcomings that emerged during the research that was conducted between 2017 and 2019 on urban green areas in the city of Turku:

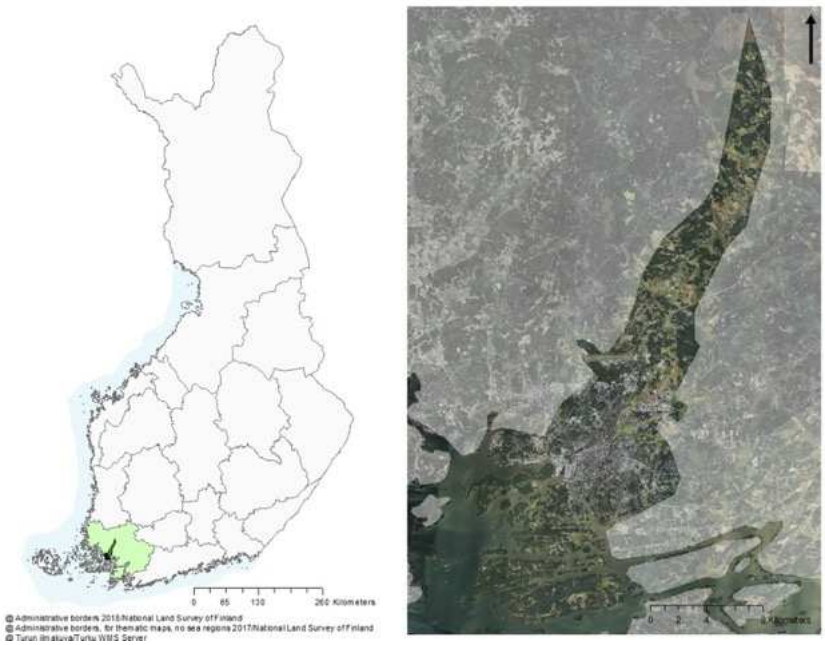

Figure 1: Aerial map of Turku: Turku's location in Southwest Finland (National Land Survey of Finland 2018).

Leadership: Shortcomings in planning showed to be related to the lack of a clear vision on the side of local authorities from design and planning, who strongly prioritised the intactness of the design and function of the City's historic parks and view improvements or changes as unnecessary. This approach leaves unsolved the question of how historic parks could be elevated and what new visions for the future of green areas can be imagined. Ultimately, green areas need to be planned in direct relationship with their urban context with consideration especially for the wide range of users who are direct beneficiaries and also stewards of the land. The challenge that remains with this approach is how to identify the right point of intervention that would significantly enhance the value of green areas; also, what actions could best support the holistic integration of a green network in the future. In the case of Turku, the lack of systemic thinking in leadership

posed difficulties on the implementation of results and how the city could capitalize on the advantages of foresight as a decision-making tool in planning.

Planning: In planning, green area size matters. Measurements are essential for developing baselines and for comparing the proportion of green areas to grey areas. Yet, at the time of our study, an inventory of green areas including small and large pockets had not been produced by officials in charge of landscape planning. We found that while the master plan did include a list of the parks owned by the city, areas on private or semi-private lots were excluded. To assess the significance of the supportive and functional benefits of green areas, it is necessary to expand the scope of the areas under study and approach them as a complete system. This approach should be part of a critical analysis looking into the specific roles that green areas play for human health. Furthermore, in the centre of Turku, the majority of the public parks designated for recreation also include facilities such as buildings, playgrounds, football fields and tennis courts. These are paved areas that no longer perform the same ecological function that supporting systems of "green" vegetative surfaces are meant to perform. A change in the specific function of a green area means that its purpose is also changed. Thus, interventions in urban green areas need to consider a systemic approach, which means that under changing conditions, the quality of the entire area also needs to be reassessed.

Access design: In Turku, a human-centred design approach that carefully considers access to green areas needs further study. Due to its topography, Turku's green areas, i.e. a large number of parks, are mainly located on hills and slopes, making assessment of size and area a challenging task for planners. Universal access is a major challenge, particularly for people with mobility constraints, children and elderly people, since green areas for recreation are mainly reached through stairways or ramps. Challenges also remain concerning access points at street level, which were difficult to locate and when found, they lack universal access design. If the aim is to invite people to the experience of living in a city with good access to green space a diversity of functions and activities, the design of access points in the case of Turku is going to require further design and planning. In general, green areas can offer much more functionality and design than they do today. Proximity to a green space can be measured as a linear distance of 300 metres or 15 minutes of walking time. The proximity indicators in Turku should consider a broader area of coverage beyond the limits of its current central axis. This is particularly important for those districts of the CBD with no available green space.

3.2 The City Centre Vision 2050 Toward a New Turku

The overall Vision 2050 for the city centre developed into three primary objectives: a) an accessible and walkable centre; b) a commercially attractive centre with active green areas and public ground; and c) an engaging and vibrant social space. Awareness of the need for fundamental change in priorities stemmed from localised challenges confronted at the intersection of the commercial, historic and university districts. Some of the main challenges found were particularly related to the following:

- New development prioritising the surrounding areas of the city core. The tendency towards off-centre development, which led to fracture in planning – something that remains evident today.
- Internal deficiencies within city planning departments and local authorities and the lack of a systems-based approach and an interdisciplinary mix of sectors, disciplines and civic society as the major contributors to the process.
- The tendency towards shopping malls and other commercial development near the historic district – something that tends to transform public spaces into silent spaces and ultimately results in a less active urban life.
- The lack of human-centred design and approaches to facilitate more and better access to small and large green areas for different functions, i.e. how to connect parks on hills and slopes with street level access points on the ground as part to encourage a larger interaction of people and nature.

During the implementation of the Vision, other concerns were related to leadership efforts and poor decision making. The overall process exposed some important gaps between the tasks performed by city planners and what is actually feasible or implementable. In Turku, there is a strong tendency towards keeping the status quo. Much less importance appeared to be given to meeting targets and exploring new potential.

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4 APPROACH TO ACCESS QUALITY AND DISTRIBUTION OF GREEN SPACES

Nature is transformative. By increasing access to green areas, cities restore opportunities for improving the quality of life and human development in citizens. A "good" quality of life means, among other things, that all groups of society can enjoy equal access and opportunity for encounters with nature in their immediate environment. In urban planning, increasing access to green areas means the study of green areas as the essential connecting tissue, linking the artificial urban structure with essential self-regulating ecosystems necessary for life. So, to increase understanding of the multiple concepts that could help improve access to green areas, the term access is explained here through the lens of the following three concepts (see figure 2):

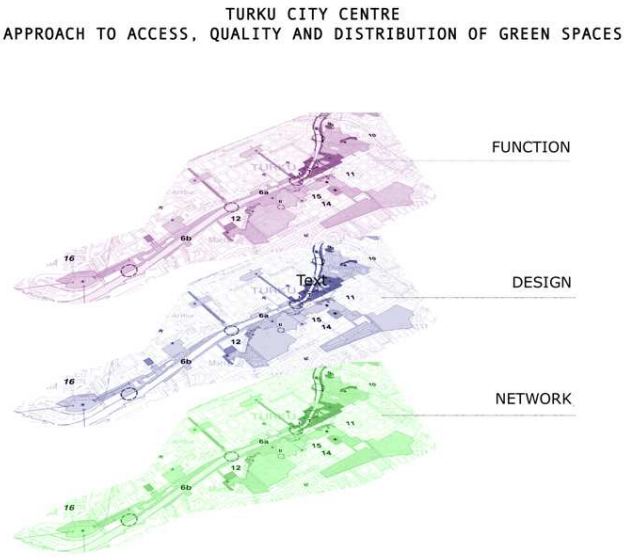

Figure 2: Approach to access, quality and distribution of green spaces[1]

1. Network: A network approach to working with green areas entails the study of a set of green spaces often classified as parks, recreational areas, sports facilities, green pockets, social spaces, and green streets. Areas combine to form the green interconnecting layer upon which the life-supporting systems of the city depend. This approach to work in a network connecting small and large pockets of green areas enhances ecosystem properties and the potential for emergence of new functions. From this perspective, access to green spaces will mean a system of green spaces integrated as part of a larger unit, in other words, a network that is circular in process and dynamic and flexible in nature. It also refers to the self-regenerative properties of the urban green layer and how its properties can be self-sustained, self-preserved and self-regulated.

2. Design: In the urban context, access to green requires a human-centred design process that considers the multiple dimensions of nature's intelligent design. When we consider green areas, the right design should ensure the right access for a given area. Provisions need to be made for inviting, universal, attractive and aesthetic access with consideration of future trends in changing environments. Design also means consideration for the network's node and accessibility, not only facilitated by design but also optimized. Here, careful design can enable solutions for building better linkages between green spaces, pockets and pathways with mobility, and other networks. Design for green public space should enable better connectivity between neighbourhoods, linking urban cores with surrounding areas.

3. Function: The function of green spaces is crucial. Green pockets, passages, and pathways must be designed with a specific purpose in mind. This means that the layer of ecosystem functions for well-being facilitates social and human development for those living in densified areas. For example, in the case of Turku, improving access to green areas will require a detailed inventory of the size, number of areas and accessibility of green spaces, individually but also as part of the overall system. A detailed inventory provides information useful in identifying gaps and inadequacies in the network and can assist planners in settting benchmarks for the city's minimum accessibility targets as part of a social and ecological strategy.

[1] Jones, Ana & Wilenius, Markku (2018b). Access to Green; Enhancing Urban Attractiveness in Urban Centres – the Case of Turku. FFRC eBook 6/2018, Finland Futures Research Centre, University of Turku.

5 THE ROLE OF FORESIGHT AND FUTURES STUDIES IN URBAN PLANNING

In futures studies, foresight has the potential for making the invisible visible. Foresight is a window on not one but multiple pathways that can support city planning processes; yet, in the absence of strong strategic decision making, the real potential of foresight for materialising ideal futures would not be impactful. Our approach in this article was built on the premises of futures studies. One of the basic assumptions of futures studies is the notion that the future has many emerging properties. This explains why the future is seldom part of a direct continuum with the past. These emerging properties form a complex web of future interconnected phenomena. That is why futures studies are closely connected to systems thinking, which teaches that interrelations often matter more than the phenomena themselves (See Wilenius 2017).

In terms of foresight, determining our anticipatory assumptions about how the future will unfold is a key aspect (Fuller 2017). So, from the perspective of anticipatory systems, we need to ask how this central aspect of health – and more and better access to green areas to achieve more health – will evolve in the future. And what is the role of health in organising the physical and social space of cities?

In order to respond adequately to the above questions, we need to take a broader look at current urban transformations and their implications for the future of life in cities. From the perspective of futures studies, urban change occurs in its local context. In urban life, the modernisation and industrialisation of the last 200 hundred years has caused massive changes in the way cities are built, creating every unique human experience (Berman 1982). Cities are living entities that adapt constantly to change, some suffering from unsustainable growth. At this point, we cannot expect that the pace of change will slow; on the contrary, the general sense is that cities will continue to experience growth in the years to come.

In futures studies, weak signals are a key tool for understanding future trends. By definition, weak signals refer to phenomena that initially seem no more than background noise, but which, when connected to other phenomena, can begin to emerge as a pattern (Hiltunen 2010). Autonomous cars are an example. Ten years ago, almost no-one anticipated that driverless cars would be roaming the streets. While autonomous cars have of course been tested for some

100 years, they have nevertheless been relegated to the future and the world of prototypes. However, they have now become a reality, at least to the extent that the first real autonomous vehicles have already been deployed in cities.

Here we point to three major weak signals in today's urban context: First, changing values. According to research, values are becoming 'post material', as described by Professor Roland Inglehart in his World Value Survey (http://www.worldvalues survey.org/wvs.jsp). There is a shift from basic survival needs towards a new set of needs; today's generation values time and social connections more than its predecessors. It is worth noting that spending time in nature has become a dominant trend across multiple spheres of development.

These signals of changing value systems could be connected to a larger shift in our societies. This shift is akin to the transformation from agricultural to industrial societies some 200 hundred years ago. Now we are taking the next step, moving from an industrial society to a more service-orientated, intimately networked model of society. In futures studies, this transition has been dealt with in various ways (Wilenius 2017). One very perceptive approach concerns the shift from a society of tangible needs towards one of intangible needs advanced by Professor Pentti Malaska, founder of the Finland Futures Research Centre. According to Malaska, we are right now in the interim phase, as tangible needs are yielding to higher, intangible needs via a dynamic process, as Figure 3 shows (Pouru et al. 2018):

In the first phase, the main focus is on fundamental needs such as food, shelter and clothing. Society is mainly organised around satisfaction of these basic needs. At the next stage, these needs are superseded by tangible needs, and society is restructured with a view to satisfying them. Eventually tangible needs give way to intangible needs and society reorients itself to meet them (Pouru et al. 2018).

Malaska himself explained these transitions in the following way: 'Agrarian society satisfied basic needs, industrial society has satisfied tangible needs.' It is now becoming increasingly clear that people have needs which cannot be met with goods. These are particularly the needs for social situations, encounters, conversations, human relations and human contact. These needs can only be satisfied in the presence of another person. Agriculture has not disappeared in industrial society, but it has been transformed. In a similar

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way, industry will not disappear from modern society, but it will instead require increasingly less input and effort.

In the future, we propose – in the spirit of Malaska's findings – that we will consume ever larger volumes of human relations and that this will happen increasingly in the urban context. The particular benefit of the modern city life is that meeting different people has become really easy. He also foresaw that a new type of family network will also evolve – a community of people who live together even when relationships have outlived their capacity for reproduction within the community.

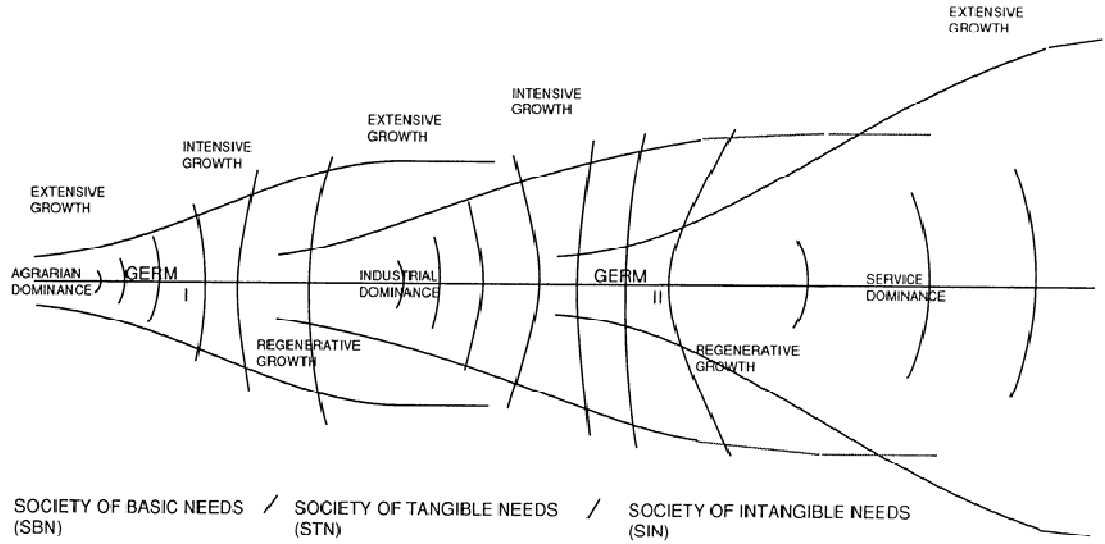

Figure 3: A model for social transformation dynamics (Malaska 1999).

To quote Malaska, 'So, are humans capable of changing? They certainly are. Just compare the situation today with agrarian society, where children worked in the fields rather than lazing around at school. This is the kind of world I would like to build in the future' (Turun Sanomat [Turku News] 1983).

While tangible needs have been largely provided by the massive material production of industrial society, as described by Abraham Maslow through his pyramid of basic needs, these new, intangible needs are on a much higher level; they are related to the search for the meaning of life itself. They are best served by a specific set of dynamic, active skills that signify a shift to the 21th century social environment. These skills could be described as follows, in terms of the challenges facing our changing global environment (Gerbrands and Wilenius 2020):

(a) Planetary living skills: How do we create a healthy relationship with our physical environment?

(b) Complexity skills: How do we manage the overwhelming amount of information and keep our thinking clear and consistent?

(c) Creativity skills: How do we enhance our capacity for finding new and unconventional solutions to the problems we face?

(d) Empathy skills: How do we grow our capacity to see issues from the perspective of others?

Building these skills provides the foundation for urban development in the same sense as the birth of industrial society created the basis for urban expansion in the previous two centuries. While providing for basic needs such as food, jobs, and relationships shaped the physical construct of cities with factories, car-fit streets, residential areas and shopping malls, deploying a new set of active skills will create a very different kind of physical space. Here we see the emergence of social, non-commercial spaces like citizen's parks and new concepts for libraries, mixed housing environments, office space, cafes, pedestrian and bike lanes. City cores become more human in scale as these intangibles needs are met through the regenerative growth of the human experience coupled with an extensive period of growth in the service sector.

In this upcoming phase of human development, health becomes an altogether different field. While 'health' primarily concerns our physical well-being and capacity to provide for basic needs in the era of tangible needs, the mentally loaded notion in the era of intangible needs takes a more holistic approach.

In the phase of intangible needs, we start to observe and emphasise very different things; for example: the role of green areas in creating solace for the mind and how they stimulate the senses, the absence of pollution of any kind in our immediate environment helps us to stay in a good mood, or the opportunity to exercise in the middle of the city to keep our bodies and minds fit. Although these features played a minor role in shaping urban development over the last 200 hundred years, they have suddenly assumed importance in our city design.

Moving to a society of intangible needs has many implications for physical space. It will pose major challenges for city design, which has traditionally been built around physical and social infrastructure, housing and mobility. The quality of experience will become the central focus of design. A look at contemporary city core design, however, often reveals little evidence of such values. The automobile continues to dominate, as it has for the last 70 years.

All in all, intangible needs will grow in importance while resource efficiency will become a key factor in organising our material world, as the 'K-Wave' framework theory implies (Wilenius 2017). In this way, societies will start to realise the potential in nature's design in a completely new way.

There are also multiple implications for the new role of nature in cities. In our studies of urban places, we detected numerous signals of a new appreciation for the urban experience (Jones and Wilenius 2018a). In most of the major Nordic countries, cities have taken major steps on these fronts: more light for city centres, more right-scaled pedestrian streets, and more activities that play out in the streets. And many more green, multi-functional areas.

We estimate that what we have been observing as weak signals, indicating a change in the paradigm of urban city core planning, are about to transform into a major shift towards a greener design principle-all this is occurring because of the shift towards a society of intangible needs described above. Hence, what we call greensight in this article will enhance its role in overall city development in a massive way as we move further into this century. With the shift towards post-material values, people will begin to appreciate nature in a new way. They will want parks instead of parking lots. They will want non-polluting, electronic mass and individual transportation systems. They will want urban forests or gardens instead of another shopping mall. Greenness will be at the core of the desired urban experience because it is increasingly important for people to bond emotionally, as technology and digitalisation continue to expand. Nature is an essential counterbalancing factor here.

Yet, for the time being, we need to admit that the old non-human-centric design still holds sway in most cities. Despite some exceptions, most city centres simply look artificial and bare; they are primarily built with concrete, and buildings' design, and materials lack the sensual aspect and human-centredness as well as a deeper psychological understanding of human nature and how it interacts with the built environment. Here, the 'return of the human perspective' remains a weak signal. Most cities still belong to this group, and even if they have many green spaces, they are not yet working sufficiently to enhance the urban experience in the context of urban nature and biodiversity. The approach to design and planning green areas in these cities remain an afterthought where the focus is on adding more concrete-based structures, taller buildings and more cars.

As we move further into a society of intangible needs, cities will become much more interactive and dynamic. In the future, we believe, cities will make increasing use of their citizens' ideas on how to design common spaces such as gardens inside city centres or suburban areas. Agendas of this type will become necessary for all cities as a form of complexity management. By engaging more inhabitants and users in the design, planning and implementation of urban policies, we can ensure more sensitive processes along the way. The only adequate way to handle this ever more complex environment is to enhance the feedback loops in the system as cities become ever more complex sets of technologies and infrastructure, with more data available for everyday operations.

6 LOOKING AHEAD: PERSPECTIVES FOR DEPLOYING SYSTEMIC THINKING AND GREENSIGHT

As we have previously mentioned, a systematic approach to restoring green areas in cities is still not a dominant trend in planning. In spite of our dependency on biological systems for wellbeing, integration of

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green areas remains a type of patchwork or is not seen as the foundation upon which we should build the cities of the future.

Applying greensight in this case means adopting policies that are more intelligent, non-partial, inclusive, and holistic. Within these policies, promotion of green areas and ecosystem functions is not relegated to a marginal agenda in city strategy. On the contrary, it is meant to elevate these areas to centre stage, not just to create healthier and vibrant cities, but also to ensure a sustainable environment, attract innovation and investment. Thus, we argue that greensight – as we have defined it – will need to become a centrepiece in policy talks where the focus will increasingly be on how to tackle critical issues of air pollution, climate change, and biodiversity loss.

Working with a new agenda for integrating nature and urban areas in the future presents multiple challenges to the old planning paradigm, but also opportunities to innovate. What we refer to as greensight means new thinking towards a certain set of principles and policies that should be employed rigorously to design and redefine the cities of this century. The following principles were born out of our most recent research and observations of some of the most proactive cities which are showing signs of moving away from the conventional to redesign and integrate green areas holistically. These new approaches open up a new line of questioning and inspire new ideas for how urban cores could be dealt with. The following are some of the main drivers we have identified as promoters of urban change:

(1) Complexity management: Complexity management requires understanding of a systems-based perspective – how cities adapt, self-organise, and change over time. In most progressive cities, the trend has been toward taking the human-scale approach as a starting point; therefore, minimising challenges; for instance, cycling in a city centre designed for cars. Complex systems are characterised by uncertainties and discontinuities. As we advance in our agenda on complexity management, it becomes increasingly important to analyse 'blind spots' in the urban context, i.e., areas to which our sectoral, sub-optimal policies do not readily pay sufficient attention.

(2) A new intelligence: Cities are looking for untapped potential and intelligent approaches in the unconventional; also, by working with new actors engaging them in the planning process, one example is the city of Barcelona. Barcelona has already earned recognition for some of its intelligent actions in educating the community in participatory and democratic processes. The successful implementation of the Superblock programme and action plan has its roots in the active participation of community and neighbourhood organisations during its design. The main priorities focus on quality of life and on expanding the city's green network that recognizes the need for high-quality public space for activities, experiences, recreation and biodiversity. In the case of smaller cities with fewer resources available to scale-up initiatives, the adoption of intelligent solutions on a smaller scale is proving to have the potential to generate big results. Smaller cities are using their advantages in terms of scale, human, social and cultural capital, to innovate. In some of the neighbourhoods of Sydney, the small-scale reactivation of laneways and fine-grain spaces is an example of how resource efficiency is used for turning underutilised hidden lanes into greener, vibrant urban blocks.

(3) Diversity and the mixed city. Planning for mixed and diverse cities creates opportunities to attract a wider range of users and boost social capital. The need for diversity in groups, users and functions opens up new perspectives for how multiple collaboration channels expand the network of connections in the urban landscape. In the case of Vienna, an urban strategy for green and open spaces considers flexibility in planning with a focus on future generations. In this case, the planning for multi-functional green and open spaces puts emphasis on social diversity to provide all groups with good access to areas where people can play, meet, and be social. By focusing on green areas, cities can promote change by inviting citizens to learn about the natural world. Learning in this context could have ample potential for creating a sense of responsibility and stewardship in those who participate.

We believe the above-mentioned drivers of change could provide the bases for what can be called 'system policies' for enabling greensight to take place at the decision-making level (Schmidt-Bleek et al. 2014). Our argument is that only serious consideration to these aspects is what will ensure the sustainability of 'healthy' cities in the long run. Here, we move beyond issues related to human health in connection with green areas to suggest that the city itself will develop an awareness of its potential by deploying more systematic and complexity-conscious policies.

7 CONCLUSION

Our relationship with nature is the most transformative challenge of our time. Developing a systems-based approach to increase access to green spaces in urban areas will mean a shift in paradigm towards a more human-centric planning. Our basic argument is that for development on a global scale, this new kind of approach to urban design will probably be the only way cities can thrive as centres for human development and interaction in the future. Already in the next decade, we shall see how an increasing number of cities, some faster, some slower, will add green design methodologies to their toolbox. This happens because people in cities are developing a new consciousness and willingness for change and activating themselves against the low quality of life and the stresses of environmentally harmful development. This indicates the emergence of a new, more environmentally-savvy generation, who we believe will lead this transformation.

If the weak signals we have observed were to become dominant, it would mean that the design of urban areas from the perspective of health and the wellbeing, would, we believe, be of central focus. Cities, which have a long history of negative effects on mental and physical health because of the pollution, noise, congestion and stress they generate, will become labs for positive and healthy life. While we are still far away from that ideal, at least we already see the first signs of development that may bring us closer to a much healthier life in urban settings.

In this upcoming new phase of human development, the field of health will become an altogether new field. While 'health' in the era of tangible needs is primarily an issue or a risk for our physical well-being and capacity to provide for basic needs, in this current era of intangible needs, urban health will need to take a more holistic, mentally loaded notion of wellbeing.

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🏆 *reviewed paper*

Urban Planning and Corona Spaces – Scales, Walls and COVID-19 Coincidences

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1 ABSTRACT

This study focuses on the role and responsibility of urban planning in mitigating the COVID-19 pandemic´s impact. The far-reaching social and economic consequences of this threat are counteracted by organisational and constructional measures to prevent lockdowns and finally illnesses and deaths. Corona spaces and voids are introduced as a consistent multi scale approach concerning the pandemics spatial implications and respective measures. These terms are operationalised for urban planning and can be used as an overarching concept to be communicated within cross-sectoral planning tasks. A comparison of Taiwan's and the USA's responses to the outbreak suggests that the coincidence at the beginning of a pandemic can be controlled by institutional precautions. On an urban scale, organisational measures (e.g. contact tracing, quarantine, and lockdown) can be supported by constructional ones concerning e.g. transport, public spaces, urban agriculture, and offices aimed at crowding reduction. If appropriate measures are applied, urban density does not seem to increase spreading the virus, whereby a regression analysis based on data of districts in Germany shows no relationship between population density and COVID-19 deaths. Lockdown prevention should be a planning goal and multifunctional approaches that integrate aspects of virus resilience should be favoured over the monothematic urban development approach (Leitbild) of a virus resilient city. Urban planning can contribute to the mitigation of future outbreaks by including pandemic preparedness in planning frameworks.

Keywords: COVID-19, urban planning, Corona spaces, pandemic preparedness, lockdown prevention

2 INTRODUCTION

Cities have always faced various threats and had to take appropriate measures to counter them, which were either constructional or organisational and often a mixture of both. For medieval European cities these threats were e.g. war and epidemics. War was an external threat, and city walls were constructed as protection to respond to it. The realisation of a city wall required thorough planning and considerable resources for its implementation, and the remains are still visible today as an urban structure. Epidemics, especially the plague, were also an external threat that immediately turned into an internal one as soon as it entered the city. The causes and the mode of transmission of the plague were unknown, thus initially there was only escape, as Giovanni Boccaccio described in his book “Il Decamerone”. Later on, quarantine was organised supplemented by hospitals where most of the sick died. Apart from the latter, the structural manifestations of the occurrence of plague were mainly votive churches and plague columns built after the end of an epidemic.

It has been 150 years since the world’s high-income countries achieved control of cholera, thanks to the implementation of safe piped water, sewerage systems, and basic hygiene principles, however, the world’s poorest remain at risk: at the beginning of the 21st century (WHO, 2017).

A new threat has emerged: SARS-CoV-2, a novel strain of the coronavirus family, which causes the pandemic disease COVID-19 (with 'CO' for corona, 'VI' for virus, and 'D' for disease). The most important means of controlling a virus for which there is no vaccine or therapy is to prevent or interrupt infection chains with the aim of preventing the exponential increase of the number of cases, which is expressed in the imperative “flatten the curve”. The transmission pathways of the corona virus have been elucidated by analysing the trend and mitigation measures in three epicentres, and the results show that the airborne transmission route is highly virulent and dominant for the spread of COVID-19 (Zhang, Li, Zhang, Wang, & Molina, 2020). Thus the spread of COVID-19, unlike cholera, which is spread among other things by polluted drinking water and could therefore be successfully combated through construction measures, is much more difficult to control with urban planning instruments.

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At present, there are already some statements from urban and landscape planners as well as architects and others about the role and responsibility of urban planning in mitigating the pandemic´s impact, in scientific studies as well as in popular media (cf. section 4). As an example, a review concerning the impact of COVID-19 on public space highlights the interface of COVID-19 and urban design; it is presumed that the COVID-19 crisis will fundamentally change our relationship to public space and it is mentioned that it will be critical to study and measure these changes in order to inform urban planning and design in a post-COVID-19 world (Honey-Rosés et al., 2020).

The aim of this study is (1) to introduce a consistent approach concerning the pandemics spatial implications, (2) to consider the role of coincidence in the pandemic, (3) to give a simplified overview of urban planning tools and their impacts, (4) to examine the usefulness of a pandemic resilient city as an urban development approach (Leitbild), (5) to evaluate urban density in respect to spreading the virus, and (6) to discuss post corona related urban developments such as pandemic preparedness, lockdown prevention, and some trends that may become reinforced by the pandemic. Before constructional measures on the scale of urban planning are examined, organisational measures for curtailing the pandemic are considered in this study.

3 CORONA SPACES AND VOIDS

In analogy to the frequently used term corona crisis, this study introduces the term corona spaces for all spaces related to the pandemic. These are (1) spaces that the virus itself occupies and in which its RNA can be detected or (2) spaces created by the social reactions of humans to the virus. The latter include empty or underused spaces, here defined as corona voids (cf. Fig. 1), which are normally populated, but which are more or less empty during a pandemic to prevent spreading the virus. Corona spaces used for isolation have boundaries which contain the virus more or less effective and which are often impassable for humans in both directions, or at least should be. Currently there are only paraphrases for corona spaces and voids. If these terms introduced here prove useful, they should be generalised so that they apply not only to coronavirus, but to all pathogens that spread through the air and can cause pandemics (e.g. airborne virus related spaces). The relevance of corona spaces for urban planning issues is discussed in section 4.

3.1 Scales and Walls

An epidemic occurs on a very small scale, at the level of the genome and human cells, but its effects occur on very different scales from human organs to global contexts.

SARS-CoV-2 is an RNA virus with a size of approximately 50–200 nm in diameter (N. Chen et al., 2020) and can occur almost everywhere, e.g. on clothes, the computer keyboard, and for a certain time in the air. Essential for the reproduction of the virus is the human cell, the corona space in the narrowest sense.

At the scale of the human body, a face mask helps to protect oneself and others. These “portable walls” belonging to the non-pharmaceutical interventions (NPIs) are part of the personal protective equipment (PPE) and could result in a large reduction in risk of infection (Chu et al., 2020).

Human movements are the conditio sine qua non for a pandemic outbreak, since they spread the virus both locally and globally. Concerning air traffic, a study’s findings showed the highly relevance of the number of flight routes as well as total passenger volume and identified it as a main vector for the global spread of COVID-19 (Lau et al., 2020). Cars play a dual role: on the one hand car mobility also contributes to the spread of the virus, on the other hand it serves as a sheltered mobile corona space as an alternative to public transport. It has been shown that the use of drive-through COVID-19 testing is an effective strategy for minimising patient contact and conserve personal protective equipment (PPE) (Ton, Jethwa, Waters, Speicher, & Francis, 2020).

Chains of infection are interrupted when the movement of infected persons come to rest. Contact tracing and subsequent quarantine for infected and suspects is initially the method of choice, as it can be limited to the affected persons and their rooms. These are the apartment with its borders (room walls, doors, windows), the shared accommodation e.g. for foreign workers, the single family house whose wall is a garden fence, and a block or a neighbourhood bordered by streets. It was estimated that early detection and isolation of cases prevented more infections than travel restrictions and contact reductions, but combined NPIs had the strongest and fastest effect (Lai et al., 2020).

Unlike quarantine, a lockdown refers to larger spatial units at different levels such as cities, districts, or countries. The "walls" around the lockdown spaces are temporary and usually of an organisational nature, sometimes even physical, when neighbourhoods are separated or border crossings are closed by temporary means. In these cases, the historical walls have a temporary revival: the city walls as well as the Great Wall of China. A lesson learned from the province of Bergamo is that in order to contain the epidemic, an urgent and decisive region-wide lockdown should have been implemented, as this might have limited the number of deaths in the province (Fagiuoli, Lorini, & Remuzzi, 2020).

Partial closures, such as the prohibition of mass events and the gathering of many people in a confined space, are intended to eliminate sources of infection and lead to empty football stadiums, clubs, department stores, schools and kindergartens, which are referred to here as corona voids.

Fig. 1: Corona void – empty subway station in Berlin 16/04/2020

Mandatory and voluntary quarantine increased home office and curfews mean that many people stay at home. This, together with a changed pandemic modal split due to more cycling, has led to a significant drop in public transport, e.g. with the number of journeys in Budapest decreased by 90% from 4.3 million/d to 430,000 million/d (Bucsky, 2020), thus creating many corona voids.

Four phases may distinguished when combating a potentially pandemic pathogen: Prevention (Keep the virus out of the country), control (trace the virus within the country), mitigation (containment of the virus), and recovery.[1] Each phase refers to the specific corona spaces, but the national border plays an important role in all phases, as many laws and rules apply nationwide.

4 COINCIDENCES

Mutations, i.e. random changes in the genome, drive the development of life on earth. Viruses mutate randomly and by chance they jump from animals to humans. Coincidences stood at the beginning of this pandemic and shape its course. Nevertheless, on the basis of coincidence emerge stable patterns. So it had long been known that a pandemic was to be expected; only the exact circumstances were unclear, thus the WHO developed a scheme for “Notifications of events that may constitute a public health emergency of international concern” (WHO, 2005).

On the level of individuals, it is random who is or is not infected by a carrier of the virus, including asymptotical cases. Hotspots of infection appear randomly on the map, often far from the epicentre of the epidemic. Now a lot depends on the decision-makers, but it is also random who is in charge at the time of the outbreak. They are responsible for the risk estimation and to manage the pandemic impact, and have to decide e.g. whether the ski circus continues in Ischgl or not[2], or whether as in Italy's virus epicentre of Lombardy, where COVID-19 patients were transferred to nursing homes by an official resolution with

[1] https://www.tellerreport.com/life/2020-03-26---corona-virus--ways-out-of-lockdown-.SJ-7vlv5I8.html
[2] https://www.politico.eu/article/the-austrian-ski-town-that-spread-coronavirus-across-the-continent/

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catastrophic consequences.[3] It is therefore important to take institutional precautions against a pandemic, as in Taiwan or South Korea, where lessons have been learned from the SARS-1 epidemic.

Example Taiwan: the "National Health Command Centre" (NHCC) is the central coordinating body, to which organisations continue to be subordinate, including the "Central Epidemic Command Centre" (CECC), newly founded on the basis of the SARS experience, and the "Command Centre for Biological Pathogens" (Wang, Ng, & Brook, 2020). The data of the National Health Insurance was compared very early on with that of the Immigration Department, the Register of Residents of Taiwanese citizens and the Foreigners Registration. This made it possible to identify and quarantine almost all persons who had been in risk areas in the past 14 days. It took NHCC a single day to establish this system. Supplemented by effective contact tracing and extensive testing, almost all suspicious cases were tracked down and the randomness was brought under control, which is reflected in low case numbers (Wang et al., 2020).

In South Korea well testing and tracking (Lee & Lee, 2020) allowed the nation to blunt the exponential spread of the disease without having to halt all internal movement and access between its cities (Park, Sun, Viboud, Grenfell, & Dushoff, 2020).

This form of institutional emergency response does not exist in the USA. The U.S. intelligence community warned in its annual “worldwide threat assessment” 2019 that the United States and the world will remain vulnerable to a large-scale outbreak of a contagious disease that could lead to massive rates of death and disability and severely affect the world economy (Coats, 2019). However, in 2018 the Trump administration closed a pandemic-response unit that the Obama administration had created after the Ebola outbreak, so no senior administration officials coordinated the efforts against the corona outbreak, Trump referred to as “an unforeseen problem,” as “something that nobody expected,” and as a crisis that “came out of nowhere”.[4] Thousands of passengers flew directly from Wuhan to the United States after Chinese officials disclosed the outbreak of the illness with health screening only beginning in mid-January.[5] The very high case numbers were countered by social distancing (Badr et al., 2020), high testing capacity and strong transmission-intervention (Chen, Li, Gao, Kang, & Shi, 2020). However, a study has estimated there may have been 36,000 fewer coronavirus-related deaths had the US entered lockdown a week earlier in March6; the Columbia University research also estimated that around 83% of deaths could have been avoided, if measures would have been taken two weeks earlier.[6]

Many other countries have also imposed a lockdown and it remains the task of future analysis and research to identify scenarios which could have been prevented that. Nevertheless, although coincidence plays a major role especially at the beginning of local infection events, it can be controlled due to the small number of cases, while the containment by a lockdown, the ultima ratio, is finally nothing but brute force against coincidence.

There are also many random elements in the development of cities, emergent processes as well as singular events. Urban planning tries to control chance; it anticipates the future, at least as far as the built environment is concerned. NB: Alexander made an attempt to understand the nature of order (Alexander, 2002) and to find ways to identify best spatial solutions in the vast "configuration space" of built environment possibilities (Alexander, 2005), however, these ideas have not yet been anticipated by planning practice.

5 URBAN PLANNING

Many measures related to corona spaces rely on organisational means (cf. Sect 1, cf. Sect 2) which can be implemented very quickly on all conceivable scales. On the contrary, urban development visions and plans usually only become effective in reality after a considerable time delay and new approaches such as process-oriented urban planning (Melo & Jenkins, 2019) are rarely used. Therefore, urban planning has only few options in the reaction to an acute virus outbreak. Nevertheless, the question rise what contribution urban planning can provide in preparing for the next pandemic. There are ideas on how to achieve good city form (Lynch, 1984), and there is the view that the new normality is changing cities (Salama, 2020), that that a new

[3] https://www.trtworld.com/magazine/the-massacre-of-italy-s-elderly-nursing-home-residents-35575
[4] https://www.theatlantic.com/politics/archive/2020/03/pandemic-coronavirus-united-states-trump-cdc/608215/
[5] https://www.nytimes.com/2020/04/04/us/coronavirus-china-travel-restrictions.html?auth=login-email&login=email
[6] https://www.bbc.com/news/world-us-canada-52757150

kind new urban planning is needed (Daneshpour, 2020), and there is the call for planning and design professionals with regard to the new tasks (Allam & Jones, 2020). What can urban planning achieve in terms of corona spaces?

5.1 Instruments and impact

A general urban development approach is the Vision (Leitbild) which lays down the broad lines of urban development. Although cities are multifunctional, the Leitbild is often monothematic: the garden city, the dense city, the car-friendly city, the smart city, and of course the climate-friendly city with its mitigation of and adaptation to climate change.

How should the Leitbild of a city look like that makes corona spaces a central design principle and thus constructively implements the virus resilient city? An important point of this Leitbild would be to solve the problem of virus resilient mass transport, either by completely new concepts for public transport or by giving preference to individual movements (walking, bicycle, car). Homelessness and informal settlements with their poor hygienic conditions should be eliminated and the lockdown of individual blocks, neighbourhoods, or districts would have to be facilitated. However, it is better to introduce health as a key principle in urban planning (Duhl & Sanchez, 1999) and to develop multifunctional solutions that integrate aspects of virus resilience in a win-win situation (Litman, 2020) than to pursue the monothematic Leitbild of a virus resilient city.

A Leitbild is concretised through concepts and plans, which are worked out for different scales. At the level of the city as a whole there is the instrument of the zoning plan, e.g. the Berlin land use planning 2020 (LUP) under the motto "thinking city ahead" that aims on considering the interrelationships of the city, making provisions for the city of tomorrow, showing development possibilities, considering many interests, and resolving usage conflicts in a transparent manner (Senatsverwaltung-für-Stadtentwicklung-und-Wohnen, 2020). It shows inter alia the activation of housing construction potentials and development areas (cf. Fig. 2).

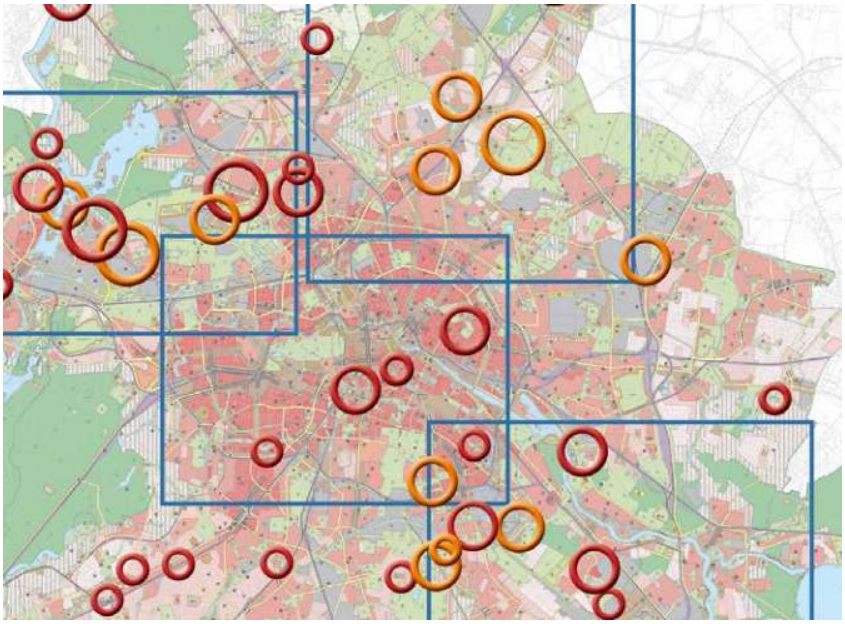

Fig. 2: Berlin LUP: Activation of housing construction potentials and development areas (Senatsverwaltung-für-Stadtentwicklung-und-Wohnen, 2020)

The LUP 2020 report deals with many topics, but the terms pandemic, epidemic, and emergency are not included. Further planning instruments, which cannot be discussed here in detail, complement or support the LUP.

Urban planning affects (1) the overall configuration of an urban area respectively the top level of the urban morphology, (2) the structure of the urban grid(s) as well as the zoning of functions which impacts the density of the built environment, and (3) the urban infrastructure, in combination with several sectoral planning instances (cf. Fig. 3). Both the driving forces of urban development and the political and legal framework play a role when planning form and function of a city.

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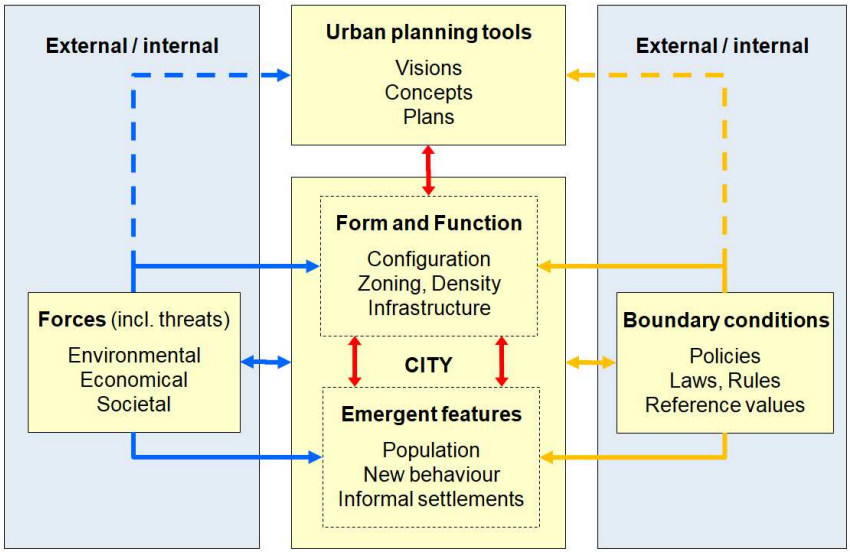

Fig. 3: Simplified representation of urban planning tools and their impact

It would go beyond the scope of this study to consider all fields of action of urban planning in detail, so it focuses on an aspect that is of particular importance regarding the pandemic context, the density.

5.2 Density

The very nature of the city is to bring people together and thereby create density. Among the factors that can be influenced by urban planning, building density has always played an important role. Examples are two contradictory urban Leitbilder which were developed by Howard in 1898 and Le Corbusier in 1922. Howard envisaged a system of garden cities for 32,000 to 58,000 inhabitants with large farms and new forests (Howard, 1898), while Le Corbusier proposed the "Ville Contemporaine", a city for three million inhabitants with segregated functions and 60-storey high-rise buildings in the centre (Rabaça, 2016). Both visions strive for different densities, served as a basis for the implementation of urban development projects and are still effective today.

Urban density is controversially discussed considering the spread of the virus: "Density Is New York City's Big 'Enemy' in the Coronavirus Fight"[7] versus "Urban Density Is Not the Problem"[8]. In another statement it says: "In a pandemic, busy urban centres are a big part of the problem. Without speedy and efficient public health measures to counter the infection's spread, the bigger and more well-connected a city, the faster it will travel.".[9]

With regard to the situation in Europe and Germany it was stated that, as a lessons of the corona crisis, cities need density in order to create urban space and thus promote social cohesion - although density is not a value in itself, but must be complemented by social and functional diversity and be defined in terms of urban development.[10] The opposite position emphasises the qualities of the "structured and limber city", such as the European settlement construction of the 20th century, and points out that the simultaneity and correspondence of different milieus make up the diversity and attractiveness of urban life.[11] NB: However, here the satellite settlements of the 60s and 70s which implemented "urbanity through density" (as Leitbild mentioned above) are ignored.

At least for Germany, there are no spatially high-resolution data on the corona pandemic at the level of urban structure types available that could be used to decide evidence-based whether dense development leads to a high incidence of infection. However, the Robert-Koch-Institute (RKI) provides data at the spatially much more aggregated level of German districts. The case numbers are not used here for evaluation, as it is not known who is currently infected and who was already infected. Critical gaps still remain in screening

[7] https://www.nytimes.com/2020/03/23/nyregion/coronavirus-nyc-crowds-density.html
[8] https://www.theatlantic.com/ideas/archive/2020/05/urban-density-not-problem/611752/
[9] https://www.bbc.com/future/article/20200424-how-do-you-build-a-city-for-a-pandemic
[10] https://www.faz.net/aktuell/wirtschaft/wohnen/lehren-aus-der-corona-krise-die-stadt-braucht-dichte-16762304.html
[11] https://www.faz.net/aktuell/wirtschaft/wohnen/warum-grosse-wohnsiedlungen-oft-besser-sind-als-ihr-ruf-16793967.html

asymptomatic people who are in the incubation phase of the virus, as well as in the accurate determination of live viral shedding during convalescence to inform decisions for ending isolation (Younis et al., 2020). The present study therefore uses the number of corona deaths based on RKI data (20/06/2020) instead of corona infected persons, even though it is subject to uncertainties.[12] In order to check whether there is a difference between rural and urban regions, the population density is used as an indicator for the settlement density and compared to the number of coronary deaths per 105 inhabitants.

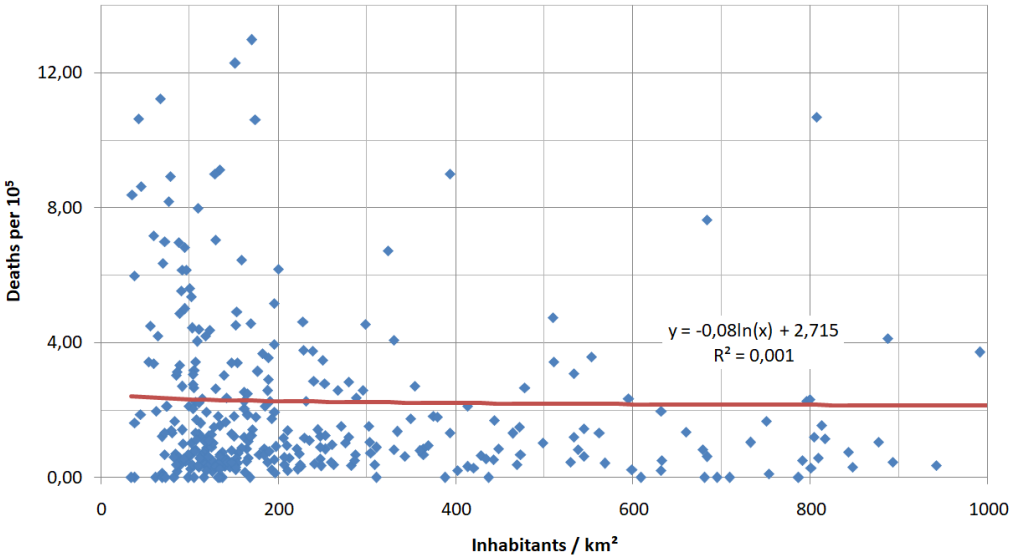

Fig. 4: Germany: relationship between population density and COVID-19 deaths on the basis of districts, extreme values not shown (own work based on RKI data 20/06/2020)

A regression analysis on the basis of districts in Germany (n=400) including the Berlin districts (n=12) yields the coefficient of determination $R^2 = 0.001$, which proves that there is no relationship between population density and COVID-19 deaths (cf. Fig. 4), at least at the level of these spatial units. This is consistent with results of a study examining SARS-CoV-2 infection rates and COVID-19 death rates in 913 metropolitan counties in the USA, which found that county density was not significantly associated with county infection rates (Hamidi, Sabouri, & Ewing, 2020).

An empirically unsupported explanatory approach states that the risk of infection does not increase with density (the number of people per unit area), but with crowding (the number of people within an enclosed space, e.g. vehicle or house): “Most infection risks are associated with specific activities – long-distance travel, worksites, stores and social gatherings – that are similar in cities, suburbs and rural areas” (Litman, 2020). This means (1) that pandemics are not an argument against dense urban structures and (2) crowding reduction (de-crowding) by social distancing or other means are a planning goal for pandemic times. However, as long as an outbreak is not detected and wherever the corona regulations[13] cannot be observed, density is still a problem.

6 POST CORONA

To avert similar events as the COVID-19 pandemic in the future, the prevention and control phases of containment of a potentially pandemic virus must be used efficiently. The measures in these phases are organisational and not constructional, but they could be supported by architectural means, e.g. a permanent or rapidly activated reserve of rooms for questioning, medical examination and quarantine of possibly infected arriving travellers at airports and railway stations. If these measures fail, an outbreak can no longer be prevented, but only mitigated.

6.1 Pandemic preparedness - lockdown prevention

Concerning urban planning pandemic preparedness should be treated as a cross sectoral planning task. The concept of corona spaces introduced in this study applies to very different spatial scales, but only a few of

[12] https://www.politico.eu/article/coronavirus-the-challenge-of-counting-covid-19-deaths/
[13] https://www.who.int/health-topics/coronavirus#tab=tab_2

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them are relevant for urban planning. In order to operationalise this term for urban planning, it must be narrowed down to areas and measurements, which will become important in the event of a pandemic. Just as flood polders are used to deliberately channel water during extreme flood events, corona spaces should be identified which need to be rapidly de-crowded and in extreme cases become corona voids. The prevention of a lockdown would be the primary planning objective and the arrangement and functionality of corona spaces can be decisive for whether a lockdown is necessary or not. Two cases can be distinguished: (1) Planning measures where pandemic preparedness is an important additional aspect and an argument when different land usages compete on the same area. (2) Planning measures that directly serve pandemic preparedness, such as hospital locations, buildings or areas for temporary reserve hospitals, or places for burial of the dead. The primary planning objective would be to do everything possible in the spatial organisation of a city to prevent a lockdown with its high follow-up costs and to keep the conditions for quarantine bearable. This lockdown prevention is especially important for populations already vulnerable as a result of occupation, class, (im)migration status, religion, gender, race, and other factors and points out that the sudden and unplanned COVID-19 lockdown in India delivered an excruciating blow to those who rely on public spaces such as the city's streets for their basic needs - food, water, shelter (Mawani, 2020).

Although a Leitbild of a pandemic resilient city will not exist, there are many suggestions on how to increase the resistance of a city to a pandemic during the mitigation phase. "The changes will be quite practical, like pop up hand washing stations, and often invisible, like tracking devices built into our sewers. If we do pandemic preparedness right, our cities might look much as they do today – just a little less crowded, with a little more local open space, and with more of the resources they need to support themselves on the doorstep."[14] NB: one component in the urban fabric is already prepared for pandemics: Gated communities are well suited for quarantine and lockdown. Using the example of Guadalajara (Western Mexico) models were developed to understand the role of urban design in disease spreading (Brizuela, García-Chan, Pulido, & Chowell, 2020), lessons can be taken from guarding a city from the COVID-19 pandemic (Xu, Shang, & Cao, 2020) and the sewage system can be mined for real-time information on contagious diseases (Snoweria, Fábio, & Carlo, 2019). The implementation of these measures will vary depending inter alia on the economic status of a city or district. Informal settlements of less economically developed cities will not be able to implement any or only a few measures, making these cities more vulnerable to pandemics. Finally, all pandemic measures, if monofunctional, will only be necessary until a vaccine is available to break the chains of infection.

6.2 Trends, enhanced

The pandemic may reinforce existing trends in urban development, as the following examples of transport, public spaces, urban agriculture, and offices demonstrate:

(1) Even before the corona crisis, there were efforts to reduce motorised private transport in cities. During the crisis, for example, roads were closed to car traffic in favour of bicycle traffic, e.g. Bogotá expands bike lanes to curb coronavirus spread: the Colombian Bogotá is opening 76 km of temporary bike lanes to de-crowd public transport, as well as to improve air quality, further 22 km of the new lanes were converted overnight to open on 17 March by reconfiguring car lanes.[15] Municipalities are now trying to keep some of these changes permanently in place.[16] In pandemic times, public transport is - as a permanent mass event that cannot be suspended - the Achilles heel of urban life and finding appropriate solutions to its de-crowding is a particular challenge.

(2) Open spaces such as forests, agricultural areas, and allotment gardens are of great importance during lockdown phases, as they allow recreation when public open spaces like playgrounds and baths are closed. In pandemic times, urban nature offers options for maintaining the well-being of urban populations, while enabling social distancing (Samuelsson, Barthel, Colding, Macassa, & Giusti, 2020) and thus promote de-crowding. Greener cities could be a key component of the COVID-19 recovery[17] – learning from the pandemic illustrates the potential for green roofs, walls and facades on environmental, economic and social

[14] https://www.bbc.com/future/article/20200424-how-do-you-build-a-city-for-a-pandemic
[15] https://www.smartcitiesworld.net/news/news/bogota-expands-bike-lanes-overnight-to-curb-coronavirus-spread-5127
[16] https://www.nytimes.com/2020/06/26/climate/cities-cars-traffic-congestion.html
[17] https://newsroom.unsw.edu.au/news/art-architecture-design/greener-cities-could-be-key-component-our-covid-19-recovery

benefits, including adapting cities to climate change, bringing nature back to city centres for workers and residents, and importantly, creating jobs.[18][19] Lockdown measures have limited the access of people to services and facilities outside of their local areas, whilst lowering the intensity of their usual physical activity and as a result, the green space within neighbourhoods has become more important in hosting people's outdoor activities (Ahmadpoor & Shahab, 2020).

(3) One of the factors that can increase urban resilience is urban agriculture (UA).[20] Here, food is produced in many different forms in an urban context (Lohrberg, Licka, Scazzosi, & Timpe, 2015), including aquaponics (dos Santos, 2016), whose economic viability has been demonstrated in urban applications (Baganz, Baganz, Staaks, Monsees, & Kloas, 2020) and which can make an important contribution to urban food security. UA is seen as an important component of the circular city (Skar et al., 2019), whose concept includes increasing the resilience of cities.

(4) Trends that have been considerably strengthened by the corona crisis are home office and virtual conferences. If this development continues after the crisis, albeit in a weaker form, this could have a direct impact on the development of office locations. In Hamburg's HafenCity, for example, 980,000 m² gross floor space (GFA) is earmarked for offices (35,000 office workplaces) that is 39 % of the total GFA, compared with residential use of 880,000 m² (35 %) GFA for about 7,500 units (HafenCity-Hamburg-GmbH, 2020). Here, placement on the market could become difficult. Co-Working (Manzini Ceinar, 2019) could also be affected by this development. Home office currently means in many cases the integration of an additional function into the home environment. Even if there is already a computer workstation, it is used much more intensively during the home office. So scaling up home office could lead to a further increase in living space concomitant with a reduction of office workplaces in the long term.

7 CONCLUSION

When the Corona pandemic is over and the "new normality" becomes the "old normality", the next pandemic could break out at any time (possibly caused by an Eurasian avian-like H1N1 swine influenza virus (Sun et al., 2020)). This study introduces corona spaces and voids to illustrate the pandemics multi scale spatial implications from the human cell to the entire globe. With the borders of corona spaces being central for the prevention, control and mitigation of the pandemics, these spaces are created by the pandemics dynamic. Coincidence plays a role here on various scales, but its impact can be neutralised by appropriate measures, especially in the prevention and control phase of the pandemic combat. If prevention and control are successful, a mitigation phase is not necessary.

Assuming that a pandemic era begins, cities must increase their resilience to a pandemic. Urban planning can help to contain outbreaks, but should not follow a monothematic Leitbild of a virus resilient city, but rather develop multifunctional approaches that integrate aspects of pandemic preparedness, e.g. measures against the climate crisis that also mitigate a virus outbreak, like inter alia bike lanes. Pandemic preparedness means reducing public health risks and should be a goal of community planning. It is a cross-sectional task that should be taken into account in as many plans as possible, comparable to the transformation towards sustainability.

Urban planning can help prepare a community for a pandemic, at least in the fields of de-crowding, well-being, and partially self-sufficiency. De-crowding is a major issue concerning lockdown prevention. Avoiding crowded public transport in pandemic times is a task, and one option for its solution is to change the modal split by significantly strengthening the cycling infrastructure. Movement reduction is another option that can be implemented by home office. Well-being of urban populations by providing green infrastructure is of particular importance during lockdown measures, as they restrict people´s access to services and facilities outside their residential areas. Partially self-sufficiency through the expansion of urban agriculture can increase resilience to food shortages that could occur as an indirect consequence of a pandemic.

[18] https://about.unimelb.edu.au/newsroom/news/2020/june/green-cities-roadmap-should-be-part-of-covid-19-recovery-stimulus,-experts-say

[19] https://cpb-ap-se2.wpmucdn.com/blogs.unimelb.edu.au/dist/c/359/files/2020/06/Roadmap-for-Green-Roofs-Walls-and-Facades-Summary.pdf

[20] https://www.resilience.org/stories/2020-05-12/urban-resilience-learnings-from-covid-19/

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Further research is needed to substantiate the findings of this study. Terms: regarding urban planning, corona space is an overarching term, as is social infrastructure or the industrial area (behind which very different realities exist), but it has to be evaluated. Another question concerning terms is whether "de-crowding" should be favoured over "crowding reduction". Scenarios: significantly better preparedness in the inter-pandemic phase is needed by using models and scenarios to clarify the social and economic impact: (1) what type of pandemic is expected, (2) how expensive will the various lockdown levels be, and (3) how expensive the measures to prevent a lockdown can be. Density: case data are needed at the level of urban structure types to further investigate whether dense development leads to a high incidence of infections. Zoning: research in the field of urban planning could demonstrate how infrastructure and zoning influence crowding, e.g. at present the separation of land use by zoning leads to traffic as a possible source of crowding. Here, the city of short distances in combination with superblocks could reduce the separation of living and working.

The last research task is a good example of integrated urban planning that also takes into account pandemic preparedness. And cities are well advised to prepare for the next pandemic, even if coincidence determines when it occurs.

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Die vielfältigen Vorzüge aktiver Mobilität auf Mensch und Umwelt (und wie wir sie erreichen)

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1 ABSTRACT

Die „Corona-Krise“ veranschaulicht, wie wichtig das Thema Gesundheit ist und welchen hohen Stellenwert die Gesundheit in der Gesellschaft hat. Neben den Maßnahmen, die wir zum Schutz vor einer Ansteckung mit COVID-19 ergreifen, sollten wir auch andere Maßnahmen, die unsere Gesundheit bewahren, umsetzen. Im Mobilitätsbereich sind das vor allem Maßnahmen, die mit bewegungsaktiver Mobilität wie Zufußgehen und Radfahren in Zusammenhang stehen. In Österreich sind unabhängig von der Corona-Krise die drei häufigsten Todesursachen Herz-Kreislauf-Erkrankungen zuzuordnen. Diese sind eng mit Bewegungsmangel sowie den Auswirkungen fossil betriebener Mobilität wie Luftverschmutzung verbunden. Weitere Auswirkungen auf unsere Gesundheit hat auch unsere Verkehrsinfrastruktur. Durch die Förderung von Radfahren und Zufußgehen, zudem die Erhöhung aktiver Mobilität am Modal Split können zahlreiche positive, direkte sowie indirekte Gesundheitsauswirkungen erreicht werden. Das Mobilitätssystem steht außerdem vor großen Herausforderungen. Es soll nachhaltig, insbesondere in Hinblick auf den Klimawandel sein, effizient, leistbar und nutzbar sowie gesund und sicher. Einen sehr wichtigen Beitrag zur Erreichung dieser Ziele kann die aktive Mobilität leisten. In diesem Paper werden zum einen die komplexen Zusammenhänge von aktiver Mobilität und Gesundheit aufgezeigt und zum anderen Motivatoren und Maßnahmen vorgestellt, die eine Verhaltensänderung der Bevölkerung hin zu aktiver Mobilität begünstigen.

Keywords: Maßnahmen, Aktive Mobilität, Gesundheit, Mobilität, Klimawandel, Infrastruktur

2 WIRKUNG AKTIVER MOBILITÄT AUF GESUNDHEIT UND UMWELT

2.1 Gesundheit

Die Entwicklungen der letzen Monate in Bezug auf die „Corona-Krise“ zeigen wie wichtig das Thema Gesundheit ist und welchen Stellenwert es in der österreichischen Gesellschaft hat (NÖN, 2020; Statista, 2020). Doch nicht nur Pandemien sorgen für eine erhöhte Sterberate. In Österreich sind unabhängig von der „Corona-Krise“ die drei häufigsten Todesursachen Herz-Kreislauf-Erkrankungen zuzuordnen. Diese sind eng mit Bewegungsmangel verbunden. Die Weltgesundheitsorganisation (WHO) empfiehlt 150 Minuten Bewegung mittlerer Intensität (während der Bewegung kann noch gesprochen werden) pro Woche (Gesundheit Österreich, 2018). In Österreich bewegt sich nur etwa die Hälfte der Erwachsenen ausreichend (Institut für Gesundheitsplanung, 2016). Durch aktive Mobilität im Alltag, also Zufußgehen oder Radfahren, kann die Empfehlung der WHO im Alltag erreicht werden. Eine Person, die jeden Tag ihren 5 km langen Weg zur Arbeit mit dem Fahrrad zurücklegt, erreicht bei einer 5-Tage Woche bereits die 150 Minuten an Bewegung pro Woche, die von der WHO empfohlen werden und fördert damit seine/ihre Gesundheit.

Aktive Mobilität beugt Fettleibigkeit, Osteoporose und verschiedene Krebsarten vor. Außerdem hat ausreichende Bewegung im höheren Alter enorme Auswirkungen auf die Verlängerung der „gesunden Lebensjahre“ und kann bei der Vorbeugung von Demenz helfen. Aktive Mobilität verringert somit auch die Wahrscheinlichkeit zu einer der Corona-Risikogruppen zu zählen. Zudem werden Rücken, Gedächtnis und Gleichgewichtssinn gestärkt und psychische Krankheiten vermieden oder abgemildert (Leuba, Schweizer & Keller, 2016). Die positiven Einflüsse von Bewegung auf die Psyche wurde bereits in zahlreichen Studien nachgewiesen. Positive Effekte sind zum Beispiel eine verbesserte Stimmungslage, erholsamer Schlaf und Stressabbau (Morita et al., 2011).

Lokale Luftverschmutzung und Lärmemissionen

Aktive Mobilität hat neben den direkten gesundheitlichen Auswirkungen auf die ausübende Person, viele weitere, indirekte Vorzüge, von denen auch die Allgemeinheit profitiert. Eine Erhöhung der aktiven Mobilität am Modal Split führt zum Beispiel auch zur Reduktion lokaler Luftverschmutzung. Besonders wichtig wäre es, dass fossil betriebener Individualverkehr durch aktive Mobilitätsformen ersetzt wird. Laut Europäischer Umweltagentur ist die Luftverschmutzung das größte umweltbedingte Gesundheitsproblem in Europa, denn Feinstaub, Stickstoffdioxid und Ozon verursachen jährlich rund 400.000 vorzeitige Todesfälle.

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In Österreich starben 2016 rund 8.200 Personen vorzeitig durch Luftverschmutzung (Gesundheit Österreich, 2016). Während der Maßnahmen zur Eindämmung von COVID-19 hat sich die Mobilität in Österreich signifikant reduziert, denn über 3/4 der ursprünglichen Arbeits- und Ausbildungswege sind entfallen (TU Wien fvv, 2020). Satellitenbilder zeigten, wie dadurch auch die Luftverschmutzung abnahm. Interessant ist auch, dass in den Gebieten, die vor dem Ausbruch von COVID-19 mit hoher Luftverschmutzung zu kämpfen hatten, eine starke Ausbreitung des Virus zu beobachten war. Laut Wissenschaftlern könnte dies auf das bereits geschwächte Immunsystem der Menschen in diesen Gebieten aufgrund der Luftverschmutzung zurückzuführen sein (EPHA, 2020).

Der Umstieg von fossil betriebenen Verkehrsmitteln auf bewegungsaktive Mobilität trägt zudem zur Reduktion von Treibhausgas-Emissionen und zur Steigerung der Lebensqualität bei, z.B. indem sie keinen oder nur kaum Straßenverkehrslärm verursachen. Lärm stört nicht nur das Wohlbefinden, sondern hat auch negative Auswirkungen auf die menschliche Gesundheit. Das Umwelt-Bildungs-Zentrum Steiermark (UBZ) zählt zu den von Lärm verursachten, kurz- und langfristigen Gesundheitsschäden bspw. Unwohlsein, Schlafstörungen, hormonelle Reaktionen wie Stress, Probleme mit dem Herz-Kreislauf-System, Hörstörungen, Bluthochdruck, ein erhöhter Blutzuckerspiegel und verringerte Leistungsfähigkeit bzw. Konzentrationsstörungen. Neben dem Rauchen ist Lärm das zweitgrößte Risiko für Herzerkrankungen (UBZ, 2020). Dies wird durch eine von der Weltgesundheitsorganisation (WHO) veröffentlichte Studie bestätigt. In der Studie wird der Zusammenhang zwischen Lärm und dem Auftreten von Schlafstörungen, kognitiven Leistungsbeeinträchtigungen und Herzkrankheiten aufgezeigt. Durch Lärmemissionen gehen jährlich mindestens eine Million gesunde Lebensjahre in West-Europa verloren, darunter zum Beispiel 903.000 Jahre aufgrund von Schlafstörungen, die durch Lärm verursacht wurden. (WHO, 2011). Rund 40% der österreichischen Bevölkerung gaben im Mikrozensus 2015 der Statistik Austria an, dass sie Lärmstörungen im Wohnbereich ausgesetzt sind. Der Straßenverkehrssektor ist dabei der Hauptverursacher für Lärmstörungen in Österreich (Statistik Austria, 2015). Die WHO empfiehlt daher, den durch Straßenverkehr bedingten Lärmpegel am Tag auf weniger als 53 Dezibel und in der Nacht auf weniger als 45 Dezibel zu halten (WHO, 2018).

2.2 Gebaute Umwelt und Flächennutzung

Die für Rad- und Fußverkehr notwendige Infrastruktur ist zudem im Vergleich zu Infrastruktur für den motorisierten Verkehr platzsparender und ermöglicht dadurch eine zwischen den Verkehrsteilnehmerinnen und Verkehrsteilnehmern gerechtere Aufteilung der Flächen und eine etwaige Entsiegelung und anschließende Begrünung von freiwerdenden Flächen. Vor allem in Städten ist das Platzangebot beschränkt. Durch die Erhöhung des Anteils aktiver Mobilität an der Gesamtmobilität, könnte einerseits der knappe öffentliche Raum in urbanen Gebieten effizienter genutzt werden und andererseits kann dadurch auch die Attraktivität urbaner Räume gesteigert werden z.B. durch Begrünung. Eine Studie der Technischen Universität Wien, die während der Ausgangsbeschränkungen aufgrund von COVID-19 durchgeführt wurde, zeigt, an welchen Orten es besonders sinnvoll wäre, einzelne Straßen für Autos zu sperren, damit beim Zufußgehen auf die Fahrbahn ausgewichen werden kann, um den Mindestabstand einhalten zu können (TU Wien, 2020).

Versiegelte Flächen sowie parkende Autos führen vor allem im Sommer zur schnelleren Erhitzung der Umwelt und vermindern durch die Speicherung von Wärme zudem die Abkühlung der Umwelt während der Nacht. Begrünung führt hingegen zu einem kühleren Mikroklima, was im Kontext mit den zunehmenden Hitzetagen in den Sommermonaten vor allem in urbanen Gebieten eine wichtige Rolle spielt. Hitze ist vor allem für ältere Menschen, Kinder, Patientinnen und Patienten mit Herz-Kreislauf- und psychischen Erkrankungen sowie Personen mit eingeschränkter Mobilität gefährlich (VCÖ, 2018). In Österreich verzeichnete das Hitze-Mortalitätsmonitoring der Österreichischen Agentur für Gesundheit und Ernährungssicherheit (AGES) insgesamt 198 Todesopfer im Jahr 2019 (AGES, 2020).

2.3 Reduktion von (Gesundheits-)Kosten

Aktive Mobilität wirkt sich nicht nur direkt und indirekt, positiv auf die Gesundheit und Lebensqualität aller aus, sondern sie schafft auch Nutzen und kann zur Reduktion von (Gesundheits-)Kosten führen. Die Gesundheitskosten betrugen 2018 in Österreich bereits mehr als 10% des BIP und werden laut Prognosen bis

2030 weiter steigen. OECD-weit und auch in Österreich steigen die Gesundheitskosten schneller als das Bruttoinlandsprodukt (OECD, 2019).

2.4 Aktive Mobilität ist inklusiv

Zuletzt ist die Förderung aktiver Mobilität auch eine Förderung sozialverträglicher Mobilität, denn viele Haushalte mit niedrigem Einkommen besitzen kein Auto und sind daher auf öffentlichen Verkehr, Rad oder Zufußgehen angewiesen (VCÖ, 2018). In der österreichischen Mobilitäts- und Verkehrsforschung werden Unterschiede im (Mobilitäts-) Verhalten auf der Mikroebene traditionellerweise zum einen auf die regionale Ausstattung und zum anderen auf die sozioökonomische Situation d.h. auf einen ungleich guten Zugang zum Mobilitätssystem, zurückgeführt. Indikatoren der regionalen Ausstattung umfassen Erreichbarkeit, Ausstattung der (Wohnstand-)Orte mit Infrastrukturen, siedlungsstrukturelle Typologien, Fahrzeugverfügbarkeit sowie vorhandene Zugänge durch Führerschein, Monats- oder Jahreskarten. Die soziale Lage wird anhand traditioneller Merkmale sozialer Ungleichheit (wie Einkommen, Geschlecht, Alter, etc.) und des Haushaltstyps definiert (Dangschat, 2018). Vor allem in den letzten Jahren hat die Bedeutung von Konzepten zu Lebensstilen, sozialen Milieus, Lebensphasen und Mobilitätsbedürfnissen in Studien als weitere mobilitätsrelevante Indikatoren allmählich zugenommen (Bell & Sumper, 2015). Deshalb ist es wichtig, Möglichkeiten für alle Bevölkerungsgruppen zu schaffen, um aktiv mobil sein zu können.

3 MASSNAHMEN ZUR FÖRDERUNG AKTIVER MOBILITÄT

Die Art und Weise wie wir uns fortbewegen, beeinflusst also unsere Gesundheit sowie Lebensqualität, die direkten und indirekten (gesellschaftlichen) Kosten von Mobilität sowie ihre Auswirkungen auf die Umwelt. Eine Veränderung unseres Mobilitätsverhaltens, hin zu bewegungsaktiven Formen von Mobilität, ist daher sinnvoll und kann auf unterschiedlichen Ebenen und von verschiedenen Akteuren vorangetrieben werden.

Es gibt bereits zahlreiche Maßnahmen, die auf die Veränderung des Mobilitätsverhaltens abzielen. Die öffentliche Hand kann Methoden ergreifen, die von strukturellen Maßnahmen, welche die Modifizierung der physischen sowie legislativen Strukturen umfassen, bis hin zu Maßnahmen, die beim Individuum ansetzen, reichen.

3.1 Bewusstseinsbildende Maßnahmen

Diese Gruppe an Förderungsmöglichkeiten für aktive Mobilität zielen darauf ab, das Verhalten durch sanfte Maßnahmen wie Wissensvermittlung, Ausprobieren, etc. zu verändern. Theorien aus der Umweltpsychologie versuchen u.a. zu erklären, wie Wissen, soziale Normen, Verbote, die soziale und physische Umwelt, das Verhalten beeinflussen, woraus dann Maßnahmen generiert werden. (Bamberg & Köhler, 2018; Flade, Brieler & Knie, 2013). Die Mobilitätserziehung von Kindern und Jugendlichen in- und außerhalb von Schulen ist eine solche Maßnahme. Dabei werden Mobilitätskompetenzen praktisch und theoretisch vermittelt, indem sie vorgestellt, diskutiert und gemeinsam ausprobiert werden, um erste Erfahrungen zu sammeln. Es können unterschiedlichste Medien und Techniken eingesetzt werden. Neben dem Erlernen des angemessenen Verhaltens im gegenwärtigen Verkehrssystem, passiert auch eine kritische Auseinandersetzung mit Auswirkungen des Verkehrsystems auf den Menschen und die Umwelt sowie wünschenswerten Mobilitätsformen.

Ein weiteres Beispiel für eine Theorie aus der Umweltpsychologie ist die Lerntheorie. Sie bietet die Möglichkeit das Verhalten noch umfassender als in behaviouristischen Ansätzen nachzuvollziehen, indem sie den Menschen nicht nur als auf Einflüsse reagierendes Lebewesen beschreibt, sondern als handelndes und überlegendes Wesen, welches mögliche Konsequenzen, je nach aktueller Situation, abwägt und sich für ein bestimmtes Verhalten entscheidet. So fahren die meisten Autofahrerinnen und Autofahrer bei einer angekündigten Radarkontrolle meist langsamer und beschleunigen, sobald sie keine Kontrollen mehr befürchten. Das Verhalten und Verhaltensänderungen formen sich danach aufgrund von Erfahrungen. Je nachdem, ob ein bestimmtes Verhalten positive oder negative Konsequenzen hat, wird dieses bekräftigt oder geschwächt und in weiterer Konsequenz vielleicht auch bewusst vermieden. Ein einmal erlerntes Verhalten ist nur schwer wieder zu löschen, auch wenn es nur noch in unregelmäßigen Abständen ausgeführt wird (Flade, Brieler, und Knie, 2013). Um den gewünschten Effekt einer Maßnahme auf das Verhalten zu erreichen, sollte die Einhaltung gesetzter Maßnahmen wie Tempolimits, Einbahnregelungen oder

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Fahrradstraßen daher auch kontrolliert und mit positiven und/oder negativen Konsequenzen verbunden werden.

Eine weitere wichtige Maßnahme ist das Ausprobieren von neuen bewegungsaktiven Mobilitätsformen. Strömberg et al. (2016) kritisieren, dass Interventionen, die lediglich auf die individuellen Einstellungen und Intentionen gegenüber einem Verhalten bzw. einer Innovation ansetzen, zu kurz greifen, da diese nur zu Beginn des Adaptionsprozesses relevant sind. Während des ganzen Adaptionsprozesses wiegt das Individuum die Vor- und Nachteile der Innovation ab. Damit eine Innovation angenommen wird, muss sie noch weitere wichtige Aspekte erfüllen: sie sollte einen relativen Vorteil gegenüber bisherigen Optionen haben; mit den Bedürfnissen und Werten des Individuums übereinstimmen; möglichst einfach zu verstehen und zu gebrauchen sein; ihre Auswirkungen sollten leicht feststellbar sein; und die Innovation sollte erfahrbar sein, um individuelle Unsicherheiten gegenüber der Innovation und ihrem Gebrauch zu beseitigen. Diese Testung ist oft ausschlaggebend bei der Entscheidung, ob eine Innovation adaptiert oder abgelehnt wird. Dabei kann dieser Test im Kopf einer Person passieren, indem sie sich die wahrscheinlichen Auswirkungen der Adaption vorstellt, oder aber in der wirklichen Welt. Vor allem bei der Veränderung des Mobilitätsverhaltens kann die Durchführung beider Testungen herausfordernd sein, da die Konsequenzen der Verhaltensänderung schwierig vorstellbar sind und es viele Barrieren gibt, welche die Testung in der realen Welt be- oder verhindern. Zum Beispiel wurden in einem Versuch, in dem Personen zur Nutzung des Busses anstatt des Autos motiviert werden sollten, die ökonomischen Barrieren beseitigt (Bustickets gratis). Insgesamt fuhr aber nur eine geringe Zahl an kostenbewussten Personen vermehrt mit dem Bus. Die Beseitigung weiterer Barrieren wäre daher nötig gewesen, um eine Verhaltensänderung bei einer größeren Anzahl an Personen zu bewirken (Strömberg et al. 2016).

Viele Autorinnen und Autoren (z.B. Strömberg et al. 2016; Ryghaug & Toftaker, 2014; Jensen, Cherchi & Mabit, 2013; Hagman, 2003) sehen das Ausprobieren bzw. Testen von Mobilitätsformen, wie zum Beispiel bewegungsaktiven Mobilitätsformen als eine Intervention, die ausschlaggebend für die Veränderung der Einstellung, ihrer Nutzung und schlussendlich ihrer Verbreitung sowie Integration in das bestehende System ist (Sovacool, 2017). Dabei scheinen besonders Testungen über mehrere Monate, idealerweise mit persönlicher Begleitung der Testerinnen und Tester, zur Adaption eines neuen Mobilitätsverhaltens zu führen, vorausgesetzt das „neu“ erlernte Verhalten kann nach dem Test fortgeführt werden (Strömberg u. a., 2016). Strömberg et al. (2016) analysierten zwei Fallstudien (UbiGo, eine MaaS-App in Schweden, und Testcyklisterna, vermehrtes Radfahren in Finnland), in denen Personen, die bereits den Wunsch hatten ihr Verhalten zu ändern, bei dieser Herausforderung erfolgreich unterstützt wurden. Viele Testerinnen und Tester von UbiGo wollten ihr neues Verhalten fortführen, konnten dies aber aufgrund der Absetzung der App nach Beendigung der Studie nicht. Die Teilnehmerinnen und Teilnehmer von Testcyklisterna ersetzten 40% ihrer Autofahrten durch das Fahrrad und einige behielten ihr neues Mobilitätsverhalten nach Ablauf des Versuchs bei (ebd.). Somit tragen sie nun zur Verbreitung dieser Praktik bei, indem sie als Vorbild und zur Inspiration für andere dienen (ebd.; Geels, 2004). Sovacool (2017) behandelt in seinem Artikel die Adaption von Elektroautos und nennt ebenfalls das Ausprobieren als wichtiges Element für die langfristige Adaption dieses Mobilitätsverhaltens. Durch wiederholtes Fahren von Elektroautos verfestigt sich diese Praktik allmählich in Form einer stärkeren individuellen Affinität zu Elektromobilität sowie einer bestimmten Nutzerinnen- und Nutzeridentität (Sovacool, 2017). Außerdem werden durch das Ausprobieren gesellschaftliche Leitbilder über neue Mobilitätspraktiken generiert (Schneider, 2018).

Bei der Veränderung des Mobilitätsverhaltens können persuasive Technologien hilfreich sein. Eine persuasive Technologie ist eine Technik oder interaktive Technologie, die dergestalt designt wird, dass sie möglichst die Veränderung der Einstellungen und des Verhaltens ihrer Nutzerinnen und Nutzer bewirkt. Dies passiert freiwillig durch Überzeugungskraft oder durch sozialen Einfluss. (Fogg, 2002; IJsselstein u. a., 2006). Persuasive Technologien werden in zahlreichen Bereichen (Verkauf, Diplomatie, Politik, Religion, Bildung, Management, Gesundheit, Nachhaltigkeit, Militär, etc.) entweder in der Interaktion zwischen Mensch und Mensch oder Mensch und Computer eingesetzt. Durch die fortschreitende Digitalisierung werden zunehmend mehr Menschen über Informations- und Kommunikationsgeräte, wie z.B. ein Smartphone, fast überall (z.B. Smart Homes) von diesen persuasiven Techniken erreicht (IJsselstein u. a., 2006). Besonders verbreitet sind Anwendungen, die zu sportlichen Aktivitäten motivieren sollen (Halko & Kientz, 2010). Das von Interreg Alpine Space geförderte Projekt MELINDA hat zum Ziel das Bewusstsein in Bezug auf Faktoren, die eine kohlenstoffarme Mobilität im Personenverkehr unterstützen zu verbessern.

Damit sollen Nutzerinnen und Nutzer die Möglichkeit haben umweltfreundliche Alternativen für ihr Mobilitätsverhalten auswählen zu können. (Interreg Alpine Space – Melinda).

Die Strategien und Techniken (z. B. Nudging, Gamification oder Framing), die in persuasiven Technologien zum Einsatz kommen, stammen aus der experimentellen Psychologie, Rhetorik und Mensch-Computer-Interaktionsforschung. Fogg (2002) schreibt persuasiven Technologien drei mögliche Funktionen zu:

- Sie können als Werkzeug fungieren, in dem sie Nutzerinnen und Nutzern dabei helfen, ein gewisses Verhaltensziel leichter zu erreichen (z.B.: Nudging oder eine App).
- Sie können die Funktion eines Mediums übernehmen das durch das Verwenden von Interaktivität und Erzählung überzeugende Erfahrungen schaffen kann, sodass das Einstudieren eines Verhaltens, das Einfühlungsvermögen oder die Erforschung kausaler Zusammenhänge unterstützt werden.
- Sie können die Funktion eines sozialen Akteurs einnehmen, mit dem Nutzerinnen und Nutzer wie mit einem echten Menschen kommunizieren (z.B.: Tamagotchi).

Alle drei Funktionen unterstützen eine bewusste oder unbewusste Verhaltensänderung (Fogg, 2002). Persuasive Technologien können für alle oder nur für eine bestimmte Zielgruppe entwickelt werden.

3.2 (Infra-) Strukturelle Maßnahmen

Auf das Verhalten kann auch durch die Veränderung der (Infra-)Strukturen bzw. Bedingungen des Verkehrssystems eingewirkt werden. (Infra-) Strukturelle Maßnahmen zielen dabei auf die Ermöglichung bzw. Verhinderung eines bestimmten Verhaltens ab und wirken so auch dem value-action gap[1] entgegen. Dieser wird oft als Grund für die Ineffizienz von akteurszentrierten Maßnahmen angeführt. Zu möglichen Maßnahmen gehören die Verbesserung der Verfügbarkeit und Qualität alternativer Fortbewegungs-möglichkeiten, wie die Einführung von Sharing-Programmen und multimodaler Lösungen (Karlsson, Sochor, & Strömberg, 2016), sowie bauliche und verkehrsregulatorische Maßnahmen, wie z.B. der Ausbau der Fahrradinfrastruktur oder die Attraktivierung von Nachbarschaften (Schoner, Cao, & Levinson, 2015; Wasfi u. a., 2016; Wang u. a., 2016; Lee und Dean, 2018; Heinen u. a., 2015). (Infra-)Strukturelle Maßnahmen sind aber oft nur die Voraussetzung für ein gewisses Mobilitätsverhalten und sollten durch zusätzliche Maßnahmen auf anderen Ebenen ergänzt werden, um wirksam zu sein (Song, Preston, & Ogilvie, 2017; Sierzchula u. a., 2014).

Die Erreichbarkeit spielt bei bewegungsaktiver Mobilität eine wichtige Rolle. Ein großes Potential für gesunde bewegungsaktive Mobilität bietet vor allem die Nahmobilität im städtischen Bereich, denn 40% der PKW-Wege sind unter 5 km und können somit zu Fuß oder mit dem Fahrrad zurückgelegt werden (VCÖ, 2018). Jedoch ergeben sich vor allem im ländlichen Raum Schwierigkeiten bei der Erreichbarkeit. Zwei Drittel der Bevölkerung erreichen das nächstgelegene regionale Zentrum mit einem ÖV innerhalb von 30 Minuten. Die Gestaltung bzw. Umgestaltung der Umwelt inkludiert Maßnahmen, die auf den Erkenntnissen der Mobilitätspsychologie entwickelt wurden. Dazu gehören die Verringerung der Fahrgeschwindigkeit, die Erhöhung der Attraktivität alternativer Bewegungsformen z.B. in Form der Verbesserung der Aufenthaltsqualität von Wohnumgebungen, die Einrichtung von Begegnungszonen, die Erhöhung des Sicherheitsgefühls im ÖV, Stärkung der Ortsverbundenheit, etc. (Flade, Brieler, und Knie, 2013). Wenn eine entsprechende Infrastrukur für das Zufußgehen geschaffen wird und der Ansatz „Stadt der kurzen Wege“ verfolgt wird, dann wird diese auch eher genutzt und die Menschen sind eher bereit auf den motorisierten Individualverkehr zu verzichten (Arbab et.al., 2020).

Ein entscheidender Aspekt ist schließlich die intersektorale Zusammenarbeit zur Schaffung von entsprechenden Strukturen, um aktive Mobilität fördern zu können. Das österreichische Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie (BMK) hat im Rahmen der Erarbeitung einer FTI-Strategie Mobilität auch das Thema Gesundheit und Mobilität aufgegriffen und besonders die Zusammenarbeit zwischen den verschieden Ministerien einerseits und jene mit anderen

[1] Value-action gap benennt die oft festgestellte Diskrepanz zwischen den geäußerten Einstellungen von Nutzerinnen und Nutzern und ihrem tatsächlichen Verhalten. Oft wird das Beispiel eines sehr umweltbewussten Individuums genannt, das sich aber nicht dementsprechend umweltbewusst verhält. Die persönliche Einstellung determiniert nicht immer und ausschließlich das Verhalten. Neben ihr existiert eine Vielzahl an weiteren Einflussfaktoren (z.B. Preis, verfügbare Infrastrukturen und Verkehrsmittel, Wetterlage, Selbstbewusstsein), die auf das Verhalten einwirken. Es ist deshalb meist schwierig, die Gründe für einen gap zu identifizieren.

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Fachbereichen andererseits herausgearbeitet (BMK,2020). Die Betrachtung des Themas von verschiedenen Seiten (sowohl aus medizinischer Sicht als auch aus verkehrspolitischer Sicht) ist wichtig, um möglichst viele Aspekte zu berücksichtigen zu können. Zusätzlich gibt es in Österreich das vom BMK geförderte Programm „Mobilität der Zukunft“, wo vor allem in der Personenmobilität eine große Zahl an Projekten, die den Fokus auf das Thema Gesundheit und aktive Mobilität gesetzt haben.

4 ZUSAMMENFASSUNG

Mobilität und Gesundheit sind eng miteinander verknüpft und spielen – gerade in Zeiten einer Pandemie - eine wichtige Rolle. Aktive Mobilität ist nicht nur gesund für jede/n Einzelne/n, sondern bringt auch positive Effekte für die Umwelt, das Klima, die Erhöhung der Lebensqualität und die Senkung von Gesundheitskosten. Bei der Erarbeitung von Maßnahmen ist es wichtig diese intersektoral abzustimmen und ein, über Fach- und Arbeitsbereiche, gemeinsames Ziel zu verfolgen. Das Mobilitätssystem steht in den kommenden Jahren vor der großen Herausforderungen, dass es insbesondere in Hinblick auf den Klimawandel nachhaltig sein soll, darüber hinaus effizient, leistbar und nutzbar sowie gesund und sicher. Einen entscheidenenden Beitrag zur Erreichung dieser Ziele kann die aktive Mobilität leisten.

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Corona: Die Rolle der Stadtplanung für die Krisenbewältigung am Beispiel Wien

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1 ABSTRACT

Die Auswirkungen von Covid-19 betrafen wie kaum eine Krise der jüngeren Vergangenheit alle Lebensbereiche in drastischer Weise. Auf Grund der schwerwiegenden Gesundheitsfolgen und pandemischen Bedrohung musste überdurchschnittlich rasant und einschneidend gehandelt werden. Die Stadtplanung und -entwicklung, als Disziplin mit einem längerfristigen Zeithorizont von mehreren Jahren bis Jahrzehnten, stellte dies vor eine ungewohnte Aufgabe. Dabei lassen die Entwicklungen der vergangenen Jahre vermuten, dass es sich bei Krisen wie der aktuellen wohl nicht um singuläre Ereignisse handelt, sondern um Ausprägungen zunehmend volatiler Rahmenbedingungen, die sich durch bereits jetzt eintretende klimatische oder ökonomische Umwälzungen tendenziell noch verschärfen werden. Entsprechend steigt das Interesse der planenden Disziplinen an der Auseinandersetzung mit Notfällen, Krisen und Katastrophen und zeitnahen Reaktionsmöglichkeiten. Nichtsdestoweniger ist die Stadtplanung und -entwicklung gefordert ihre Kernkompetenz nicht außer Acht zu lassen und auch zukünftig langfristige und vorausschauende Strategien zu verfolgen.

Der vorliegende Text wirft einen Blick auf die Wiener Stadtplanung und Stadtentwicklung. Dabei werden Fragen zu den Auswirkungen durch Covid-19 in den Monaten März bis Juni 2020 in den unterschiedlichen Planungsaspekten, -sektoren und -disziplinen aufgegriffen. Ausgangspunkt ist die Frage welche Bedeutung langfristige, strategische Ansätze und die kontinuierliche Weiterentwicklung einer robusten Stadtentwicklung in Zeiten von akuten Krisen aufweisen. Es wird weiters beleuchtet, welche bestehenden Argumentationen der Wiener Stadtentwicklung im Zuge der Erfahrungen der letzten Monate gestärkt oder geschwächt wurden. Dabei wird auch auf das Verhältnis von taktischen Adhoc-Lösungen und langfristigen Strategien eingegangen. Zu Grunde liegend ist das Verständnis, dass jede Entwicklung und Veränderung in der Stadtplanung ins Verhältnis zur globalen Klimakrise und dem Umgang damit gesetzt werden muss.

Keywords: Covid-19, Mobilität, Klimakrise, Grünraumgerechtigkeit, Strategie

2 PERMANENTE VERÄNDERUNGEN ERFORDERN ROBUSTHEIT

Rasche Veränderungen mit unabsehbaren Folgen erfordern Robustheit und Anpassungsfähigkeit des Systems Stadt. Es ist Aufgabe der Stadtplanung, diese Offenheit der Stadt gegenüber Veränderungen bei gleichzeitiger Sicherung eines auf stabilen Werten beruhenden, nachhaltigen Entwicklungspfades zu gewährleisten.

Seit dem Ausbruch von Covid-19 gibt es kaum einen Bereich unseres Lebens, der nicht aufgrund des neuen Krankheitserregers unter einem neuen Licht betrachtet und bewertet wurde. Die Art und Weise, wie wir unser alltägliches Leben führen, wie wir einander begegnen und wie wir arbeiten musste sich binnen kürzester Zeit an den Ausnahmezustand anpassen. Dabei reiht sich die Corona-Pandemie in eine mittlerweile lange Liste an Krisen ein, die das öffentliche Leben, unsere urbane Gesellschaft, die Stadtwirtschaft und die (Stadt-)Politik seit der Jahrtausendwende einschneidend verändert haben. Die Finanz- und Wirtschaftskrise von 2008/09 und der verhältnismäßig hohe Anstieg an Asylsuchenden im Jahr 2015 sind die zwei wohl am häufigsten in diesem Kontext zitierten Krisen der jüngeren Vergangenheit.

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Die Häufung krisenhafter Entwicklungen ist bestimmend geworden für unsere Zeit. Der hohe Grad an globaler Vernetzung und die beschleunigten Zyklen des Wandels haben die Komplexität gesellschaftlicher Phänomene immens erhöht und erschweren entsprechend deren Steuerung und die Implementierung von Lösungen auch für anerkannte Probleme.[1]

Dennoch stellte der Mitte März 2020 durch die globale Verbreitung des neuartigen Coronavirus SARS-CoV-2 (Covid-19) nahezu weltweit ausgerufene „Lockdown" eine Zäsur einzigartiger Ausprägung dar. Wie sich der dadurch erzwungene Stillstand fast des gesamten wirtschaftlichen und sozialen Lebens zum Zweck der Eindämmung der Virusausbreitung auf die wirtschaftlichen Entwicklungspfade und den Wohlstand in Städten und Regionen auswirken wird, bleibt bislang eine offene Frage.[2] Gewiss ist jedoch, dass die Krise innerhalb kürzester Zeit große Schwachstellen und immanente Widersprüche innerhalb unserer Gesellschaft sichtbar gemacht hat, die zu akzeptieren wir bislang allzu oft bereit waren.[3] Entsprechend steht auch die Stadtentwicklung und Stadtplanung vor Herausforderungen, deren Gewicht durch den Schock der Pandemie deutlich sichtbar wurde.

Dabei ist es für die Stadtplanung und -entwicklung entscheidend, nicht jede Krise notwendig als Wendepunkt zu betrachten, sondern langfristige Auswirkungen und Entwicklungsszenarien abzuwägen. Gerade in Zeiten der gehäuften Krisenanfälligkeit müssen wir uns vor Augen führen, dass jede Krise anders ist und die unterschiedlichen Krisen teils sogar widersprüchliche Anforderungen an das System Stadt stellen.

Die Lösung kann daher nur sein, Maßnahmen und Strategien zu forcieren, die sich in möglichst vielen (Problem-)Situationen bewähren und in hohem Maße robust sind. In der akuten Bewältigung der Pandemie konnte beobachtet werden, dass in unsicheren Zeiten die Priorität langfristiger Entwicklungskonzepte in den Hintergrund rückt, während die Dringlichkeit anderer Maßnahmen steigt**. Doch darf dabei nicht aus dem Blickfeld verloren gehen, dass langfristige Strategien die Voraussetzung für wohlgesetzte kurzfristige Maßnahmen sind.**[4]

3 HANDLUNGSFÄHIGKEIT DER STADTPLANUNG UND IHRE LANGFRISTIGE UND VORAUSSCHAUENDE RAUMENTWICKLUNG

3.1 Neue Dynamik in der Mobilität durch Covid-19

Am Beispiel des Mobilitätssektors lassen sich viele Beobachtungen zu Covid-19 exemplarisch beschreiben. Einerseits ist die Mobilitätsplanung auf langfristige Entwicklungen ausgelegt und hat weitereichenden Einfluss in alle Bereiche des öffentlichen Lebens. Andererseits war es gerade der Mobilitätssektor in dem vielerorts taktische Adhoc-Maßnahmen gesetzt wurden, wie die Sperrung von Straßen für den MIV, der Einsatz von sogenannten Pop-Up-Radwegen oder auch Änderungen in den Taktungen des ÖVs.

Mobilität ist eines der Themen, die schon vor dem Ausbruch der Pandemie viele Städte vor große Herausforderungen gestellt haben. Aktuell wird dieser Sektor immer stärker als Querschnittsmaterie um die Verteilung von Freiräumen in der Stadt und der Klimakrise diskutiert. Die Mobilität als solche durchlief auf Grund von Ausgangsbeschränkungen, Hygienevorschriften und einer allgemeinen Reduktion von Wegen viele temporäre Veränderungen. Um die Auswirkungen der Gesundheitsgefährdungen und pandemische Ausbreitung Covid-19 einzufangen wurde gerade in der Mobilität eine Reihe an Adhoc-Maßnahmen gesetzt. Hierdurch wurde vielerorts Fragen zum Überarbeitungsbedarf langfristiger Strategien der Stadt- und Mobilitätsplanung erhoben.

Die Stadt Wien setzen sehr stark auf einen attraktiven öffentlichen Nahverkehr. Maßnahmen wie eine Jahreskarte für 365 Euro oder kontinuierliche Investitionen in den Ausbau des U-Bahnnetzes werden von den Bewohnerinnen und Bewohnern Wiens sehr gut angenommen, wie stetig steigende Nutzerinnen- und Nutzerzahlen zeigen. Allein im Jahr 2019 wurden im Vergleich zum Vorjahr 30.000 zusätzliche Jahreskarten verkauft.[5] Während des Pandemie-Beobachtungszeitraums konnte allerdings eine 80%-ige Verringerung des

[1] Innes & Booher, 2018
[2] The Guardian, 2020
[3] United Nations, Department of Economic and Social Affairs, 2020 und Nicola et al., 2020
[4] Carsten, 2005
[5] Wiener Linien, 2020

Fahrgastaufkommens im ÖV festgestellt werden.[6] Diese Situation war mit der in anderen europäischen Städten vergleichbar.[7] Der Rückgang war mitunter dem Umstand geschuldet, dass es so gut wie unmöglich ist, im urbanen öffentlichen Verkehr die empfohlenen Abstandsregeln einzuhalten. Deswegen wurden öffentliche Verkehrsmittel von vielen Verkehrsteilnehmerinnen und Verkehrsteilnehmern vorübergehend gemieden. Hohe Fahrgastdichten in vollen Zügen der U-Bahn zu den Spitzenzeiten sind in der urbanen und kompakten Großstadt nicht zu vermeiden. In der Tat sind sie Ausdruck eines gut funktionierenden Verkehrssystems und unterstreichen die erfolgreichen Bemühungen Wiens im Bereich des öffentlichen Verkehrs.

Neben akuter Ansteckungsgefahr war auch die deutliche Reduktion der Anzahl der Wege aufgrund der Ausgangsbeschränkungen und des Anstiegs an Homeoffice Grund für den Rückgang der Fahrgastzahlen. Statt einer morgendlichen und abendlichen Stoßzeit, kam es zu einer Entzerrung der Spitzenzeiten im ÖV. Aus dieser Beobachtung während der Pandemie lassen sich neue Überlegungen für das gesamte ÖV-System ziehen, das derzeit auf wenige Spitzenstunden am Tag ausgelegt ist. Der morgendliche Schülerinnen-, Schüler-, Berufspendlerinnen- und Berufspendlerverkehr bestimmt die Kapazitäten der „Transportgefäße" U-Bahn-Züge, Straßenbahnen und Busse und somit deren ganztägigen Einsatz. Covid-19 hat allerdings Ansätze aufgezeigt, wie die Auslastung in der Spitzenstunde neben dem bisherigen Ausbau des ÖV-Angebots wie dichtere Intervalle und neue Linien, auch durch externe Maßnahmen sehr stark beeinflusst und entzerrt werden kann. Ein Abbau der Spitzenbelastungen im ÖV in bereits dicht getakteten Bereichen hätte einen ökonomisch deutlich effizienteren Betrieb und starke Kosteneinsparungen für die öffentliche Hand zur Folge. Dabei sollte allerdings immer eine Abwägung erfolgen, um bereits erreichte Qualitäten nicht zu unterschreiten.

Die Smart City Wien Rahmenstrategie 2019-2050 (kurz: SCWR), als Wiens Strategie für eine nachhaltige Entwicklung, zählt den ÖV zum „erweiterten Umweltverbund".[8] Als Zielvorgabe nennt die Smart City Wien Rahmenstrategie 2019-2050 einen Anteil von 85% der zurückgelegten Wege im erweiterten Umweltverbund bis zum Jahr 2030.[9] In der längerfristigen Verlagerung des Modal Splits ergibt sich nicht nur für die Stadt Wien eine anhaltende Herausforderung, die durch die fortschreitende Klimakrise an Dringlichkeit zunimmt. Den Ausbau des ÖV, auf Grund eines kurzfristigen Fahrgastrückgangs einzudämmen, wäre langfristig sehr kontraproduktiv. Der kontinuierliche Ausbau des umweltfreundlichen Nahverkehrs ist nämlich ein entscheidender Faktor in der Transformation der Städte hin zu einer klimaresilienten Zukunft. Gleichzeitig setzten die Strategien der Stadt Wien auch auf ein robustes System Stadt, das neben dem bereits sehr gut ausgebauten ÖV stetig an einer Verbesserung der Fuß- und Radinfrastruktur arbeitet, mit der auch Neugestaltungen des Straßenraums, der lange primär für die Ansprüche des Autoverkehrs gestaltet war, einhergeht.[10]

Diese langfristige Strategie erhielt durch Covid-19 in zweierlei Richtungen eine neue Dynamik. Einerseits wurde zwischenzeitlich ein Umstieg auf die verstärkte Nutzung des privaten Autos in der Stadt befürchtet, wodurch ein individuelles Schutzbedürfnis scheinbar befriedigt werden könnte. Der niedrige Benzinpreis, der eine hohe Bedeutung für die individuelle Attraktivität des Autos hat, verstärkte diese Entwicklung. Zusätzlich wurden Maßnahmen wie die kurzzeitige Aufhebung der Kurzparkzonen in Wien gesetzt, diese sind allerdings hinsichtlich der langfristigen Ziele der Stadt sehr kontraproduktiv und wurden nach wenigen Wochen revidiert.[11,12] Wichtige Bemühungen im Bereich des Klimaschutzes oder auch der Verbesserungen der Gesundheit der Menschen in Wien würden durch ein Wachstum des MIV sogar stark gefährdet.

Allerdings konnte für Wien vor allem eine sehr starke Zunahme des Fahrradverkehrs festgestellt werden. Die Zählstellen wiesen im April ein durchschnittliches Plus von über 20% im Vergleich zum Vorjahr auf, das auch in den Folgemonaten anhielt.[13] Covid-19 verstärkt in diesem Zuge eine Dynamik, die in den

[6] Stadt Wien, 2020a
[7] TU Wien, 2020 und Agenzia Roma Servizi Per La Mobilità Srl, 2020
[8] *Zum „erweiterten Umweltverbund" gehören neben Gehen, Radfahren und dem öffentlichen Verkehr zusätzlich auch Sharing- und Pooling-Angebote, wie z. B. Car-Sharing und Fahrgemeinschaften.*
[9] Stadt Wien, 2019: 65
[10] Stadt Wien, 2019: 38
[11] Orf.at, 2020a
[12] Orf.at, 2020b
[13] VCÖ, 2020

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Großstädten Europas – besonders in jenen mit hoher Luftverschmutzung – seit einigen Jahren beobachtet werden kann und durch städtische Strategien aktiv unterstützt wird. Kurzfristige Maßnahmen wie die Errichtung von vier temporären Radwegen (sog. Pop-Up-Radwegen) in Wien trugen dem steigenden Anteil an Fahrradfahrerinnen und Fahrradfahrer im Verkehr Rechnung und förderten temporär die Verkehrssicherheit der Radlerinnen und Radler in der Stadt.[14] In der Folge bleibt abzuwarten, ob sich ephemere Projekte wie temporäre Radstreifen, nun, da sie einmal umgesetzt sind, eher werden verstetigen können und so einen Beitrag zur Veränderung des Modal Splits zugunsten aktiver Mobilitätsformen leisten, oder ob die Ankündigung der Überwindung der Krise auch das Ende dieser taktischen Anpassungsmaßnahmen im Verkehrssektor bedeutet. Festgehalten kann zumindest, dass Covid-19 dem Mobilitätssektor neue Erkenntnisse beschert hat, die in die Umsetzung der langfristigen Strategie einfließen können.

Beispiele wie sog. Pop-Up-Radwege unterstreichen den Umstand, dass es vor allem kleinteilige Projekte zur Anpassung der Verkehrsorganisation sind, die zur Krisenbewältigung implementiert wurden. Sie sind als Teil der wohlgesetzten kurzfristigen Maßnahmen zu sehen, die nur aufgrund langfristiger Strategien ermöglicht wurden. Vor allem aber sind die Pop-Up-Radwege Ausdruck einer Adaptierbarkeit des robusten Stadtsystems, dass auf einen krisenbedingten, gestiegenen Bedarf reagieren konnte. Es bleibt abzuwarten, ob diese Dynamik andauert oder kurzlebig bleibt. Auswertungen der Technischen Universität Wien (TU Wien) unterstreichen, dass Pop-Up-Radwege sich steigender Beliebtheit erfreut haben.[15] Den Nutzerinnen und Nutzern aktiver Mobilitätsformen werden sie sicherlich positiv in Erinnerung bleiben. Gesamtstädtisch können sie helfen langfristig die Effekte einer notwendigen Verkehrswende sichtbar und erlebbar zu machen. Auf jeden Fall unterstützen sie im Sinne einer „Psychologie der Pop-up-Stadt“ positive Erfahrbarkeit von Veränderungen.[16]

3.2 Dicht und gemischt

Zeitgleich erlitt ein strategisch erwünschtes Merkmal der Stadt – die hohe bauliche Dichte – eine negative Konnotation: Wer während der Ausgangsbeschränkungen die mitunter kleinen und voll ausgelastete Wohnung verlassen wollte um frische Luft zu schnappen, war angehalten, dies auf unmittelbarem Wege und zeitlich begrenzt zu tun. Doch Grün- und Freiräume sind im Stadtgebiet nicht überall solchermaßen verteilt, wie sie benötigt werden. Hierdurch erhielt die Diskussion über die qualitätsvolle Dichte in der Stadt frischen Wind.[17,18] Allerdings zeigen bestehende Strategien, Fachkonzepte und temporäre Maßnahmen Wiens, wie bspw. die Aktion „Mehr Raum zum Rausgehen“ (temporäre Begegnungszonen) mittlerweile bereits die schockfeste Handlungsfähigkeit und das große Potenzial zur Veränderung in Städten wie Wien.[19,20]

Zu Beginn der Pandemie wurde vermutet, dass eine hohe Dichte an Einwohnerinnen und Einwohnern die schnelle Verbreitung des Virus befördern würde. Diese Befürchtung bewahrheitete sich aus einer Vielzahl von Gründen nicht. Nicht zuletzt weil Städte mit höherer Bebauungs- und Bevölkerungsdichte einen hohen Grad an Handlungsfähigkeit erlauben. Sie sorgen für ein dichtes Netz an Einrichtungen der Daseinsvorsorge und des Gesundheitssystems und ermöglichen im Sinne des Grundsatzes „Stadt der kurzen Wege“ einen raschen Zugang zu Gütern und Dienstleistungen des täglichen Bedarfs wie beispielsweise der Hauszustellung von Lebensmitteln.[21,22] Dass Dichte die Verbreitung des Virus nicht zwangsläufig begünstigt hat, ist kein wienspezifisches Phänomen, sondern lässt sich auch am Beispiel anderer Metropolen weltweit belegen. Eine hohe Bebauungs- und Bevölkerungsdichte ist Basis für belebte Stadtteile, hochrangige ÖV-Infrastruktur, urbane Zentren und die Versorgung mit zentralen Einrichtungen sowie Gütern und Dienstleistungen des täglichen Bedarfs.[23] Die hohe Bevölkerungs- und Bebauungsdichte ist somit für ein urbanes Umfeld und die damit verbundenen Qualitäten entscheidend.

[14] Stadt Wien, 2020b
[15] Kurier, 2020
[16] Futurezone.at, 2020
[17] Faz.net, 2020
[18] New York Times, 2020
[19] Stadt Wien, 2020c
[20] Stadt Wien, 2020d
[21] Harvard Political Review, 2020
[22] New York Times, 2020
[23] Stadt Wien, 2020f

Im europäischen Vergleich weist Wien eine sehr dichte Siedlungsstruktur auf. Mehr als 4.500 Menschen leben im Durchschnitt pro Quadratkilometer. Dies macht Wien zu einem effizienten, ökologischen Siedlungsgebiet mit vielen Zentren städtischen Lebens.[24]

Ein genauerer Blick auf einzelne Quartiere zeigt allerdings, dass die durchschnittliche Dichte allein kein geeigneter Indikator für die allgemeine Bewertung ist. Die Einordnung von Dichte während der Pandemie muss in Abhängigkeit von öffentlich zugänglichen Frei- und Grünräumen erfolgen. Denn beispielsweise die Bevölkerungsdichte des 15. Wiener Gemeindebezirks misst mehr als 20.000 EW/km² und damit viermal so viele Menschen, wie der Durchschnitt von ganz Wien angibt.[25] Gleichzeitig sind es auch eben diese sehr dichtbesiedelten Bezirke, die über wenig private Freiflächen, wie einen eigenen Garten oder einen Balkon verfügen. Insgesamt 39% der Menschen in Wien haben gar keinen Zugang zu privaten Freiflächen.[26]

Dies verdeutlicht die Umsetzungsdringlichkeit bestehender Zielvorstellungen der Stadt Wien. So sind zwar in Summe mehr als 50% der Flächen in Wien den Grünflächen zuzurechnen, jedoch sind diese nicht gleichmäßig im Stadtgebiet verteilt. Das Fachkonzept Grün- und Freiraum der Stadt Wien greift diesen Umstand auf und erklärt eine Grünraumgerechtigkeit in Wien zum Ziel.[27] Die Bedeutung dieser strategischen Zielsetzung wurde durch die Covid-19-Situation enorm gestärkt.

Neben der Verteilung von Grün- und Freiflächen führte Covid-19 auch in weiteren strategischen Ansätzen zu einem Bedeutungszuwachs. Denn mit der aktuellen Verteilung des öffentlichen Raums war das Einhalten von Abstandsregeln oder auch Ausweichen auf Geh- und Radwegen nicht immer möglich. Dies unterstrich die Sinnhaftigkeit neuerer planerischer Ansätze, die beispielsweise die Breite von Gehsteigen in den Mittelpunkt stellen und für eine Neuaufteilung der Verkehrsflächen in der Bestandsstadt und für breite Gehwege in Entwicklungsgebieten eintritt.

Auch zeigt sich hinsichtlich der veränderten Anforderungen an öffentliche Räume bzw. Straßenräume durch Covid-19 sowie bezüglich des Umgangs mit dem Klimawandels ein Zielkonflikt auf. Derzeit werden Straßenquerschnitte in Stadtentwicklungsgebieten tendenziell großzügig geplant, jedoch wird im Hinblick auf den Klimawandel insbesondere am Beispiel des Wiener Stadtentwicklungsgebiets Seestadt Aspern gefordert, dass die Straßenquerschnitte zukünftig wieder schmäler gestaltet werden sollen, um mehr Belebtheit sowie durch entsprechende Bebauung und Begrünung mehr Schatten zu erzeugen.[28] Dem gegenüber steht der aktuelle Bedarf an Ausweichflächen auf Gehsteigen durch Covid-19, welche im Falle von schmäleren Straßenquerschnitten deutlich geringer ausfallen würden, weshalb großzügig angelegte öffentliche Räume und damit auch mögliche Ausweichflächen an Bedeutung gewonnen haben. Generell ist daher davon auszugehen, dass in Zukunft die Planung von entsprechend flexibel und weitläufig ausgestalteten öffentlichen Räumen, um diese bei Bedarf adaptieren zu können und damit Adhoc-Maßnahmen bzw. mehr Rücksichtnahme zwischen Passantinnen und Passanten zu ermöglichen, an Priorität gewinnen.

Covid-19 muss nicht eine Abkehr von Qualitäten urbaner Dichte einläuten – noch immer wird ein Großteil des öffentlichen Raums im dicht bebauten Siedlungsgebiet monofunktional genutzt und steht primär dem MIV als Parkfläche oder Verkehrsraum zur Verfügung. In der Debatte um die Verteilung öffentlicher Räume entstand durch Covid-19 weltweit eine bis dato ungeahnte Dynamik, die die Richtung bestehender strategische Ansätze Wiens bekräftigen. Der Ruf nach öffentlichen Räumen zum Spazierengehen und Verweilen ließ sich auch in Wien stark vernehmen. Krisenmomente wie Covid-19 unterstreichen bestehende strategische Ansätze Wiens, öffentliche Räume flexibler zu gestalten und von monofunktionellen Nutzungsideen der Moderne Abstand zu nehmen. Diese Strategien gestatten Wien räumliche Potentiale, um den Bedürfnissen aller Menschen in der Stadt gerecht zu werden. Adhoc-Maßnahmen wie temporäre Begegnungszonen haben das Potential von Freiflächen in der dichten Stadt offengelegt.

[24] Häberlin, 2019
[25] Stadt Wien, 2020e
[26] In folgenden Wiener Bezirken haben mehr als 50 Prozent der Bewohner und Bewohnerinnen keine privaten Freiflächen (Balkon/Loggia/Terrasse oder privater Garten): 1.-9. Bezirk (ausgenommen 7. Bezirk), 15., 18. und 20. Bezirk. In den Bezirken 7, 16 und 17 liegt dieser Anteil zwischen 40 und 50 Prozent.
[27] Stadt Wien, 2015: 15
[28] Gehl, 2018: 6ff

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Die bestehende Strategie und Planung Wiens ermöglichten teilweise rasche Reaktionen und Anpassungen, von denen sich ein Erkenntnisgewinn für zukünftige Projekte versprechen lässt. Bereits der Wiener Stadtentwicklungsplan 2025 (kurz: STEP 2025) gibt die Leitinitiative vor, dass innerhalb von ca. 250 Metern alle Menschen in Wien von ihrer Wohnung aus den nächstgelegenen Abschnitt des Freiraumnetzes erreichen können.[29] Mit der Öffnung und Einrichtung temporärer Begegnungszonen in Wien konnte der potentiell zur Verfügung stehende Raum zum Zufußgehen und Verweilen auch in dichtbesiedelten und bebauten Stadtteilen sprunghaft gesteigert werden.

Die Erfahrungen des Beobachtungszeitraums haben erneut bestätigt, dass derlei Maßnahmen planerisch moderiert werden müssen und mit einer (temporären) Gestaltungsänderung öffentlicher Räume einhergehen müssen, um die neuen Nutzungsmöglichkeiten zum Ausdruck zu bringen. Auch in Zukunft wird es wichtig sein, derlei Maßnahmen gestalterisch zu begleiten, um die Nutzungsmöglichkeiten und die Intention der Maßnahme sichtbar und erlebbar zu machen.

Lernen können derlei Adhoc-Maßnahmen von langfristig geplanten Projekten, wie beispielsweise die „Coolen Straßen“. Sie zeigen das Potential kleinteiliger Veränderungen auf, wenn diese mit einer nichtbaulichen, gestalterischen Veränderung des öffentlichen Raums begleitet wird. Solcherlei Maßnahmen mit Verstetigungsansatz wie die „Coolen Straßen“ schaffen in mehrfacher Hinsicht langfristig eine Verbesserung. Sie kreieren Orte zum Aufhalten im Freien, zum Spielen und Abkühlen in der Nachbarschaft. Sie sorgen für zusätzliche Sitzgelegenheiten und nutzen dafür den vorhandenen Raum durch ein Fahr-, Halte- und Parkverbot für Autos. Flankiert werden derlei kurzfristige und verstetigende Maßnahmen von langfristigen Forschungsprojekten der Wiener Stadtplanung zum Thema Placemaking, Tactical Urbanism oder auch Superblocks.

3.3 Schock und Krise – Doppelte Wirtschaftsförderung?

Neben den teils dramatischen gesundheitlichen Folgen für die von der Krankheit Betroffenen, sind bereits auch weitreichende Krisentendenzen für die Wirtschaft erkennbar. Diese ziehen budgetäre Änderungen nach sich, deren Folgen noch lange spürbar sein werden. Der Ausnahmezustand und die damit einhergehenden benötigten Wirtschaftsförderungen stellen eine Chance dar, den notwendigen und herausfordernden Systemwandel strategisch zu gestalten. Andernfalls droht ein doppelter Investitionszwang. Denn die Konfrontation mit den Auswirkungen des Klimawandels ist unausweichlich. Aus diesem Grunde sollten Investitionen immer eine klimarelevante Komponente haben. Diese Forderung ist fester Bestandteil der Wiener Stadtplanung und erfährt Unterstützung beispielsweise durch das Österreichische Institut für Wirtschaftsforschung (WIFO).[30,31]

Die Einschnitte, die durch Covid-19 ausgelöst wurden, können eine wirtschaftliche Krise nach sich ziehen mit verheerenden sozialen Folgen. Neben einem Anstieg der Arbeitslosigkeit und finanziellen Problemen, die den Zugang zum öffentlichen, kulturellen und sozialen Leben erschweren können, manifestieren sich die Auswirkungen in der Auslastung und Nutzung der Erdgeschoßzonen und damit in der durchmischten, polyzentrischen Stadtstruktur. Schon jetzt sind Vorzeichen negativer wirtschaftlicher Folgen im Stadtbild zu beobachten, wenn beispielsweise Türen von Ladenlokalen in Erdgeschoßzonen auch nach den Lockerungen geschlossen bleiben. Es ist alarmierend, wenn in einer Umfrage vom April 2020, auf die sich auch die Wirtschaftskammer Österreich (WKO) bezieht, unter Wiener EPUs, Kleinstunternehmerinnen und Kleinstunternehmern und sogenannten „neuen Selbständigen“ 26% der Befragten angeben, ihre angemieteten Gewerbeflächen bereits gekündigt zu haben bzw. planen, diese in Kürze zu kündigen.[32] Ende Mai bis Anfang Juni 2020 hat sich dieser Trend bereits verstärkt, sodass nur noch 72% der Umfrageteilnehmerinnen und Umfrageteilnehmer beabsichtigen ihre Gewerbeflächen weiter zu nutzen (10% haben bereits gekündigt, 18% ziehen eine Kündigung in Erwägung).[33] Eine wohnortnahe Versorgung mit Gütern, Dienstleistungen und sozialen Einrichtungen (wie bspw. Gesundheitseinrichtungen)[34], ist für eine gut funktionierende Stadt nicht nur in Zeiten eingeschränkter Mobilitätsmöglichkeiten entscheidend. Die

[29] Stadt Wien, 2014: 118
[30] Stadt Wien, 2019
[31] WIFO, 2020
[32] ImGraetzel.at, 2020a
[33] ImGraetzel.at , 2020b
[34] Faz.net, 2020

Grundsätze der Stadt der kurzen Wege sowie der wohnortnahen Versorgung mit Gütern und Dienstleistungen sind seit langem in der Wiener Planungskultur verankert und wurde jüngst im Rahmen des Fachkonzepts „Mittelpunkte des städtischen Lebens – Polyzentrales Wien“ deutlich gestärkt. Das Fachkonzept zeigt wie sich die Zentrenstruktur Wiens in Zukunft weiterentwickeln soll.[35]

Ganz im Einklang damit wurde durch Covid-19 eine verstärkte Aufmerksamkeit auf die Alltagsökonomie (Daseinsvorsorge und Nahversorgung) gerichtet. Die Alltagsökonomie stellt das alltägliche gesellschaftliche Zusammenleben sicher, da diese wirtschaftlichen Aktivitäten auch in Zeiten von Covid-19 benötigt werden.[36] Mit diesem Ansatz wird unter anderem der Fokus auf die lokale Ökonomie gelegt, welche durch ihre wohnortnahe Situierung besonders krisenrelevant erscheint. Zudem hat sich gezeigt, dass neben den alltäglich benötigten Dienstleistungen und Gütern zusätzliche ökonomische Aktivitäten benötigt werden, die zum urbanen Leben beitragen (z.B. soziale Treffpunkte).[37] In diesem Sinne trägt die Alltagsökonomie auch zu lebendigen Grätzeln sowie der Versorgungsinfrastruktur bei und ist somit im Hinblick auf die Robustheit der Stadt gegenüber sich verändernden Rahmenbedingungen zu stärken.

Nicht zuletzt im Bereich der Stadtentwicklung und Stadtplanung selbst können sich die Folgen der durch Covid-19 ausgelösten Wirtschaftskrise und damit verbundenen budgetären Anpassungen auswirken. Um weiterhin eine nachhaltige räumliche Entwicklung Wiens zu gewährleisten und qualitätsvolle Projekte in Stadtentwicklungsgebieten, aber auch der Bestandsstadt realisieren zu können, ist sicherzustellen, dass die Qualitätskriterien sowie die Planungsgrundsätze weiterentwickelt und umgesetzt werden. Darüber hinaus kann Stadtentwicklung mit den gezielten Projekten einerseits die Wirtschaft unterstützen (z.B. Neugestaltung des öffentlichen Raums) und andererseits werden im Rahmen von großmaßstäblichen Stadtentwicklungsprojekten von öffentlicher als auch privater Hand Investitionen getätigt, welche sich ebenfalls wirtschaftlich positiv auswirken.

Bund und Länder haben in Österreich zeitnah mit weitreichenden finanziellen Maßnahmen reagiert. Sowohl von Seiten des Landes Wien als auch des Bundes wurden mit Beginn der Covid-19-Krise Konjunkturpakete verabschiedet, Rettungsschirme gespannt und Soforthilfen versprochen. Staatliche Wirtschaftshilfen können nicht nur dringend benötigte Auffangmaßnahmen leisten, sondern auch langfristige Effekte aufweisen. Daher ist es weitsichtig und sinnvoll, die Finanzhilfen mit vereinbarten Zielen Wiens zur Bekämpfung der globalen Klimakrise in Einklang zu bringen. Katastrophal wäre es, wenn durch Covid-19 die Bekämpfung der Klimakrise ignoriert, missachtet, oder sogar untergraben würde. So ist mit Nachdruck darauf zu achten, dass jede wirtschaftliche Investition neben den sozialen Auffangmaßnahmen auch klimarelevante Impulse setzt. Bemühungen der Smart City Wien als Wiener Strategie für eine nachhaltige Entwicklung dürfen nicht in den Hintergrund rücken. Stattdessen sollte die derzeitige Situation und die freigegebene Wirtschaftsförderung genutzt werden, um die Ziele des Pariser Klimaabkommens und der UN-SDGs zu erreichen.

Unterstützung erhält diese Forderung unter anderem vom österreichischen Institut für Wirtschaftsförderung (WIFO). Dieses hat vier Empfehlungen verfasst, die sich auch an Wien wenden und die Strategie der SCWR bekräftigen. So empfiehlt das WIFO, dass Soforthilfsmaßnahmen dem Klimaschutz zumindest nicht zuwiderlaufen und dass eine Entwicklung in Richtung kohlenstofffreier Wirtschaft und Gesellschaft durch Konjunkturpakete begünstigt wird. Diese sollen weiters die Innovationskraft der heimischen Unternehmen stärken und eine Verringerung der Verwundbarkeit der Wirtschaft durch die Abhängigkeit von globalen Supply-Chains ebnen. Darüber hinaus erachtet das WIFO es als bedeutend, dass die Ökologisierung des Wirtschaftssystems vorangetrieben und an die geplanten Konjunkturpakete gekoppelt wird.[38]

Der Wiener Kontext bietet eine Reihe an Möglichkeiten in dieser Richtung. So zeigte die Wiener Vizebürgermeisterin und Stadträtin für Stadtentwicklung, Verkehr, Klimaschutz und Energieplanung unlängst Ansätze zur Verschneidung nachhaltiger städtischer Strukturen im Energiesektor und Arbeitsplätze auf: „Auf 60 Prozent der Dachflächen Wiens können wir Solar bzw. Photovoltaik installieren, das führt zu Aufträgen und nachhaltigen Arbeitsplätzen. Wir wissen, wenn man in Infrastruktur für den öffentlichen Verkehr investiert, schafft man um zwei Drittel mehr Arbeitsplätze als bei Autobahnen.“[39] Mit der

[35] Stadt Wien, 2020f
[36] Wiener Zeitung, 2020
[37] Stadt Wien, 2020f: 18
[38] WIFO, 2020
[39] News.at, 2020

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anstehenden Bauordnungsnovelle wurden bereits wichtige Schritte für mehr Klimaschutz bei Neubauvorhaben gesetzt. Verpflichtende Solaranlagen für Wohn-, Bildungs- und Gewerbegebäude stärken die Nutzung erneuerbarer Energien. Hierdurch kann das Solarpotential Wiens um ein vielfaches besser ausgenutzt werden.[40] Doch nicht nur bei Neuinvestitionen können nachhaltige Impulse gesetzt werden, die entscheidend sein werden, um neben den sozialen Aspekten des Covid-19-Schocks Auswirkungen der Klimakrise abzufedern. Auch in konventionellen Branchen bestehen Chancen für einen erforderlichen Strukturwandel, die in Folge der Konjunkturpakete nicht vernachlässigt werden sollten.

Die Stadt Wien hat den Weg der Ökologisierung des Wirtschaftssystems in seiner SCWR bereits vor Ausbruch der Pandemie verankert.[41] Eine Ausrichtung auf Kreislaufwirtschaft bspw. zielt mitunter darauf ab, dass Materialverbrauch in der Stadt und damit verbundenen Treibhausgasemissionen drastisch reduziert werden. Sie gilt als wichtiges Werkzeug zur Umsetzung der UN Agenda 2030 für nachhaltige Entwicklung (SDGs). Mit dem Kreislaufwirtschaftspaket 2015 wurde die Transformation auch von Seiten der EU politisch und gesetzlich angestoßen.[42]

Wirtschaftliche Förderungen sollten sich an diesem Prinzip orientieren und es unterstützen. In Anbetracht drohender Ressourcenknappheit ist eine Abkehr von der bisherigen linearen Wirtschaftsweise des „Entnehmens – Herstellens – Nutzens – Wegwerfens“ dringend geboten. Die aktuelle Situation und die damit einhergehenden benötigten Wirtschaftsförderungen stellen eine Chance dar, den herausfordernden Systemwandel strategisch zu gestalten. Denn eine Konfrontation mit den Auswirkungen des Klimawandels ist unausweichlich. Dementsprechend sollten Investitionen, nicht nur in der derzeitigen Situation, immer eine klimarelevante Komponente haben. Wenn in Wirtschaft investiert wird, muss dies im Sinne der Klimaziele sein – sonst muss doppelt investieren werden.

4 CONCLUSIO NOTFÄLLE, KATASTROPHEN, EPIDEMIEN – DIE ROLLE DER STADTPLANUNG

Ein Blick auf die Zusammenhänge und Querschnittsmaterien beweist, dass die Stadt Wien in vielen Bereichen auf stabile Entwicklungsstrategien zurückgreifen kann, um kurzfristige Maßnahmen zu setzen, die auch langfristige Wirkung entfalten können. Sie müssen nur in scheinbaren Krisenzeiten nicht unter den Tisch fallen, sondern auch aktiv weiterverfolgt werden. Selbstverständlich müssen Aktivitäten an neue Gegebenheiten angepasst werden. Dabei muss jedoch sorgfältig abgewogen und eingeordnet werden, wobei es sich um vielleicht nur temporäre Impulse handelt und was bleibende Wirkungen sein können. Festzuhalten ist, dass während des Beobachtungszeitraums die bestehenden Strategien nicht ernsthaft in Frage gestellt wurden und sich weiterhin auf der langfristigen Agenda der Stadt Wien mit dem Zeithorizont 2030 und 2050 befinden.

Die durch Corona aufgezeigten Schwachstellen wurden von der Planung bereits im Vorfeld als Herausforderungen erkannt und benannt. In der Zuspitzung der Ereignisse und der akuten Krise wurde ihre Bedeutung bekräftigt. Die Gegenüberstellung von langfristigen Strategien und Adhoc-Maßnahmen stellt für die weitere stadtplanerische Arbeit die Frage in den Raum, wie das Lernen von Krisen institutionalisiert werden kann. Denn für die Stadtplanung und Stadtentwicklung sind zwei aufgezeigte Stoßrichtungen für einen längerfristigen Lernprozess entscheidend: Erstens, das Lernen von Adhoc-Maßnahmen für langfristige Strategien und zweitens, die Bedeutung von langfristigen Strategien als Voraussetzung für Adhoc-Maßnahmen. Dabei muss es Credo sein, dass wenn die Planung kurzfristig agieren muss, sie nicht von ihren langfristigen Zielen abweichen sollte.

Zwar zeigte sich im Beobachtungszeitraum, dass Wiens Zielsetzungen für die Zukunft auch in Zeiten der permanenten Veränderungen Bestand haben und dass die langfristigen Strategien der Stadt Wien sich als relativ beständig in der Krise erwiesen haben. Nichtsdestotrotz bedarf es gleichzeitig einer kontinuierlichen Auseinandersetzung mit den Strategien und Leitlinien, um sie adaptieren zu können, so dass sie langfristig zu einer robusten Stadt beitragen können.

Die Wiener Stadtplanung und Stadtentwicklung arbeitet kontinuierlich an einem Ausbau von robusten Stadtstrukturen und -systemen. Es zeigt sich aber auch, dass in der Krise mitunter Adhoc-Maßnahmen

[40] Wien.gv.at, 2020
[41] Stadt Wien, 2019: 85
[42] Europäische Kommission, o.J.

gesetzt werden müssen, um auf Extremsituationen reagieren zu können. Für die Stadtplanung ist dies ein eher ungewöhnlicher Umstand. Die Planungsdisziplin orientiert sich zumal normalerweise an einem langfristigen Planungshorizont und in der Zukunft gesetzten Umsetzungsmaßnahmen. Daher stellt sich die Frage was es für eine Disziplin mit langfristigen Planungshorizonten bedeutet, wenn es zu einer dichteren Taktung von Veränderungen kommt.

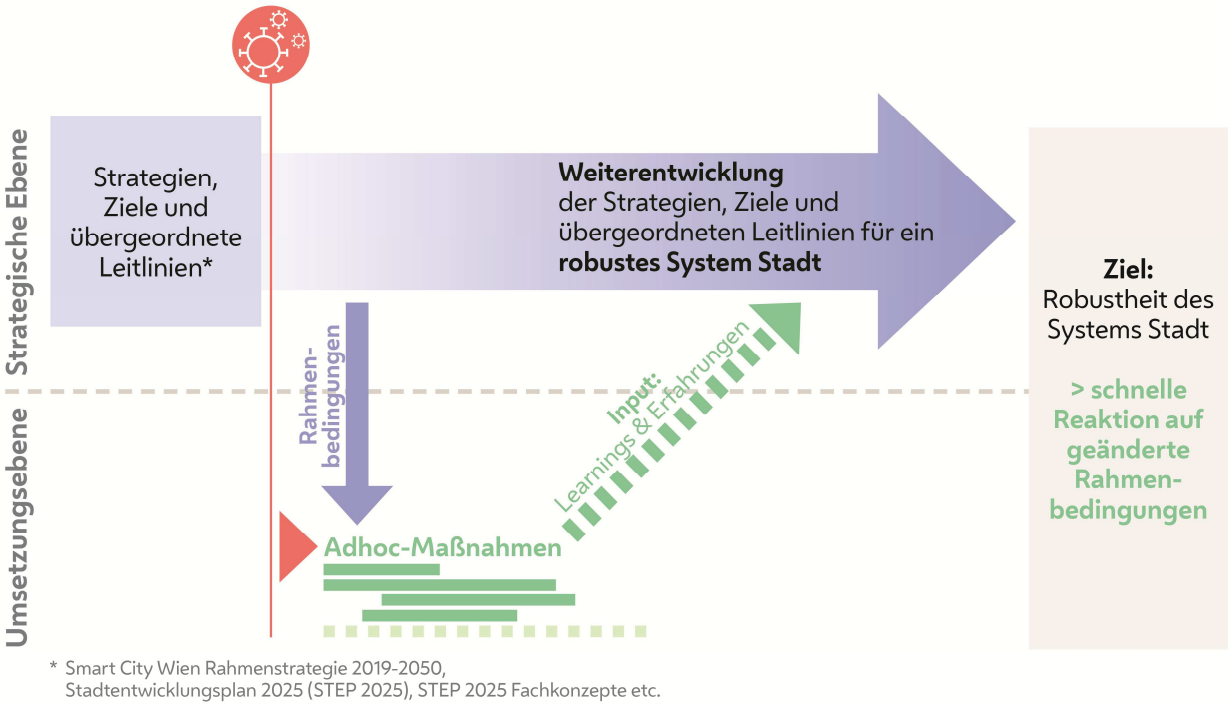

Abbildung 1: Schematische Darstellung des Effekts von Covid-19 auf die strategische Ebene der Stadtplanung und -entwicklung sowie des Umgangs mit Adhoc-Maßnahmen (eigene Darstellung)

Durch die Häufung von Krisentendenzen ist die Stadtentwicklung angehalten sich weiter mit langfristiger Herstellung von Robustheit sowie kurzfristiger, taktischer Reaktionsgeschwindigkeit auseinanderzusetzen. Akute Problemstellungen wie Covid-19 können eine seltene Gelegenheit für die Stadtplanung darstellen auch kurzfristig Adaptionen im Bereich der Stadtentwicklung im Sinne einer „Pop-Up-Stadt“ zu erproben. Eventuell steckt in der Pop-Up-Stadt und dem taktischen Urbanismus eine gangbarer Weg für das Erproben von langfristigen Entwicklungen und Ausloten von robusten Stadtstrukturen. Denn nicht nur akute Einschnitte wie Covid-19, sondern auch langfristige Bedrohungsszenarien wie die Klimakatastrophe bis hin zur fortschreitenden Digitalisierung stellen die Planung vor immer neue und schnelllebigere Herausforderungen und Problemstellungen, auf die die Planung heute schon mit robusten Antworten reagieren soll.

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Socio-Economic Transformation of Urban Nodes in Amman: Determining Ingredients of Success

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1 ABSTRACT

Amman has experienced different types and modes of urban transformation in its neighborhoods' urban structures. Such transformations have shaped these neighborhoods on social and economic levels leading to prosperity of some and the decline of others, without knowing why and how to encourage or prevent. However, this phenomenon was ivestigated through the paper to identify the causes and consequences of these transformations. It will identify the crucial aspects resulting in such transformations and try to display an understanding of the phenomenon to enable better development and sustainable change in the future.

Three urban nodes were analyzed in this paper based on a master thesis submitted to the Department of Architecture at the German Jordanian University. The analyzed urban nodes are Jabal Al Hussein, Shmeisani and Um Uthaina. The authors mapped the trends and dynamics in these nodes along time and applied mixed method tools to reach the causes and drivers for such transformation. Main findings were resulted from the survey to determine few major undertakings in Amman. Such includes avoiding developing certain urban nodes and neglecting the adjacent ones. More attention should be paid to the quality and the quantity of the granted commercial touristic investments licenses. Expanding the system of vertical construction to achieve an optimal utilization of spaces along with avoiding random commercial distribution between residential layouts. Such findings have shown to have great weight in causing informal urban transformation.

The main output of this paper is displayed through specific strategies, guidelines and policies that govern urban nodes towards proactive planning rather than informal growth and change. The results of this study showed that economic, social and service factors played a major role in these transformations. The aspects that can curb the decline in these urban nodes and the flourish of others.

Keywords: sustainable change, development, urban nodes, neighbourhood, urban transformation

2 INTRODUCTION

"Cities are the spatial articulations of political, demographic, economic, technological and cultural developments, which take place on local, regional, national and global scales" (Sennett, 1992; Fainstein, 2001; Lefebvre, 2002; King, 2007). (Rossi, 1982), mentioned that the city comes to be a masterpiece. The city is readable through form and space but understood through time. The unity of these parts is fundamentally supplied by history, by the city's memory of itself. Moving elements in a city, the people and their activities, are as important as the stationary physical parts. The identity of the city is derived from the identity of those living in it, and vice versa. (Lynch, 1981) cited that the degree of good city performance is determined by its ability of providing biological, psychological, social and cultural requirements to its inhabitants. (Lefebvre, 1991), stated in "The Production of Space" that space may not change, but "our perceptions of it do, therefore they become finer, more intelligent, deeper, more differentiated. While space may be stable in general outlines for some time, it is ever changing in detail. Only partial control can be exercised over its growth and form. (Trancik, 1986), pointed out that "people require a relative stable system of urban spaces in which to develop themselves, their lives, and their culture".

Traditional urban theories examine how cities develop and grow through systematic interactions of infrastructures, people and economic activities. Traditional urban theories examine how cities develop and grow through these kinds of interactions, and in macro terms are based on advantages that co-location (i.e., the physical location where urban and economic activities are in close spatial proximity to one another) can offer to economies and societies (Harvey and Clark, 1965).

The growth of Amman from the 1920s to the present has been phenomenal; in terms of its population, physical extent and regional geopolitical importance. (Al-Asad, 2005), has referred to what he describes as "ever-growing Amman". What was in the early 1920s a small town of little more than 2000-3000 people is today a major regional city with a recorded population of 4 million (Department of Statistics, 2015). The phenomenal growth of the urban area in both size and significance has occurred in "drastic growth spurts that have transformed the look and feel of the city and its connections with the outside world" (Al-Asad, 2005).

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Such growth spurts have also meant that although geopolitically Amman currently stands as one of the most important cities in the modern Arab world, one of its major characteristics is that it is, for the most part, a contemporary metropolis.

The main concern of this study is to investigate what is happening in Amman regarding its urban nodes by concluding a set of factors affecting the transformation of these nodes through history. Amman is transforming in many ways, one of which is in the centers of neighbourhoods that acted well in the past, but lost interest, attraction, and other drawbacks and were replaced in the attraction by new centers and nodes that stood as priority destination from a social trend perspective. These centers indicated as urban nodes have had changing image and character along time and Amman is facing this challenge of economic drawback each decade after a new center arises and wins interest.

The need for efficient proactive recommendations, strategies, guidelines and policies that govern urban nodes is presented as a crucial aspect in this paper. Therefore, the main objectives of this paper are the identification of the dynamics of urban nodes in Amman, mapping specific case studies to conclude a set of aspects that characterized these nodes, determining the positive and negative socio-economic components in the three selected urban nodes and concluding the positive aspects for sustaining and developing them. Moreover, the paper is targeting an urban policy for neighbourhood centers as a proactive strategy to overcome this economic and social drawback and preserving the uses for the centers on the long term.

3 THEORETICAL REVIEW

3.1 Concepts and aspects of urban transformation

Urban transformation is explained by urban development and urban change by outlining urbanization processes in planning history (Roberts and Sykes, 2000), and paradigm shifts resulting from the non-existence of a single explanatory theory on the concept of urban transformation. (Alexander, 1984). Paradigm shifts, which arise from an interaction between the philosophy of science and the philosophy of planning, not only make up the concept of urban transformation but also set up different theories, practices and methods on urban transformation in consecutive paradigmatic periods. (Hillier and Healey, 2010). The organizational level of urban transformation could be considered as a basic difference resulting from urban processes shaped by the planning system and contingent spatial dynamics. (Gürler, 2009). In addition, the spatial level of urban transformation could be considered as a basic similarity because of restructuring-oriented economic development shaped by political-economic frameworks (Gürler, 2009). The shift from a modern to a liberal paradigm puts emphasis on integrated urban regeneration approaches. (UN-HABITAT, 2011).

(Hillier et al., 1993) exemplifies the natural urban transformation process theory, which accounts for built environments that are not affected by rigid planning systems, regulation plans, various trusts connected to plots, religious aspects, collective memories, historic artefacts and urban areas protected by law. The spatial configuration of the street network configuration influences the flow of movement and location of economic activities. An ‘urban transformation’ process is a process when an urban area transforms from a deserted to a vital and attractive place. Urban transformation is spatially dependent on the street network configuration containing streets with high spatial integration values on various scales aggregating high building density and a high degree of land use diversity. Likewise, the degree of density influences the degree of functional mix (Van Nes and Ye, 2014).

Traditional urban theories examine how cities develop and grow through systematic interactions of infrastructures, people and economic activities (Harvey and Clark, 1965). The Central idea is that cities are large social networks. In This sense, cities are not just large collections of people; they are agglomerations of social links. The quality attributes of buildings and urban spaces reflect long histories of social and natural events. This requires that the built environment of cities change gradually, in response to social and economic needs and that, in this sense, it remains alive (Alexander, 1977). In both physical and socio-economic terms, the ways in which urban phenomena are conceived determines the ways in which they are measured and then analyzed (Donnay et al, 2001). As Giddens says, “space is not an empty dimension along which social groupings become structured but should be considered in terms of its involvement in the constitution of systems of interaction” (Giddens, 1984). He relates space to system integration with the concept of ‘time-space distanciation and to social integration with the concept of ‘locale’ and ‘region’. In the

case of social integration where the role of space is more explicit, he uses the notion of 'locale' and 'region'. A 'locale' is the setting of any interaction, not just the environment, the space where interaction takes place, but all the features of this space that individual drawn upon in the sustaining of the communication. A locale is the means that helps the communication of meaning. So, social integration is based on the interactions in circumstances of co-presence, which takes place in 'locales' and 'regions'. (Giddens, 1979). Space is an important element for social integration and organization since the integration in this case is based on the 'face to face' relations, this means actors co-present in space. System integration, on the other hand, refers to relations that are not face to face but which presuppose these relations for the system to be created. (Giddens, 1981).

3.2 Social Urban Transformation Theories

Urban spaces as not only all buildings, objects and spaces in the urban environment, but also the people, events and relationships with them (Madanipour, 1999). In that regard, he argues that social space is a fundamental part of everyday life, and that 'our spatial behavior' is defined by the space around us therefore, defining space is an integral part of our social existence (Madanipour, 1996). For Lefebvre, the everyday is linked first with a structural element, second with elements 'structured' by determined and fragmented activities and functions associated with society and third with elements which are organized by apparatus existing on the macro scale in society. (Lefebvre, 2002). Lefebvre sees space as an important element of the everyday life because of the meaning that it carries. Space is a product of society, but is also used as an instrument to exercise power and control. Instead of space being a possession for common use, it has become an object of exchange. But to become exchangeable it should first become interchangeable, because exchange implies interchangeability "the interchangeability of a good makes that good into a commodity" (Lefebvre, 1991) and this happened by the abstraction of it of any meaning.

The right to participation maintains that citizens should play a central role in any decision that contributes to the production of urban space. Lefebvre does not clearly say that decisions that produce urban space should be made entirely by inhabitants. However, it is clear that the role inhabitant's play must be central and direct.

3.3 Economic Urban Transformation Theories

Economic development is "a process of continually improvising in a context that makes injecting improvisations into everyday life feasible"(Jacobs, 1984). Cities in this sense, whose real boundaries are economic rather than political, are settlements that consistently generate their economic growth from their own local economies. Their pools of skills, manufactures and materials, at once diverse and concentrated, provide the best conditions for the birth and growth of entrepreneurial small firms and an ever-increasing division of labor from which "new work can be added to old". (Jacobs, 1969), defines a city as "a settlement that consistently generates its economic growth from its own local economy." Also, "Cities are places where adding new work to older work proceeds vigorously. Indeed, any settlement where this happens becomes a city". (Jacobs, 1969). (Florida, 2004), argues that if cities today wish to rejuvenate themselves, they need to pursue policies that attract creative people. He is partly right. But the marvel of the living city is that it makes ordinary people extraordinary by placing them in a network in which information and opportunities, conducted by dense social ties, come at them from many and often unexpected directions.

(Jacobs, 1969) believes that capital must be used productively in financing economic trial, error and development. This is a costly process, as most innovative ventures will fail. Expensive, however, does not mean wasteful, for in the long run development work is crucial as cities must compensate for production transplanted in smaller towns and rural areas, and for exports lost because they are now being produced in former customer cities. Systematically spending money on projects that have no economic rationale only insures urban decline. (Coleman, 1990), points out that it is through "relations of trust" that complementarities among human capital can be utilized. Jacobs was one of the first to point out the nature and significance of trust and social networks in economic development and political activism, even coining the term "social capital". (Jacobs, 1961). (Putnam, 2000), defines social capital as "networks of trust and norms of reciprocity." He makes a very useful distinction between "bonding social capital" and "bridging social capital." (Ikeda, 2007), pointed out that "action space" is filled with social networks. A new business and the invention of systematic hybridization were the unintended consequence of urban life.

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For Jacobs, a better measure of the economic vitality of an economic system is the ratio of new work to total work. She replaces the norm of efficiency with the norm of new work, which in turn is measured by how much the division of labor multiplies, becomes more complex, over time. “The rules that govern the economy are actually changing” because even if the “actual things that development produces change, and even the methods by which people make the things change”, the process of development doesn’t. (Harris, 2009).

4 AMMAN URBAN GROWTH

Amman city is a multicultural city, home of Jordanians from different backgrounds as well as an immigration point for many Palestinians, Iraqis, Syrians, Egyptians and others. Amman city is thorough Arab city with a diverse vision for the future. ‘It became a sort of ‘‘lung’’ that has provided much needed breathing space for populations in the region suffering from political displacement (Palestinians since 1948, Iraqis since 1990, Syrians since 2011, and others)’, (Al Asad, 2004). So, that today, Amman ‘‘is playing an increasingly important role in the life of the region’’. (Al-Asad, 2004). In the urban context, problems arose in planning the city of Amman. The main reasons for this were the absence of standards of regulation, the reliance on personal judgment, the lack of studying the geographical distribution, agricultural lands, and others such as the absence of a comprehensive planning study of the city of Amman. After the Gulf War in 1991, the urban activity increased in the city of Amman, resulting in the emergence of new residential and urban centers and the development of the architectural movement in Jordan and in Amman in particular.

Amman today is polarized by socio-economic status and cultural perspective into obvious eastern and western within the city. Districts patterns in Amman city follows strict socio-economic lines, with wealthy neighbourhoods which show significant “western” cultural influences and lifestyle, concentrated in the western areas of the city and poor neighbourhoods that are culturally traditional conservative, in the east. There are marked differences in building structures and infrastructure between the east and the west of Amman city. In recent years, the westward expansion of Amman has occurred in parallel with a rapid inflation inland values and housing prices caused, in part, by an inflow of investment capital from the gulf and by the settlement of affluent Iraqis displaced by the two Gulf wars. The housing market in the western areas of the city functions outside of the rent controlled older central and eastern neighbourhoods and can only be accessed by the very affluent. (Abu Thiab, 2012). “At a broader level, there is a market and well-recognized differentiation between the west and the east of the city, which is best recognized when the distribution of category B residential lands is viewed”. (Potter et al., 2009).

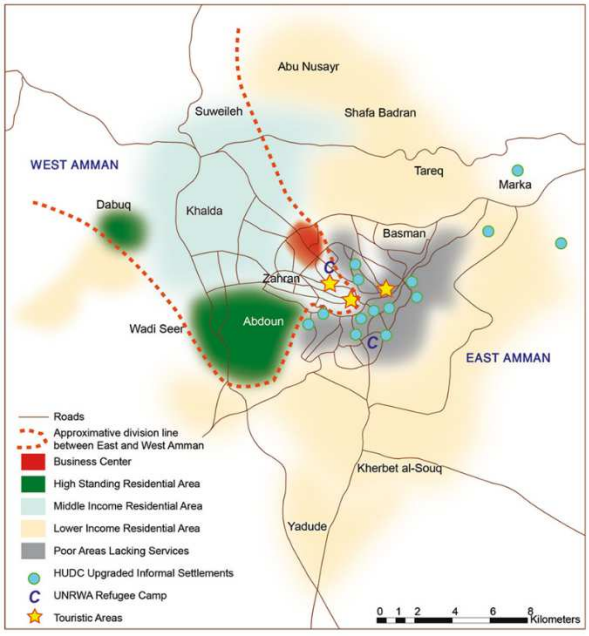

Figure 1: Synthetic Map of the Social Disparities in Amman. Source: (Ababsa, 2013)

The wealthy areas of west Amman extend in wedge-like patterns from the original affluent quarter of the central city up to cooler areas in the hills that surround the capital. (Potter et al., 2009). Wealthy neighborhoods boast excellent infrastructure, with large and luxurious apartment’s blocks, houses and villas.

Residents of west Amman constitute the country's elite comprising of Jordanians nationals, many Palestinian origin, and rich expatriates. In addition, a number of respondents highlighted that many better off Iraqis who arrived in Jordan after 2003 have taken up residence in these neighborhoods. "Most of Amman's explosive growth in the last fifty years has been concentrated in respectable and upmarket West Amman as shown in figure 1 below (Ababsa, 2013); other districts to the north, south and east are much poorer, though more populous" (Teller, 2002).

Decreased importance of the of downtown economic center within the central area of activities in the late seventies of the twentieth century has led to the emergence of a number of new centers in the residential neighbourhoods in Amman- as a reaction to the pressures of this center- such as Jabal Al Hussein and others. That led to the exodus of the financial conglomerates to it, this has contributed to the renaissance of urban development in these neighborhoods, on the architectural, planning and organizational level.

Over the past 20 years, growth in Amman, has involved a rapid outward expansion due to both urban development and a series of amalgamations. Growth is transforming Amman from its former distinct pattern of hill development to a large metropolitan body with a variety of settlements, including cities, towns and villages, located within its boundary. Amman's built-up area has absorbed former peripheral towns.

5 METHODS

A mixed method with a qualitative and a quantitative design was used to provide a better understanding of this study. Exploratory sequential mixed design methods involved the procedure of first gathering qualitative data to explore a phenomenon and then collecting quantitative data to explain the relationships found in the qualitative data (Creswell, 2014).

The sequence was qualitative data collection followed by quantitative data collection. On one hand, qualitative design used to elaborate the case study through an in-depth investigation of the socio-economic transformation of the urban nodes in Amman, which are Jabal Al-Husain, Um-Uthaina, and Shmeisani. Then, the analysis states the socio-economic situation of those mentioned urban nodes throughout the different transformation stages based on visual observation and face-to-face interviews. On the other hand, a quantitative approach was used to address constructs of research inquiry including city and space, urban nodes and urban transformations using close-ended structured questionnaire.

A snowballing sampling technique was used to select 600 interviewees who are categorized into three groups; officials from GAM, traders from Jabal Al-Hussein, Shmeisani and Um-Uthaina that are selected to conduct the face-to-face interview to highlight their opinion regarding the socio-economic status of these urban nodes through years and the various users from Jabal Al-Hussein, Shmeisani and Um-Uthaina. Those were selected to highlight their opinion regarding the socio-economic status of these urban nodes over years in addition to their needs and satisfaction about the services and facilities.

Quantitative data was collected through identifying main settings in the three neighborhoods, the Khalid bin Waleed Street in Jabal Al Hussein, Thaqafa Street in Shmeisani and Shat Al Arab Street in Um Uthaina. Main constructs and variables were further identified to do the survey. Such have constructed the questionnaire on levels of social and Cultural aspect with 22 questions, economic aspects with 16 questions and public services aspects with 11 questions.

6 DATA COLLECTION, ANALYSIS AND SYNTHESIS OF RESULTS

A comprehensive analysis to reveal insights of the three selected urban nodes: Jabal Al Hussein, Shmeisani and Um Uthaina was conducted. The investigation tackled the surrounding space, the structure, and all related required summarizing the site.

Jabal Al Hussein neighborhood as the first investigated neighborhood in its urban center is located within the Abdali area. Jabal Al Hussein grew and developed along with the growth of Amman during the years from 1946 to the present day. Jabal al-Hussein is an important residential and economic urban node consisting of number of small neighborhoods that have grown significantly on its fringes such as Jabal al-Hussein camp and Khaled Bin Al-Waleed Street that extends from Gamal Abdel Nasser, Al Dakhiliya circle to the Downtown of Amman.

In the 1980s, the products sold in Jabal Al-Hussein urban node; clothes, jewelry, shoes, antiques, etc., met the tastes and needs of the citizens and tourists in terms of quality and price. In the 1990s, Amman witnessed

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the return and flow of Jordanians and Palestinians capitals from the Gulf, in view of the fact that Jabal Al-Hussein area was characterized by economic and commercial growth and success at that time, it encouraged them to invest in the construction of real estate and buildings and in opening various different shops. This encouraged the increase in the demand for Jabal Al Hussein from citizens and tourists and became a commercial and tourist attraction. Investments in Jabal Al Hussein in that period gained prosperity compared to other areas in Amman. These mentioned factors; Investment and promotion factors, created social variables in that period. They were considered positive in terms of availability of jobs and improving the incomes of investors. Figure 2 shows the time line of prosperity and the urban transformation that caused draw back to the neighborhood.

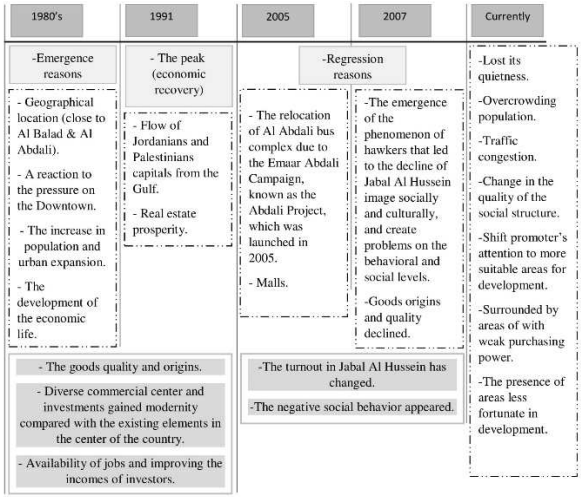

Figure 2: Jabal Al Hussein historical timeline. Source: (Researcher, 2017)

Shmeisani was the second case investigated in this paper. Shmeisani is in the western part of Amman city within the Abdali area, in the middle of the Greater Amman Plan and its borders adjacent to the city center. The residents of Amman began to live in Shmeisani in the early 1960s when the ancient Amman began to grow in its population. In the mid-seventies, Shmeisani became one of Amman's finest neighborhoods. Shmeisani was located between the Dakhiliya circle and the headquarters of the former General Intelligence Department, but now it is located between the Dakhiliya circle through the city sports circle to the peripheries of Khalda, Sweifiya and the peripheries of Jabal Amman within the scheme of 1992. Shmeisani is a vital area due to its location in the center of modern Amman, bordered to the north by University Street and Hussein Sports City, to the east by Jabal Al Hussein, Al Abdali, which will be the new center of Amman and Jabal Lweibdeh. It is considered the economic heart of the city: where Amman Stock Exchange is located, and major centers for most banks operating in Jordan. This selected neighborhood as well won great importance for decades and suddenly witnessed draw back as shown in figure 3.

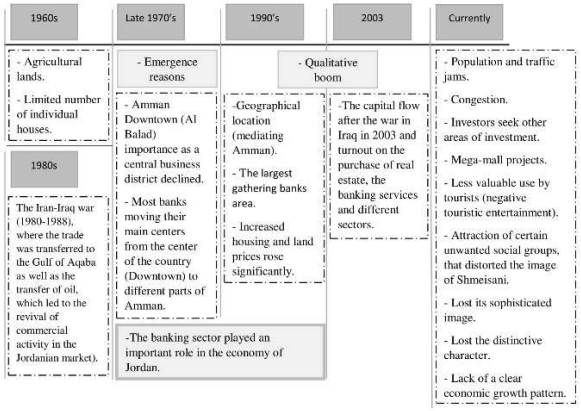

Figure 3: Shmeisani historical timeline. Source: (Researcher, 2017).

As a third case investigated in Amman Um Uthaina, it is located southwest of Amman. The area surrounds Mecca Street to the south and Zahran Street to the north and is adjacent to the neighborhoods of Sweifiya, Abdoun, Sixth circle and Rabieh. There are two important factors affected Um Uthaina, first is the search of

some social groups for residence places outside the overcrowding commercial and residential areas. At the same time, Um Uthaina enjoys the advantages of calm and peacefulness on the one hand and the relative proximity to the commercial activity centers (for example Wadi Saqra, Rabieh, Mecca street, and Sweifiya) On the other hand. Um Uthaina still retain its generally clear residential character except Shatt Al Arab street (Gold Souk) and Crown Plaza Hotel. It is characterized by social sophistication, as most of the families living in it are of a highly educated and financial class. This was demonstrated in the way of construction it possessed, private gardens, facades, architectural decorations of buildings. Um Uthaina, has transformed into a high end residential area, after it was booming with commercial activities in the late eighties and nineties. This transformation has benefitted its residents and attracted others of same interest to reside there giving it a sound residential character in the present time.

According to the survey conducted in the three neighborhoods and their urban nodes, findings have resulted to identify the main aspects of success, failure and transformation of them as shown in the analysis below.

6.1 Jabal Al Hussein Socio-Economic Major Findings

Jabal Al-Hussein is surrounded by adjacent areas of weak purchasing power, and less fortunate in development. Urban nodes should be developed under a comprehensive plan by taking into consideration all the aspects and developing the whole nodes not focusing on developing a node and neglecting an adjacent one.

The phenomenon of hawkers that led to the decline of Jabal Al Hussein image socially and culturally, created problems on the behavioral and social levels, which affected the degree of turnout in the urban node by citizens and tourists. Hawkers should be organized and allocated in specific spots by GAM.

The origins and quality of goods in Jabal Al Hussein played a huge role in the regression of the commercial turnout, in addition to the mega mall appearance that affected the commercial vitality negatively in Jabal Al Hussein.

Indicators	Jabal Al Hussein
Social Community requirements (Social/Cultural aspects)	
The social relation and situation, social level, social values, social urbanization, social development and availability of social security. 	The social relations and situation previously was better than now; the social behavior did not maintain as it was and did not witness any positive development. Jabal Al Hussein witnessed regression in terms of: social level, social values, social urbanization, social development and availability of social security.
Social problems: harassment phenomenon. 	Social problems: harassment phenomenon, due to the regression of the social security in this urban node, families don't go any more to the gardens or parks.
Unattractive urban node socially. 	Jabal Al Hussein is considered as unattractive urban node socially, most people mentioned it's not acceptable to their ambition socially and prefer to leave to quieter suitable areas.
Surrounding adjacent areas. 	Jabal Al-Hussein is surrounded by adjacent areas of weak purchasing power, and less fortunate in development.
Population overcrowding, buildings and traffic congestion. 	Population overcrowding, buildings and traffic congestion are considered as major issues that lead to regression.
Commercial Competitive level / (Economic aspect)	
Commercial vitality. 	In spite its privileged geographical location within the Capital Amman and its diverse commercial activities, the commercial vitality of Jabal Al Hussein did not develop but regressed.
Tourists' turnout. 	The turnout by the tourists declined and that indicates the decline in the commercial and tourism vitality of Jabal A l Hussein.
Building congestion. 	Buildings congestion affected negatively on the node.
Hawkers' phenomenon. 	The phenomenon of hawkers that led to the decline of Jabal Al Hussein image socially and culturally, created problems on the behavioral and social levels, which affected the degree of turnout in the urban node by citizens and tourists.
Goods origins and quality. 	The origins and quality of goods in Jabal Al Hussein played a huge role in the regression of the commercial turnout.

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Mega malls. 	Mega malls appearance negatively affected the commercial vitality in Jabal Al Hussein.
Investment size vs traders, businessmen, decision makers and competent authorities. 	The investment size in Jabal Al Hussein considered medium, while the attention of the traders, businessmen, decision makers and competent authorities is towards the large or mega investments.
Promoters' attention. 	The promoters' attention moved to more attractive areas for development.

Figure 4: synthesis of results in Jabal Al Hussein

6.2 Shmeisani Socio-Economic Major Findings

Some sort of commercial investments (negative touristic entertainment) do not suit the overall good sophisticated image of Shmeisani, led to the attraction of certain unwanted social groups, which distorted the image of Shmeisani. Avoiding the random commercialization, and studying the tourism investment granted licenses is very much needed.

Indicators	Shmeisani
Social Community requirements / (Social/Cultural aspects)	
Congestion. 	Shmeisani also suffered from congestion and remained oscillating between being a residential area and a commercial area at the same time.
overcrowding housing, population and traffic jam. 	Some of the Shmeisani residents prefer to leave to quieter places because of the overcrowding housing, population and traffic jams, and because of the changes that swept the area and made it lose the distinctive character that it enjoyed.
Increase and diversification of the economic growth. 	Increase and diversification of the economic growth in Shmeisani (quantitively not qualitatively).
Negative touristic entertainment. 	Some sort of commercial investments (negative touristic entertainment) do not suit the overall good sophisticated image of Shmeisani, led to the attraction of certain unwanted social groups, which distorted the image of Shmeisani.
Harassment phenomena. 	Harassment phenomena, decline in the social relations, social family situation witnessed regression.
Commercial Competitive level / (Economic aspect)	
The investment size. 	The investment size in Shmeisani is average because the commercial node in Shmeisani is not a shopping destination, unlike Jabal Al Hussein, it's not a commercial diverse node with all kind of shops. The commercial node created to serve the banks area and the tourists in the hotels, so it's basically restaurants, cafes and some basic daily serves.
passive entertainment area. 	The change of the nature of the commercial area into passive entertainment area, led to the decline of the commercial node, and regression in the turnout of locals and tourists.
commercial regression. 	Some other reasons led to the commercial regression are: goods origins and qualities, mega mall projects in other areas, congestion in buildings and traffic and the investors' attention moved to other urban nodes.
Arabic influx. 	The heavy Arabic influx, created a booming in the real estate market and the investment sector effected Shmeisani positively.

Figure 5: synthesis of results in Shmeisani

6.3 Um Uthaina Socio-Economic Major Findings

Um Uthaina still retain its generally clear residential character (quiet, sophisticated, pleasant and comfortable atmosphere) except Shatt Al Arab street (Gold Souk) that added value to the residential area of Um Uthaina, Um Uthaina does not become a commercial area; services are available to meet the needs of its population. Besides, it's surrounded by socially and economically equivalent areas.

Indicators	Um Uthaina
Social Community requirements / (Social/Cultural aspects) Commercial Competitive level / (Economic aspect)	
Residential character. 	Um Uthaina still retain its generally clear residential character except Shatt Al Arab Street (Gold Souk) and Crown Plaza Hotel, and has not become a commercial area; services are available to meet the needs of its population.

Social atmosphere. 	It is characterized by social sophistication, the social atmosphere in Um Uthaina is quiet, comfortable and pleasant.
Surrounded areas. 	Um Uthaina is not surrounded by areas that are less fortunate in development.
Behaviour patterns. 	It does not suffer from the negative behavior patterns flow that cause inconvenience or harassment.
Attractive residential neighborhood. 	Um Uthaina socially considered an attractive residential neighborhood, enjoys social security, social urbanization, and surrounded by similar areas, due to that most of its residence prefer to stay in it.
Family and kids public spaces. 	There are no parks, gardens, public places for families or children's play areas.
Arab influx. 	Um Uthaina was affected by the migrations, this has led to cultural and social diversity as a result of the mixed cultures of the neighborhood inhabitants.
Tourists'' turnout. 	Due to its residential character, the tourist's turnout in Um Uthaina is limited.

Figure 6: synthesis of results in Um Uthaina

7 TRIANGULATION OF FINDINGS IN JABAL AL HUSSEIN, SHMEISANI AND UM UTHAINA

(1) Many factors affected the public services sector in Jabal Al Hussein, Shmeisani and Um Uthaina, building congestion, population overcrowding, traffic, the increase of the mixed-use buildings and the heavy influx of large numbers of Arabs.

(2) Public services deficiencies: parking services, validity of the pedestrian corridors and movement, public transportation, are not accommodating the community needs.

(3) While the: security services, electricity services and civil defense are excellent.

Based on the analysis that were undertaken according to several theoretical resources, narrative interviews with different locals and interviewing officials in Greater Amman Municipality was conducted. The level of strength for each indicator affecting the basic aspects of this study was synthesized towards few aspects that are seen crucial in affecting urban transformation.

Social aspects are affected in various manners due to the confusion in planning the neighborhood. Neighborhoods have to have distinct character that allows smooth development. Residential character or commercial and business identity should be kept or tailored through urban policies that guide the growth and development. It is noticed and analyzed that these neighborhoods were subject to influence according to sudden and unplanned growth and within the absence of guidelines that regulate that growth and define the settings especially in the newly developed areas. The absence of such policies are basic causes of this negative transformation.

On the other hand, the economic aspects and strengths or weaknesses suggest a similar attention to the verification of the identity formation of distinct neighborhoods with certain line of development. Social and economic attention should be catering to a synergized image of neighborhoods and should be working under the same line of urban policy and not allowing ad hoc decisions upon investment and developers individual preferences.

8 CONCLUSION

Two pillars of development should be tackled as a result and conclusion to this survey and discussion, the social community level and the commercial competitive level.

The concept of urban development must be comprehensive and not confined to certain urban node without the other. It is not possible to pay attention to an urban node and neglect the adjacent one because this leaves a very negative impact on the population of the less fortunate node in development.

One of the most important criteria that must be considered on objectiveness and scientific basis, is to determine the terms of granting commercial licenses (quality and quantity) by considering the criteria of commercial competition and avoid imbalance in distribution and the implementation of the population ratio

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criteria (overcrowding). Avoiding overpopulation in addition to an important factor is to maintain the social environment status, without traditions prejudice.

Studying the category of the granted touristic investment license, where licenses cannot be prevented for commercial tourism investments, but it is important to respect the sanctity of society in residential areas, and not to cram tourist facilities causing inconvenience to the residents, due to its negative effects.

It was observed that one of the reasons of the regression in the analyzed urban nodes is the origin and the quality of the goods. Comparing this to other new modern nodes in the city it is clearly noticed that this reflects negatively on the entire node. By improving the quality of the goods this will ensure better exposure to new technologies that will enhance the urban node to grow in a better way.

The general plan should include the subject of random commercialization into the study on scientific and objective basis.

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Smarte Sirenen im Rahmen kommunaler Klimaanpassungskonzepte im Spannungsfeld von Stadtklimatologie und Stadtplanung

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1 ABSTRACT

Der urbane Raum wird voraussichtlich besonders stark von Klimaveränderungen betroffen sein. Dies gilt es gegenwärtig zu berücksichtigen, um auf zukünftige Herausforderungen entsprechend vorbereitet und angepasst zu sein. Dabei gilt es vielfältige, oftmals widersprüchliche Anforderungen zu bewältigen, die mit unterschiedlichen Aspekten der Planung einhergehen. Mittels einer soliden und vorausschauenden Planung gilt es darauf Rücksicht zu nehmen, dass die Bevölkerung infolge von Stadtentwicklungs-, Stadterneuerungs- und Stadtumbaumaßnahmen in ihrer Wohn- und Lebensqualität nicht negativ beeinflusst wird (z. B. durch die Veränderungen des Lokalklimas, wenn Fußgänger im Sommer unnötigem Hitzestress ausgesetzt werden, da möglicherweise die vormals schattenspendende Vegetation einer Umstrukturierung zum Opfer gefallen ist).

Eine der großen Herausforderungen der kommenden Jahre auf der Ebene der örtlichen Planung wird es sein, sich auf wetterbedingte Extreme wie Starkregenereignisse oder Hitzewellen vorzubereiten. Im Rahmen solcher rezenter Extremereignisse zeigt sich, dass die Folgen für die gesellschaftlichen und räumlichen Strukturen mitunter deutlich ausfallen können. Städte sind aber vielfach noch nicht ausreichend auf solche Szenarien vorbereitet.

Auch wenn es gegenwärtig bereits eine große Anzahl an Klimaanpassungskonzepten gibt, ist die Klimaanpassung ein Arbeitsfeld, das weiterer Forschung bedarf, beispielweise hinsichtlich der Bewertung der Effektivität geplanter bzw. bereits umgesetzter Maßnahmen.

Am Beispiel der knapp 100.000 Einwohner zählenden Stadt Kaiserslautern wird im Rahmen eines Forschungsprojektes ein Klimaanpassungskonzept entwickelt, das aufzeigt, wie die Siedlungs- und Freiraumentwicklung der Stadt klimaoptimiert auf Hitze- und Starkregenereignisse reagieren kann. Ein erster, wichtiger Baustein eines solchen Konzeptes ist eine zielführende stadtklimatologische/ siedlungsökologische Kartierung der Vor-Ort-Situation, um potentielle Risikogebiete für z. B. Starkregenereignisse im Bestand zu identifizieren. Darauf aufbauend sollen strategische Maßnahmenkonzepte für betroffene Quartiere erarbeitet werden.

Als neues Konzept der Klimaanpassung soll dabei der Aufbau eines akustischen Warnsystems für die Bevölkerung untersucht und technisch ausgelegt werden. Extremereignisse mit Gefahrenpotential für die Bevölkerung, insbesondere Starkniederschläge, Gewitter und Stürme, erreichen die Städte oft mit sehr kurzer Vorwarnzeit. Nach dem weitgehenden Abbau der Zivilschutzsirenen bieten „smarte“ Sirenensysteme, die dezentral mit verhältnismäßig geringer Schallleistung installiert werden und situationsangepasste Sprachdurchsagen verteilen können, einen neuen Ansatz zur Schadenminimierung. Die Menschen sollen mithilfe eines optimierten Einsatzes von „Smarten Sirenen“ vor dem Eintreffen von Extremereignissen gewarnt werden, und dies unter Berücksichtigung der urbanen Gebäudestruktur, mit dem Ziel die betroffenen Standorte vorab zu informieren, um notwendige Maßnahmen, z. B. die Räumung von Tiefgaragen und Kellern, die Betätigung von Absperrventilen oder das Aufsuchen sicherer Orte, rechtzeitig treffen zu können.

Keywords: Katastrophenschutz, Starkregen, Frühwarnung, Bevölkerungsschutz, Sirenen

2 EINLEITUNG

Im Rahmen eines Klimaanpassungsprojektes in der Stadt Kaiserslautern wird derzeit der Frage nachgegangen, inwiefern der Einsatz akustischer Warnsysteme im öffentlichen Raum eine potentielle

Maßnahme gegen bzw. für das Auftreten von Extremereignissen (z. B. Starkregen) darstellen kann. Diese Anpassungsmaßnahme fällt in den Zuständigkeitsbereich der kommunalen Verwaltung. Zudem kann diese Maßnahme nicht als langfristig zu erreichendes Ziel angesehen werden, sondern sie dient vielmehr der Reaktion auf ein akut auftretendes Ereignis mit einem entsprechend schnellen Handlungsbedarf.

Somit sind Sirenen vergleichbar mit Warn-Apps, wie z. B. NINA® oder KATWARN® – einem kostenfreien, vom Fraunhofer-Institut entwickelten Warnservice – die unterstützend installiert werden können. Bisher ist die Verwendung von Sirenen für solche Ereignisse nicht gebräuchlich, wäre aber vor allem im Hinblick auf bevorstehende Starkregenereignisse denkbar. Im Folgenden soll ein kurzer Abriss der verschiedenen Arten von Sirenen und Warnsignalen gegeben und diskutiert werden. Zudem werden erste Überlegungen vorgestellt, welche Sirenentypen für ein beispielhaft betrachtetes Stadtquartier im Untersuchungsraum in Betracht gezogen werden sollten.

3 GEFAHREN- UND WARNSIGNALE DURCH SIRENEN

Die Verwendung von Sirenen zur Verbreitung von Gefahren- und Alarmierungssignalen ist seit Anfang des 19. Jahrhunderts gebräuchlich. Zusätzlich zur Alarmierung der Feuerwehr, die bis zur Einführung funkgestützter, „stiller“ Alarmierung regelmäßig durch Sirenen umgesetzt wurde, begann Deutschland nach dem Zweiten Weltkrieg ein flächendeckendes System von Zivilschutzsirenen aufzubauen, das über Warnämter gesteuert wurde und die Bevölkerung über wenige, standardisierte Signale vor Katastrophenereignissen warnen bzw. entwarnen konnte. Das Sirenensystem hatte damit im Wesentlichen eine „Weckfunktion“ für die Bevölkerung, die nach Hören des Signals regelmäßig das Radio einschalten und weitere Informationen empfangen sollte. Weitergehende Informationen konnten bzw. können mit diesem System nicht transportiert werden.

Nach Ende des Kalten Krieges wurden die Warnämter 1993 aufgelöst und das in Spitzenzeiten aus 80.000 Sirenen bestehende System ungefähr halbiert. Im Wesentlichen sind die Sirenen verblieben, die für die Feuerwehralarmierung weiterhin erforderlich sind. Die Zuständigkeit ist auf die Kommunen übergegangen – allerdings hat das Bundesamt für Bevölkerungsschutz und Katastrophenhilfe inzwischen erkannt, dass durch den Wegfall des bundesweiten Systems mit flächendeckender Weckfunktion für die Bevölkerung eine Schutzlücke entstanden ist, die sich wegen der unvollständigen Versorgung mit Endgeräten, aber auch der lückenhaften Netzabdeckung, mit Warn-Apps nicht auffangen lässt.

Der Frage nach der Nutzung bzw. dem Einsatz von Sirenen liegen zwei internationale Normen zu Grunde:

(1) DIN EN ISO 7731: Ergonomie – Gefahrensignale für öffentliche Bereiche und Arbeitsstätten – Akustische Gefahrensignale (ISO 7731:2993); Deutsche Fassung EN ISO 7731: 2008

(2) DIN EN ISO 9921: Ergonomie – Beurteilung der Sprachkommunikation (ISO 9921: 2003)

Die „DIN EN ISO 7731: Ergonomie – Gefahrensignale für öffentliche Bereiche und Arbeitsstätten – Akustische Gefahrensignale“ nennt die Kriterien für die Erkennbarkeit akustischer Warnsignale, insbesondere für Fälle mit starkem Störschall. Darüber hinaus werden die physikalischen Grundsätze der Gestaltung, ergonomische Anforderungen und die entsprechenden Prüfverfahren für Gefahrensignale geregelt. Der Fokus liegt hierbei auf akustischen Gefahrensignalen – Gefahrenhinweise im Rahmen sprachlicher Verständigung werden nicht von dieser Norm thematisiert (DIN EN ISO 7731, S. 5). Mit dieser Thematik befasst sich hingegen in der DIN EN ISO 9921:2003: „Ergonomie – Beurteilung der Sprachkommunikation“. Auf Grundlage dieser beiden internationalen Normen rückt die Warnung durch Sirenen mittels Signalton bzw. mittels Sprachkommunikation in den Mittelpunkt.

3.1 Gefahrensignale durch Hochleistungssirenen

Wäre das Ziel der Sirenenwarnung der Einsatz eines Gefahrensignals, so müssten zwei zentrale Aspekte Berücksichtigung finden:

(1) Ein deutschlandweit einheitliches Sirenensignal, das die Bevölkerung warnt bzw. entwarnt – einminütiger Heulton zur Warnung vor einer unmittelbar bevorstehenden Gefahr; einminütiger Dauerton gibt Entwarnung.

(2) Mit dem Signal müssen bundesweit einheitliche Handlungsempfehlungen verbunden sein.

In Deutschland bestehen diese in der Nutzung möglicher Informationsmedien, um weitere Hinweise zu erhalten (Ministerium für Inneres, Digitalisierung und Migration, o.J.).

In Frage kommen hierfür sog. Hochleistungssirenen auf hohen, exponierten Standorten, die in Kriegszeiten z. B. dem Zivilschutz dienten oder auch neu installierte Sirenensysteme, die u. a. zur Alarmierung der Feuerwehr zum Einsatz kommen. Neben einer sehr hohen Schallleistung, die von oben in die Bebauung eindringt, zeichnen sich diese Sirenen durch eine hohe Reichweite aus und decken somit ein großes Umfeld ab. Dabei erfüllen sie in erster Linie den Zweck der Abgabe eines akustischen Gefahrensignals, das die Menschen auf eine Gefahrenlage aufmerksam machen soll, ohne jedoch Schreckreaktionen hervorzurufen. Eine der letzten „historischen" Sirene dieser Art befindet sich z. B. noch auch auf dem Dach der Kottengrundschule in Kaiserslautern und könnte theoretisch zur Warnung vor Extremwetterereignisse eingesetzt werden.

Gemäß der DIN EN ISO 7731:2008 muss das eingesetzte Gefahrensignal eindeutig und „so beschaffen sein, dass jede Person im Empfangsbereich das Signal hören und auf dieses in der vorhergesehenen Weise reagieren kann" (DIN EN ISO 7731, S. 7). Zudem darf es den A-bewerteten Schalldruckpegel von mindestens 65 dB an jedem Ort innerhalb des Signalempfangsbereichs nicht unterschreiten (DIN EN ISO 7731). Zusätzlich wird vorausgesetzt, dass mindestens eines der folgenden Kriterien erfüllt wird:

- die Differenz zwischen den beiden A-bewerteten Schalldruckpegeln des Signals und des Störschalls muss bei den Messungen des A-bewerteten Schalldruckpegels größer als 15 dB sein (LS, A – LN, A > 15 dB) und/oder
- die effektive Mithörschwelle in dem betreffenden Oktavband muss im Rahmen der entsprechenden Oktavband-Schalldruckpegel-Messungen von dem Schalldruckpegel des Signals in einem oder mehreren Oktavbändern um mindestens zehn dB überschritten werden (LSi, Oct – LTi, Oct > 10 dB) und/oder
- die effektive Mithörschwelle in dem betreffenden Terzband muss im Rahmen der entsprechenden Terzband-Schalldruckpegel-Messungen von dem Schalldruckpegel des Signals in einem oder mehreren Terzbändern um mindestens 13 dB überschritten werden (LSi, 1/3 Oct – LTi, 1/3 Oct > 1 3dB) (DIN EN ISO 7731).

Damit ein Signal deutlich zu verstehen ist, wird demnach ein Schalldruckpegel von mindestes 80 dB im Empfangsbereich benötigt. Als Höchstintensität des Signals wird im Rahmen der DIN ISO Norm auf 118 dB(A) im Signalempfangsbereich, also an der nächstegelegenen von Menschen betretenden Stelle, verwiesen, der in jedem Fall nicht überschritten werden sollte. Ein zu hoher Schalldruckpegel kann hingegen Schreckreaktionen oder sogar Gehörschäden zur Folge haben, die für Gefahrensituationen kontraproduktiv wären (DIN EN ISO 7731).

Darum wäre die Warnung der Bevölkerung vor bevorstehenden Starkregenereignissen mittels des Gefahrensignals einer Hochleistungssirene eine potentielle Maßnahme. Allerdings ist der potentielle Nutzen eher gering, da keine differenzierten Informationen verteilt werden können, sondern nur abstrakt auf Gefahren hingewiesen werden kann. Ein derartiger Einsatz der Sirene wäre keine „Entweder/ Oder-Entscheidung", sondern kann vielmehr als eine „sowohl als auch"-Lösung/Maßnahme gesehen werden, die die Verfügbarkeit weiterer Informationsträgermedien voraussetzt. Vor allem wäre sicherzustellen, dass dem Signal eine entsprechende bundeseinheitliche Bedeutung zugrunde gelegt wird bzw. entsprechend adäquate Handlungsempfehlungen zugeordnet werden können. Somit wäre gewährleistet, dass auch nicht-ortsansässige Personen folgerichtig reagieren. Eine solche Realisierung wäre jedoch sehr aufwendig, wodurch von dieser Idee Abstand genommen wurde.

3.2 Warnsignale durch „Smarte Sirenen"

Eine weitere Möglichkeit wäre die Nutzung einer Sirene zum Durchgeben von gesprochenen Handlungsanweisungen. Hierzu könnten beispielsweise elektronische Lautsprecher installiert oder sog. „Smarte Sirenen" angewendet werden. „Smarte Sirenen" sind gegenüber den Hochleistungssirenen für die Anwendung in Bodennähe ausgelegt. Sie besitzen eine geringere Schallleistung, um u. a. Hörschäden zu vermeiden. Um eine ausreichende Abdeckung des betroffenen Bereichs zu gewährleisten, müssen sie in geringen Abständen montiert werden.

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Insbesondere bei den Lautsprechern mit hohen Schallleistungen bis 160 dB(A) an Hochleistungssirenen spielen die Gesetzmäßigkeiten der Schallausbreitung eine zentrale Rolle, um sicherzustellen, dass durchgegebene Warntexte auch tatsächlich überall im betroffenen Stadtquartier verständlich wahrgenommen werden können. Ein ausreichendes Niveau der Verständlichkeit im Empfangsbereich wird auch in der zugrunde gelegten DIN ISO 9921:2003 als wesentlicher Aspekt bei Sprachkommunikation angeführt. Gleichzeitig verweist sie auf eine gute Gestaltung, um negative Auswirkungen wie bspw. mögliche Hörschäden oder Umweltprobleme auf ein Mindestmaß herabzusetzen (DIN ISO 9921, S. 3f.). Es ist erforderlich, dass der Empfänger der Warntexte diese zu 100 % richtig erfassen kann – eine ausreichende Lautstärke sowie einfache Sätze sind eine Grundvoraussetzung. Eine zu geringe Lautstärke, schwierig zu erfassenden Sätze sowie aufgrund großer Distanzen zu den Ausgabegeräten nur bruchstückhafte Erfassung der Durchsagen und Mehrfachreflexionen an Gebäuden oder auch die Überlagerung des Schalls mehrerer Geräte, können in Gefahrensituationen kontraproduktiv sein.

Im Zuge solcher Überlegungen muss somit auch die vorhandene Bebauung berücksichtigt werden. Diese wirkt nicht nur als Hindernis, sondern kann vor allem bei sehr großen Sirenen, die weite Bereiche abdecken, zu Mehrfachreflexionen der Warntexte führen. Hier werden insbesondere das Gesetz der Schallausbreitung sowie die Schallgeschwindigkeit zu einer Art „KO-Kriterium“ des Einsatzes von Hochleistungssirenen zur Abgabe ebensolcher Warntexte. Um einen großen Bereich abzudecken, wären mehrere derartigen Sirenen erforderlich. Allerdings würden sich diese teilweise überlagern, unterschiedlich laute und aufgrund der Schallgeschwindigkeit zeitversetzte Durchsagen – einschließlich etwaiger Echos – produzieren und so zu einer Unverständlichkeit der Durchsage führen und demnach wenig Sinn ergeben bzw. sogar kontraproduktiv und gefährlich sein. Daher ist von einem Einsatz der Hochleistungssirenen auf Hochstandorten abzusehen. Sie kommen allein für die Abgabe von Gefahrensignalen in Betracht.

Abb. 1: Beispielhafte Anordnung „Smarter Sirenen“ in der Fußgängerzone von Kaiserslautern, um eine adäquate Abdeckung und Erreichbarkeit der Menschen zu gewährleisten.

Anders stellt sich diese Situation bei „Smarten Sirenen“ dar. Diese decken kleinere Bereiche ab, wodurch sich das Problem der Schallgeschwindigkeit hier nicht in einem gravierenden Maße niederschlägt und somit vernachlässigt werden kann. Die Anbringung erfolgt, wie bereits erwähnt, in Bodennähe an Außenfassaden von Gebäuden oder an Straßenlaternen. Bedingt durch die niedrige Befestigungshöhe und u. a. zur

Vermeidung von Hörschäden arbeiten „Smarte Sirenen“ im Gegensatz zu Hochleitungssirenen mit einem deutlich geringerem Schalldruck – statt 160 dB(A) ist für „Smarte Sirenen“ von einer Überschreitung der empfohlen Höchstintensität gemäß DIN ISO 7731:2008 von 118 dB(A) abzusehen. Allerdings existiert natürlich auch bei „Smarten Sirenen“ eine Hinderniswirkung durch die Bebauung, die im Zuge der Planung zu berücksichtigen ist und sich sowohl auf die benötigte Anzahl der Geräte, als auch auf die Anordnung ebendieser im Untersuchungsraum auswirkt.

Abbildung 1 legt beispielhaft dar, dass für einen Quartiersausschnitt innerhalb der Kaiserslauterner Innenstadt, auf einer vergleichsweise geringen Fläche (ca. 20 ha bzw. 800 Straßenmeter) mindestens 11 „Smarte Sirenen“ notwendig wären, um sicherzustellen, dass der gesamte Fußgängerbereich durch ein entsprechendes Warnsignal abgedeckt wird. Die dunkelblau dargestellten Bereiche weisen mit 85 dB hierbei in Abbildung 1 die potentiellen Standorte der „Smarten Sirenen“ aus.

Zusätzlich führen u. U. Fassadendämmung und Mehrfachverglasung dazu, dass die Warnungen nicht zuverlässig ins Gebäudeinnere oder in Innenhöfe dringen können, sodass sie lediglich der Warnung der Bevölkerung dienen, die sich im Freien bzw. in der Nähe der Sirenen befindet. Dennoch wäre der Einsatz von „Smarten Sirenen“ zur Warnung der Bevölkerung vor bevorstehenden Starkregenereignissen und für Durchsagen zu empfehlenden Verhaltensweisen denkbar.

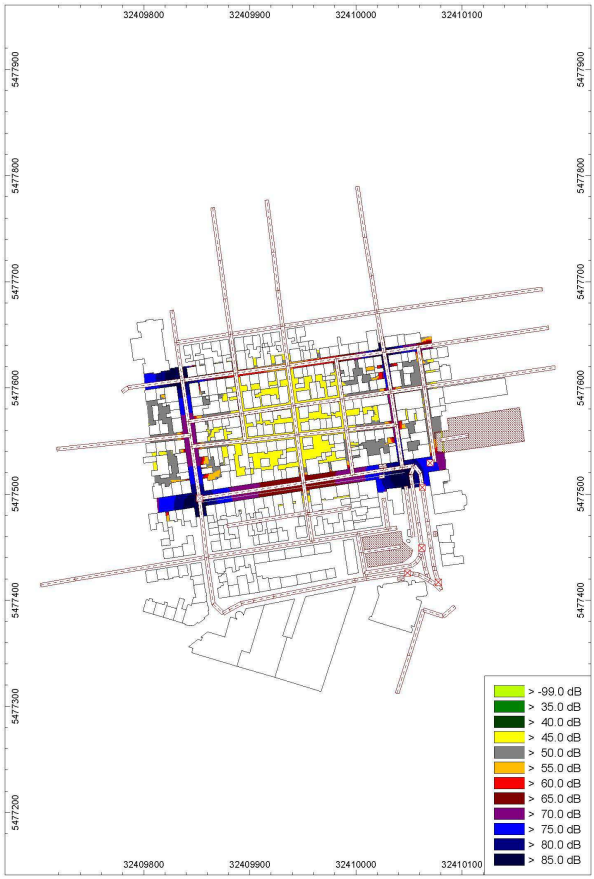

Abb. 2: Beispielhafte Anordnung „Smarter Sirenen“ im Stadtquartier „Kotten“ im Bereich der Innenstadt von Kaiserslautern, um ein adäquate Abdeckung und Erreichbarkeit der dort lebenden Bevölkerung zu gewährleisten.

Für das System der „Smarten Sirenen“ sollten insbesondere Gebiete bzw. Straßen mit hohem Publikumsverkehr in Betracht gezogen werden, um unmittelbar eine größere Menschenmenge auf nahende/ drohende Extremereignisse aufmerksam machen zu können. Dafür bietet sich bspw. eine Fußgängerzone wie in der Innenstadt von Kaiserslautern an (s. Abb. 1). Oder auch ein dicht bewohntes bzw. dicht bebautes Stadtquartier, das potentiell stärker als andere Bereiche von z. B. den Auswirkungen eines Starkregenereignisses betroffen wäre (s. Abb. 2). Grenzen werden hier allerdings auch durch Störgeräusche gesetzt. Während in einer Fußgängerzone verhältnismäßig geringe Hintergrundgeräusche um 50 dB(A) zu erwarten sind und die Sprachdurchsagen daher auch bei 65-70 dB(A) noch gut verständlich sind, muss an stark befahrenen Straßen – vor allem in geschlossen bebauten Straßenschluchten – mit Störgeräuschen > 70

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dB(A) gerechnet werden, so dass die Anforderungen an das Sprachsignal viel höher werden. Angesichts der aus Sicherheitsgründen notwendigen Beschränkung der Schallleistungen sind damit deutlich geringere Abstände ziwchen den Sirenenstandorten, im folgenden Beispiel etwa 50 m, erforderlich. Dies erhöht Aufwand und Kosten beträchtlich – bei gleichzeitig meist deutlich geringerem Passantenaufkommen.

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How the Shareplace Pilot Regions Deal with the Corona Crisis

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1 ABSTRACT

The Interreg Central Europe co-funded three-year project SHAREPLACE ("Shared mobility and Regional transport integrated Planning for a better connected Central Europe") addresses, among others, the development and implementation of new mobility services in order to enhance the existing transport network based on the current needs of travellers. These new tools and services are being developed for five pilot regions, located in Croatia, Germany, Hungary and Italy. One objective of the project is to show how a co-design approach can support the design and implementation of new mobility services. Although the situation in terms of availability and quality of services as well as strategic planning processes are quite different in all pilot regions, they all profited from using living labs and stakeholder involvement for the development and design of services. Due to COVID-19 the situation change and the pilot regions are facing new challenges.

How can participation work in times of COVID-19 and social distancing? This paper shows how the SHAREPLACE pilot regions deal with the new situation and which new experiences they made.

Keywords: Covid-19, pandemic, Interreg procect, co-design approach, stakeholder involvement

2 THE SHAREPLACE PROJECT

The Interreg Central Europe co-funded project 'SHAREPLACE' ("Shared mobility and Regional transport integrated Planning for a better connected Central Europe") tackles mobility needs and existing transport options in five pilot regions, located in Croatia, Germany, Hungary and Italy by developing and implementing new tools and services for better connected local, regional and transnational transport networks. The quality of transport networks in hinterland regions in Central Europe varies in terms of provided public transport services, infrastructure for environmental friendly transport modes and moreover, of interoperability between existing services. All pilot regions have in common a general lack of connectivity to the Trans-European Transport Networks (TEN) for passengers.

Moreover, they show a common need to fill the gaps in the networks to make their territories more accessible, and the intention to implement and better integrate shared and flexible solutions to reach their objective.

The overall goal of SHAREPLACE is to develop an innovative approach to improve the connectivity of local, regional and transnational transport systems. SHAREPLACE is open to all types of passenger transport and target groups.

The challenge in each region is not only to set up new mobility services but to integrated them with the existing services. The current development within the project is to use the platform digitransit (https://digitransit.fi/) as a basis and develop, where needed, the relevant add-ins. Digitransit is a journey planner that uses several open source components to provide features such as mobile routing and real-time information support. Although data availability varies from region to region, European ruling (DR EU 2017/1926) will make it mandatory for transport operators to provide their data by 2021 in formats that can be integrated in different platforms.

Mobility solutions are tested and evaluated in the pilot regions. Lessons learned and technical developments from the implementation will be made available in order to allow other regions to benefit from the experiences. Business models will be examined for each pilot area, covering the different aspects necessary to make transport viable both for users as well as operators. SHAREPLACE will provide learnings from the co-creation process and how they helped shape new transport solutions.

2.1 The Shareplace Pilot regions

The overall goal of SHAREPLACE is to develop an innovative approach to improve the connectivity of local, regional and transnational transport systems. By implementing Living Labs and actively engaging stakeholders, transferable solutions for a more integrated, accessible and harmonized mobility system in five

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central European regions will be created, tested and change of behaviour will be monitored. These solutions will be supported by innovative business models and strategic guidelines for policymakers and planners. The Living Labs will be set up on municipality level whereas concrete implementation areas will be found together with local and regional stakeholders during the course of the project. The SHAREPLACE regions vary in terms of their geographical, socio-demographical, economical and structural characteristics, also the pilot activities are different.

2.1.1 Bergamo (Italy)

Bergamo province is located in the middle of Lombardy, economically the most important region in Italy.

With 1.100.000 inhabitants and 242 communities, it is the third most populous centre of the region after Milan and Brescia.

The pilot activities in Bergamo are focussing on the integration of sharing options (especially carpooling) in to local and regional transport networks. The co-creation process was set up on municipality level and the concrete pilot area was defined by the co-creation process and according to the innovation potential and feasibility. The University of Bergamo was choosen as the concrete pilot area. The results of the experimentation will be scaled up at municipality level to improve the connectivity of peripheral areas to the regional transport system. The second pilot activity includes a DRT system with the bus company ATB Consorzio S.c.r.l. on the route between the Bergamo railway station, the University of Bergamo - Caniana headquarters, the Bricoman car park of Dalmine and the University of Bergamo - Dalmine headquarters. This service will increase the accessibility of the university by connecting two important strategic urban mobility hubs to the campus.

2.1.2 Crema (Italy)

Like Bergamo, Crema is also part of the Lombardy region, located in the north of Italy. The pilot activites in Crema are focusing on developing and optimizing flexible transport options through collaboration. On municipality level the co-creation process was started and the test results will be scaled up with the Miobus offer, which is provided by the regional transport provider Autoguidovie.

2.1.3 Osijek (Croatia)

The City of Osijek is the centre of Osijek – Baranja County and one of four macro-regional centres in the Republic of Croatia. It is also a gravitational point of the entire Eastern Croatia (Slavonija, Baranja and Srijem), a region where 84.9% of settlements face depopulation. The city of Osijek implemented a pilot activity focusing on planning and governance for seamless mobility-based systems. It will allow further integration of City operated bus and tram services, with other mobility providers (e.g. ride, car and bike sharing services). The pilot activities in this region include a Bus DRT pilot element and a multimodal trip planer. The aim of this Bus DRT pilot is to identify the conditions and obstacles for the implementation of this kind of services and to propose development guidelines and recommendations. The multimodal trip planning service should include national railway transport and urban public transport (bus and tram), as well as FlixBus GTFS database with the possibility of future integration of bike and car-sharing services.

2.1.4 Ulm (Germany)

Ulm is located in the southeastern region of Baden-Württemberg (Germany) right on the border to Bavaria. The city is situated on the slopes of the Swabian Alb, which means that the topography is partly hilly. The various hills in the city's area represent a significant challenge for sustainable mobility solutions.

The pilot activities in Ulm are focusing on the integration of sharing services into regional and local transport networks. Especially the growing commuter flows will be used for testing and involve several companies and the employees of the City of Ulm.

2.1.5 Zalaegerszeg (Hungary)

Zalaegerszeg is located in the western Transdanubia region, in Zala county. The western Transdanubia region is the second smallest region in Hungary depending on the size of the territory. At the southwestern parts of the town hills are typical. The central and northern parts are located in a valley area, while the eastern areas are at the edge of a hilly area. The pilot activities focuses on developing and optimizing flexible options through collaboration. The area for the pilot actions is the commuting, suburban area of the city

consisting of 111 settlements, summing up relevant commuting flows (ca. 3,400 students and ca. 14,600 workers), and highlighting public transport unserved areas and poor connections to main transport hubs within the city (main railway and bus station). On the one hand a DRT system is planned and will be tested and one the other hand a carpooling system will be implemented, which links the local/regional buses and the trains to the nearest bus stops.

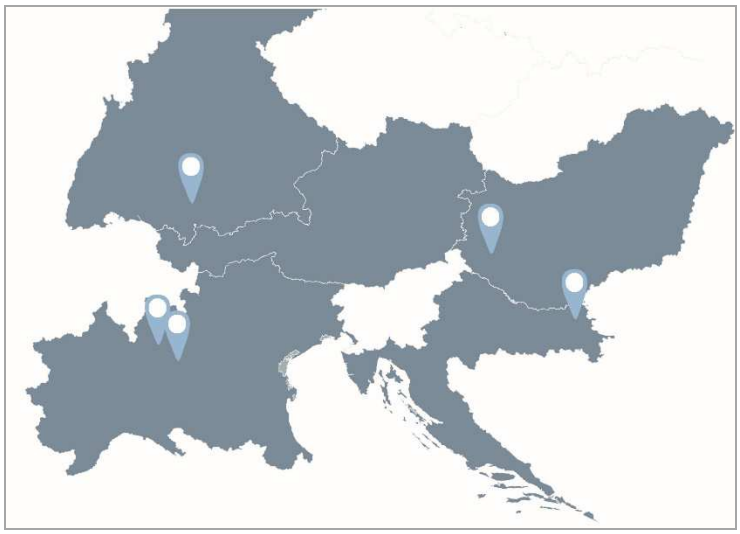

Figure 1: Location of the SHAREPLACE pilot regions (AustriaTech, basis from Interreg Central Europe)

2.2 Co-design approach in Shareplace

As powerful spatial planning tools, co-design approaches represent a key element of the SHAREPLACE project. The term co-creation refers to user and stakeholder involvement during the product design and development process.

Co-design reflects a shared design process, where designers and not trained people in design are working together to develop products, tools, processes and services. The co-design approach combines the collective creativity of diverse actors across the whole range of a development process (Sanders & Stappers, 2008).

In the SHAREPLACE project we use co-design as a collective creative process which is facilitated as workshops, with diverse stakeholders who sketch, ideate, experiment, learn and develop concepts together (Mattelmäki & Sleeswijk Visser, 2011). A co-design process as several phases with different steps, which are interlinked. The process is started by understanding and framing the problem through sharing and comparing the experiences of the participating stakeholders. On this basis, diverse alternatives will be explored, by identifying the local resources and capabilities. The aim is to find and develop a shared solution supported by all stakeholders, which can be tested and developed further within an iterated co-design process.

In SHAREPLACE, each pilot followed a similar work plan defined within the project, but then carried out the different activities such as living lab meetings and co-design workshops according to local needs and with their respective groups of stakeholders. However, a general approach could be identified, comprising several project phases, which are interlinked and can be applied in other settings as well. Part of our approach is the testing of the developed services in each pilot region. This phase should have started in February/March 2020 but had to be stopped abruptly due to restrictions due to COVID-19. Pilot regions cover hotspots such as Bergamo and Crema in Italy, but also other regions, less affected, at least in the beginning of the outbreak, such as Osijek in Croatia.

3 CO-CREATION IN TIMES OF COVID-19

As a key element of the SHAREPLACE project co creation is also during COVID-19 important. In SHAREPLACE, each pilot followed a similar work plan defined within the project, but then carried out the different activities such as living lab meetings and co-design workshops according to local needs and with their respective groups of stakeholders. Due to COVID-19 there were shifts and changes in the planned activities.

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Because of COVID-19 the implemented carpooling service in Bergamo, which was launched in the area of the university had to be stopped. The University of Bergamo was closed and the target group that consists of students and university staff was not available. Additionaly some other research about working from home was carried out and the planed seminars and meetings were held online.

In Crema testing was planned to start in April but it was postponed and will have a shorter testing period. Fewer people use public transport because of COVID-19 and holiday season. The plan is to hold online living labs in the end of summer. Since many schools and universities will probably continue online, there will be less regular bus services. If no testing is possible, experiences from other cities will be evaluated to prepare the implementation of the service later this year.

The routing application for the pilot projects in Osijek was completely finished and prepared for users but unfortunately, the living labs had to be cancelled in April. Right now, there is less public transport because of COVID-19 and additionally they are using the summer schedule because no students are there. In September when school restarts, testing with a smaller group of people should start. Two surveys and a co-design workshop are planned. They will be held online which could have an influence on the number of participants.

In Ulm events and talks with politicians and on mobility conferences had to be cancelled. The bike sharing service is available but with less users because of home school and home office. An online living lab was conducted and a public online webinar and workshop with transport operators took place. Other virtual meetings and workshops are planned. Instead of some events, Ulm will make a video about the implemented services instead.

In Zalaegerszeg the first testing phase was done but other planned pilot activities had to be postponed. They should start by the end of August and last until October. The testing has to be adjusted to the changed local schedules. If it´s not possible to conduct tests with many people, it will be done with a smaller group. The results will be used to prepare everything for testing at a later point of time. Online meetings are planed to involve different stakeholders.

4 CONCLUSION

The new situation with COVID-19 and the social distancing showed us that it is possible to make co-creation processes also without phisical meetings. But it is important to think about different things.

On the one hand it is important to stay in touch with the target groups and different stakeholders and to make them aware that the projekt continue. This can happen throuh E-mails, phone calls or newsletter. On the other hand it is important to think about the target groups, for example are they students or elder people, who maybe do not have access to online tools. In some cases it was necessary to change the target groups because they were not available.

Furthermore, it is important to evaluate the timing of participatory processes and define essential and non-essential activities. This analysis will provide a shortlist of selected activities. Which activities can maybe be done at a later stage.

Another challenge is the testing of new online tools to include different stakeholders in the co-creation process. It is a chance for the pilot regions to gain more flexibility and had the chance to reach a larger number of people because they did not have to be on site but the preparation of online meetings and co-creation processes is more complex and different. An additional possibility to reach different stakeholders is to create videos for target groups instead of meetings. Our pilot region Ulm will make a video about the implemented services instead of events.

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Adaptive Architecture and Urbanism - Weave, Rethinking Dense Urban Coastal Cities Around World for Present and Future Scenarios to Make Sustainable and Egalitarian Habitat

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1 ABSTRACT

The aim and objective of the PhD research is to expand coastal cities to adapt as per rising sea level. Taking problem as opportunity to bring Science, Engineering, Government policies and Design together to make Resilient, Sustainable communities which shall float on water and stay on ground as well. Floating city shall be designed using existing and new methods / technologies under research envisioned for floating. The quest is to make sustainable habitat enabling people to live, work, learn and play. Aim is to instill sustainable recycling methods, energy conservation and optimum usage of land and marine Eco system. The research would serve as a model for evolving sustainable neighbourhoods designed in a modular way, which can be easily extended or re-arranged, so as to adapt for future socio-economic realities. The PhD research is being carried out in Innsbruck University, Institute of Experimental Architecture, Hochbau for Design, Architecture and Urbanism. The research is primarily focused on the coastal city region of Mumbai, India with flooding and other relative problems, the city is facing. The research shall undergo analysis of case studies, books and writings published on coastal cities, thus understanding its morphological, social, economic, political and environmental (marine, terrestrial and atmospheric) aspects. This research shall be beneficial for many cities in various countries across the globe which are in a similar situation of rising sea levels and flooding. Eg: Jakarta of Indonesia, Osaka of Japan, etc.

Key words: floating cities, extended or re-arranged, 3-C global warming, rising sea levels, coastal areas flooding, climate change, poverty, pollution, land cost and availability, adaptive architecture and urbanism, design, engineering, materials and social science, deliver resilient forms, sustainable.

2 INTRODUCTION

One of the biggest threat to cities around the world is rising sea-levels, caused by the expansion of water at higher temperatures and melting ice sheets on the north and south poles. UN climate negotiators meet for summit in 2017, there is a new figure on the table: 3C. Until now, global efforts such as the Paris climate agreement have tried to limit global warming to 2C above pre-industrial levels. However, with latest projections pointing to an increase of 3.2C by 2100, these goals seem to be slipping out of reach.

When it comes to flooding, the coastal cities are most vulnerable. Millions of people live in the urban areas and sea-level rise will reshape densely and sparsely populated areas, which has great impact. Many of Asia's fast-growing coastal megacities, with populations of 10 million or more, are vulnerable to multiple flood threats. Mumbai capital of Maharastra, India, Dhaka, capital of Bangladesh and Manila of Philippines, among others, face a future of heavier rainfall and higher storm surges. Cities like Indonesia's Jakarta, are also sinking fast. Some spots in Jakarta are sinking at a rate of 20 to 28 centimeters a year.

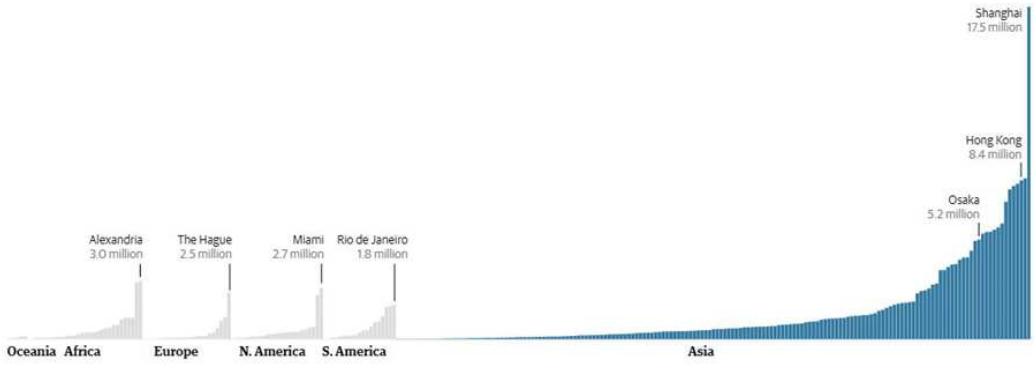

Fig-1 Asian cities will be worst effected (the regional impact of these changes is highly uneven, with four out of five people affected living in Asia) – Source: The Guardian

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3 THE PROBLEM

Mumbai, capital city of the state of Maharashtra, according to United Nations, as of 2018, is the most populous city of India and seventh-most populous city in the world with a population of roughly 20 million. A large island was created from the former seven smaller ones (Colaba, Little Cloaba, Bombay, Mazagaon, Worli, Parel and Mahim) and the largest land reclamation projects were completed by 1862. Mumbai is the result of intensive land reclamation measures that continue to this day.

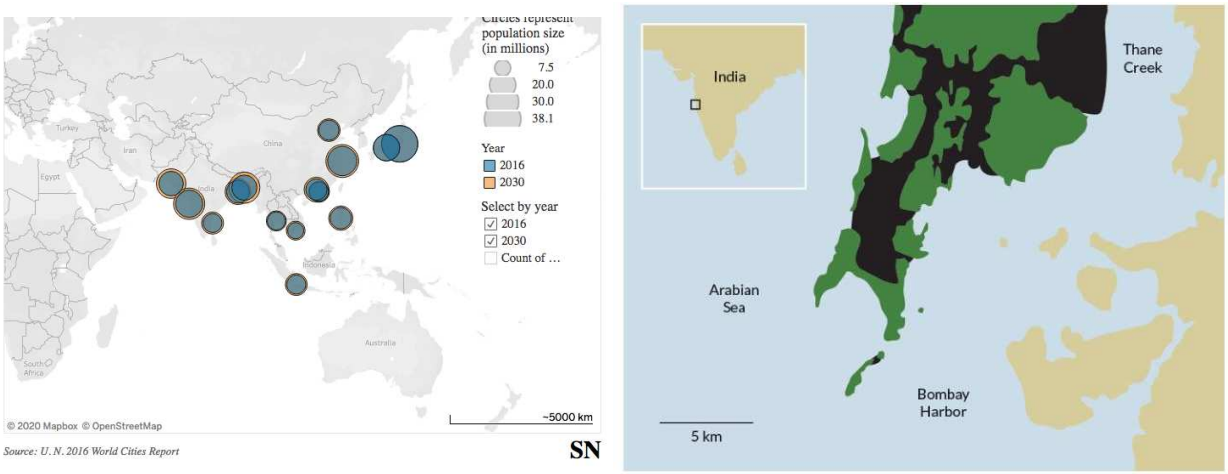

Fig. 2 Mumbai is built atop landfill (black) that connects several islands (green) in the middle of Bombay Harbor. Those passages once allowed water to flow through the system at high tide and during monsoon rains. Source: T. Riding/J. Hist. Geography 2018.
Fig.3 Population estimation for asian coastal megacities, 2016 and 2020. Source: U.N 2016 World Cities Report

Mumbai's flood risk makes the city a "high risk" place for climate change vulnerability. The second most worrying category after "extreme risk," according to Verisk Maplecroft's 2018 hazard index. Among the world's 31 mega cities, Mumbai ranks as the ninth riskiest, based on about 50 factors ranging from preparedness to exposure to climate shocks like heat waves, drought, hurricanes, and flooding. Mumbai's high population density, high poverty rates and poor sewage and drainage systems "heighten the risk posed by climate-related events like flooding".

3.1 Industrialization & Urbanization related issues

Typical issues: slums and neglected communities, air pollution, water contamination, industrial solid waste and poor urban sanitation.

Causes: rapid industrialization, low rates of emission treatment and lack of efficient waste management

Major impact: housing, industrial pollution disasters like the one in Bhopal, India, disturbance to the eco system, health issues, like tuberculosis due to air pollution

Spatial extant of impact: local and regional.

3.2 Poverty related issues

Typical issues: neglected communities, slums, low access to safe drinking water, and contamination of water bodies

Causes: inadequate housing and infrastructure, rapid population growth, income disparity and migration

Major impact: increased incidence of infant mortality, no proper air and ventilation in homes, sanitation related health impacts such as diarrhea, cholera, tuberculosis etc.

Spatial extant of impact: local

3.3 Rapid economic growth related issues

Typical issues: CO_2 emission, Nox emission, noise, municipal solid waste

Causes: Increased mobility, more emphatic economic activity, heavy Industries, less priority on environment

Major impact: Global warming, acid rains, heaps of garbage, blockage of sewers, deadly floods bring India's financial capital to standstill.

Spatial extant of impact: local and regional

3.4 Wealthy lifestyle related issues

Typical issues: Over burdening of energy resources, dioxins, obesity

Causes: High consumption, rich lifestyle, non-nutirious food consumption, low incentives for improvement

Major impact: Chemical ingredients and dioxin-caused abnormalities, over extraction of resources

Spatial extant of impact: Regional, global

Mumbai "is an extremely important city in terms of the economic wealth it generates". The city's economy rivals that of some developed nations in Europe. Its stock exchange is valued at around $2.2 trillion - almost twice the entire GDP of Mexico or Australia. Its Hindi-language Bollywood entertainment industry generates billions of dollars in global revenues each year.

4 WHY FLOATING OVER LAND RECLAMATION

Most of the coastal cities are expanding on sea, building artifical land by land reclamation. Eg: Pulau tekong – Signapore, Central and wan chai – Hong kong, Palm Jumeriah - Dubai etc.

The Disadavtages of land reclamation are

(1) High costs of constuction

(2) Enormous material needed to fill the depth and reclaimed land must be wary of soil subsidence

(3) Constrcution time to build projects takes long due to its process

(4) Damaging marine eco system and environment

(5) Flooding and earth quakes can create more damage and problems in future.

Floating structures are structures which stay afloat by relying on the buoyancy force of the water

(1) Floating platforms can adpat and adjust as per rising sea levels and flooding

(2) Floating cities, platforms, strcuture can be build easily and quickly

(3) Floating platforms are more environment friendly

(4) Floating platforms does not damage marine eco system

(5) Floating cities can be protected from earthquakes

(6) Floating structures are easy and fast to build

(7) Floating modular form is easy to fit and can be rearranged as per requirement

(8) They don't suffer differential settlement as they are flat in form

5 FLOATING STRUCTURES

Very large floating structures have been used for a variety of purposes like roads, bridges, mobile offshore base airports. Their presence is largely due to a severe shortage of land and the sky-rocketing land costs in recent times. There are basically two types of very large floating structures, namely the semisubmersible-type and the pontoon-type. Semi-submersible type floating structures are raised above sea level using column tubes or ballast structural elements to minimize the effects of waves while maintaining a constant buoyancy force.

5.1 Hood Canal Floating Bridge, USA

Type: Pontoon bridge with retractable draw span, Location: North West United States, Year of completion: 1961, Total length: 2398m , Clearance: 17m, Material: Concrete and Steel

5.2 Floating Airport Runway, Japan

Type: Modular mega-floats (4 large steel pontoons), Location: Tokyo Bay, Japan, Year of completion: 2000, Total length: 1000 m, Width: 60 m Height: 3 m Material: Steel

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Fig.4 Hood Canal Floating Bridge, USA, Fig.5 Floating Airport Runway, Japan.

6 FLOATING ARCHITECTURE AND URBANISM

People are already living on water for centuries in some places around the world example floating village in cambodia. The idea of floating structures is not a new revolutionary concept. However, the concept of building on water has been reintroduced with a new idea to live, work, play, instead of bridges, airports and roads. The new idea is to accomplish a very large floating structure which is as big as a city which can accommodate housing, institutions, commerical, recreation spaces, sports complex, offices, industries and more. Floating city concepts from various architects in making urban scale to small scale homes. One of them is Kiyonori Kikutake 'Marine City' and Koen Olthuis 'Offshore housing'

Kiyonori Kikutake's 'Marine City' was one of the first main actors in the movement, describing a new radical idea of designing a floating city in the ocean; self sustainable, flexible, clean and safe, earthquake-proof, impervious to flooding and away from urban sprawl on the main land. the circular foundations would float on bottle-like forms boasting rich aquaculture farming. a surely radical idea for his time, breaking all traditional conventions and addressing issues important even today, sustainability, modularity and alternative living concepts. the project is based around steel rings, measuring over two miles in diameter, on which towers would sit holding 1250 magnetized living units that could be easily replaced without causing any damage to the structure.


Fig.6 Tokyo Bay Plan, project of the Metabolist and Structuralist movement, 1960 (Kenzo Tange). Fig.7 The architects of Waterstudio.NL not only design floating houses in the luxury segment in the IJburg district of Amsterdam but also in the rest of the world. © Koen Olthuis – Waterstudio.NL

Floating houses in Amsterdam designed by Koen Olthuis: Mr. Olthuis's architectural firm waterstudio has completed more than 200 floating homes. which allows the buildings to get much bigger and be a lot more stable. They have a patented technology to create special "floating foundations" with foam and concrete – what he calls as floating land. These foundations move up and down on piles. This allows to go up to 200 x 200 meters in dimension and create larger structures. And they use the term amphibious to describe these floating foundations that rest on piles. The foundation is set on dry land, and when the water comes, the foundation comes loose from those piles and floats upward, and become a floating house.

7 SCIENCE, ENGINEERING AND TECHNOLOGY FOR FLOATING STRUCTURES

Floating cities are only possible in reality with the advanced science, engineering and technology in construction industry. Architects and Engineers are constantly working on and building with floating system called mooring. A mooring system is necessary to ensure that the floating structure is kept in position and prevented from drifting away under critical sea conditions and storms. A freely drifting floating structure may lead to damage to the surrounding facilities and infrastructures.

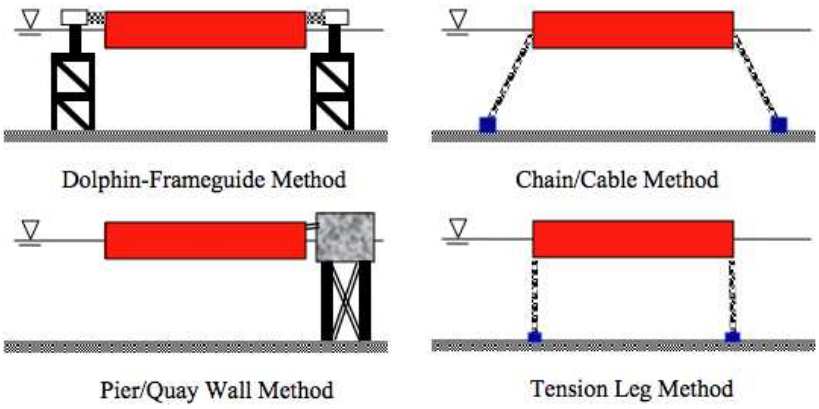

Fig.8 Various Types of Mooring Systems

8 SUSTAINABLE DEVELOPMENT GOALS:

As per United Nation, The 17 Goals are all interconnected to make sustanaible cities and communites. Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all cities. addressing the global challenges faceing, including those related to poverty, inequality, climate change, environmental degradation, peace and justice.

Fig.9 U.N. 17 Sustainable Development Goals

9 SUMMARY

The above study research will be further developed and applied to make Architecture and Urban Design Strategies for Mumbai's floating city. Taking Mumbai problems – flooding, high population, pollution, land costs and construction in city as an opportunity to expand its future proposals as floating city instead of land reclamation method. the research further focuses on its immediate context's need and requirements to bring design, science, engineering and policies together to make resilient and sustainable floating communities. Construction of housing, institutions, sustainable recycling industries and recreational facilties as per socioeconomic realities which benift for poor and middle class. To accomplish a cost effective sustainable method in collaboration with Public, Private, Institutions and Government.

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The Art of Curating an Accessible, Safe & Inclusive City

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1 ABSTRACT

Building Accessible, Safe, & Inclusive Indian Cities (BASIIC) is an action research programme implemented by the National Institute of Urban Affairs (NIUA) of the Ministry of Housing and Urban Affairs (MoHUA), Government of India. It intends to bring in a paradigm shift in the urban planning and design process by incorporating the tenets of universal accessibility, safety, and inclusivity as the first principle across three levels of government and a wide range of relevant stakeholders. It is supported by the Department for International Development of the UK Government funding through an accountable grant to NIUA.

The programme developed through the process of co-creation and multiple rounds of consultation with the key relevant stakeholders and beneficiary groups highlights the value of working with target beneficiaries - persons with disabilities, elderly, women & children (People) as change agents. The transformation in action is the identification of existing gaps in policies and guidelines (Policy) relevant to the above beneficiaries and demystification to a larger group of stakeholders. Outcomes envisaged include more accessible, safe, and inclusive placemaking (Place) for a better quality of life and liveable communities & neighbourhoods.

This curation of accessible, safe and inclusive cities through People-Policy-Place (P3) in a collaborative manner with all the quadruple helix actors - government, civil society, academic & research, and industry/start-up on-board is a step towards sustainable development goals.

Keywords: India, inclusive, safe, accessible, persons with disabilities

2 INTRODUCTION

Urbanization is characterized by rapid economic growth, industrial development and aspiration to reduce poverty. Urbanization intends to achieve an improved quality of life, attributes to better employment & education, socio-economic growth, ease of availability of products, higher level of facilities and services, and provisions of recreation, and entertainment. However, the complex structure of urban societies often leads to the marginalization thus creating inequality and discrimination. This includes transportation, healthcare, and social welfare among many other services, which may not always be emphathetic to the needs of vulnerable groups, including persons with disabilities, elderly, women, and children.

Higher densities, stress on available resources, and degrading quality of environment have already made urban living in Indian cities quite challenging in itself and it is particularly true for these vulnerable groups. Lack of universal design is a challenge in most of the public buildings including schools, banks, offices, and public open spaces. Restricted mobility, dependence on others, lack of sensitivity among fellow citizens, create a sense of insecurity and isolation among these vulnerable groups, impacting their physical as well as mental health. Abuse, social stigmas, and exposure to accidents and crime have created a sense of fear. The estimates point out that around 25% of India's population would need universal accessibility to live independently and with dignity, making it imperative to emphasize on 'Accessible and Inclusive component' as the right path for achieving sustainable development.

3 BASIIC PROGRAMME

National Institute of Urban Affairs (NIUA) in collaboration with Ministry of Housing and Urban Affairs (MoHUA) and support from the Department for lnternational Development (DFID) of the UK Government is implementing the programme "Building Accessible, Safe & lnclusive Indian Cities (BASllC)" through a Technical Assistance Support Unit (TASU) established at NIUA. The principal goal of BASIIC is to build the capacities of Indian cities to be sensitive and responsive to the needs of the persons with disabilities (PwDs) and vulnerable sections including elderly, women, and children. It aims to homogenize the relevant definitions and concepts and to holistically build the capacity of practitioners to plan and implement the tenets of universal access and inclusiveness. The programme shall also actively work to gather the key

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stakeholders on a common platform and demonstrate innovative solutions – technologies, programs, and service delivery models in the realm of universal access. It will develop a monitoring and evaluation framework for pilot cities to assess and improve their standards of universal access and inclusivity and promote replicability in other Indian cities.

3.1 Key objectives

- Revision and integration of the policies, guidelines, and standards for universal access, safety, and inclusivity to all but more so for Persons with Disabilities and vulnerable sections- (Policy)
- Mapping the areas of opportunity in implementation of policies and provisions at the city level and replicable solutions for making cities more accessible and inclusive for PwDs - (Place)
- Empowerment of practitioners and relevant communities (professional and citizen-led) through peer-to-peer learning, knowledge management and capacity building for long-term sustainability - (People)

3.2 Key focus areas

- Universal Design & Accessibility projects (Pan city/ Area-based), Safety Initiatives (Spatial and social), Inclusive Policy & Guidelines for persons with a disability, women, elderly, and children in the urban areas (especially smart cities), Use of assistive technology and IoT in Urban development; Social security & Schemes

4 CURATION THROUGH CO-CREATION

The programme intends to pursue the approach further and bring in a paradigmatic change in the existing urban planning and design process by assimilation of the tenets of universal accessibility & safety, ultimately leading to a holistic approach towards inclusive development. Adopting the UNCRPD motto of "Nothing for Us - with Us", the programme is entirely designed through the process of co-creation and participation and activation of a continuous dialogue among various relevant stakeholders. Pre-emptive and participatory planning, Capacity building of the urban policymakers and practitioners as well as strengthening the existing legislative framework through advocacy initiatives are among some of the transformational approaches adopted by the programme to achieve the expected outcomes.

The process of co-creation as adopted by the programme is a five-step progressive approach to Engage, Understand, Ideate, Define, and Validate and has been reflected in the aim and objectives of the programme. The genesis of the programme is based on the recommendations given in a consultation held in September 2018. It highlighted legislative framework and guidelines, inclusive design & planning, institutional arrangement & capacity building, awareness generation, up-gradation of ICT components in smart cities, and regular monitoring and evaluation as six major areas of interventions.

The follow-up consultation held in September 2019, resulted in finalization of the programme framework and tenets through the process of co-creation.

5 THE ART OF CURATING AN ACCESSIBLE, SAFE & INCLUSIVE CITY

The proccess of curation under this programme is structured around three key areas – People, Policy, and Place that are critical for an accessible, safe, and inclusive city.

5.1 People

Marginalized or under represented communities can be broadly categorized into following two vulnerable groups, based on

- Socio-Economic Characteristics – like caste, race, income
- Demographics/ physical & emotional state of a person- like disability, age, sex, etc

The programme targets the vulnerable groups belonging to the second category as the beneficiaries. The vulnerable groups including persons with disabilities, elderly, women, and children often faced discrimination due to a lack of access to the opportunities of personal growth. Limited or no accessibility of the built environment, from housing to street designs, to public buildings and public open spaces, and limited

inclusion of the policies and urban services including water & sanitation, healthcare & education systems, and livelihood opportunities, barriers to information and technologies, have hindered their path of empowerment. The cultural attitudes including negative stereotyping and social stigma and exposure to crimes, abuse, and accidents have further led to their marginalization in the urban areas. It is in this context, that a need has been identified to adopt a bottom-up approach of ideation of innovative ways to improve access to build environments, basic services, emergency response, and information for targeted vulnerable groups. The needs and potential of each individual are different depending upon the types of disability, age, sex as well as socio-economic status. The huge diversity among the target groups makes it important as well as interesting to include their participation in the art of curation of accessible, safe, and inclusive cities.

Since its inception, the program has managed to identify and connect with important stakeholders and the opportunities for the National Institute of Urban Affairs to leverage its strengths in the area of accessibility, inclusivity, and safety, especially in the evolving urban ecosystem. The programme has associated itself with the Ministry of Housing & Urban Affairs, Government of India and Ministry of Social Justice & Empowerment, Government of India, and has represented itself at various platforms. Disable person organizations (DPOs), Civil Societies, research organizations, and private entities working actively in the field have been identified, consulted, and engaged over time.

The program currently finds itself at a critical juncture, where validation of its understanding of the sector, highlighting the areas of priority, and forging partnerships for achieving envisioned objectives are its primary objectives for success. Moreover, with the BASIIC program, NIUA at an institutional level intends to mainstream the dialogue on accessibility, safety, and inclusivity in the urban context. It is in this context that the need for a variety of time-critical consultations with the identified stakeholders at the city, state, and national levels is critical. These consultations have made "People" Participation a significant part of the programme which will directly or indirectly feed into the programmes intended outcomes, support partner cities in their plans, and subsequently, fortify NIUA's role in the urban narrative of "Cities for All".

5.2 Policy

India is a signatory to the 'Declaration on the Full Participation and Equality of People with Disabilities in the Asia Pacific Region' (2000). It also signed the 'Biwako Millennium Framework' (2002) for developing an inclusive, barrier-free, and rights-based society. The 'Biwako Plus Five' (2007) further efforts towards an inclusive, barrier-free, and rights-based society for persons with disabilities in Asia and the Pacific'. India has also ratified the 'UN Convention on the Rights of Persons with Disabilities' (2008). In the revision of relevant acts, as a response to the participation in the UNCRPD, the need components of accessibility, safety, and inclusivity of disable persons in the built environment have been stressed.

Under the National Policy for Persons with Disabilities (2006), PwDs are recognized as valuable human resource for the country, underlining the need for the creation of a facilitating environment that provides equal opportunities and focus on the protection of their rights. National Institution for Transforming India (NITI) Aayog, Government of India has been emphasizing on Sustainable Development Goals (SDG) goals/targets to be reflected in all state/ local government programs and policies. The SDG 10 signifies "equal opportunity" to all which strengthens the need for inclusivity of the unprivileged and the vulnerable including the Persons with Disabilities.

Some of the key urban missions of Ministry of Housing & Urban Affairs, Government of India - Swachh Bharat Mission (SBM-U), Pradhan Mantri Awas Yojana - Urban (PMAY-U), Smart Cities Mission, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), National Heritage City Development and Augmentation Yojana (HRIDAY) promote accessibility and inclusivity practices in the development process. Enforcement and implementation on the ground is seen as the major challenge with varying impact. It is, therefore, required to clearly define the extent of inclusion and accessibility provisions to ensure stringent implementation.

Following are some of the observations derived based on a detailed review of the existing acts, policies, and guidelines as well as global treaties and conventions. It highlights participation and consultation of the stakeholder as one of the key components to achieving inclusivity in the policies and schemes.

(1) The need was felt for a comprehensive and holistic approach towards universal access, safety and inclusivity into the urban development, better incorporation and cross-referencing among the different

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guidelines, integration into the statutory system, and participation of the stakeholder in the development process.

(2) Community integration, the extent of involvement, engagement, and participation of an individual in the same manner as the typical citizen in the community, is an important issue for individuals with disabilities, the elderly, women and children.

(3) Critical role of sensitization and awareness among the citizens.

5.3 Place

A systematic review and analysis of the current and proposed projects of all 100 Smart Cities in India was conducted to understand the potentials of partnership. Among the shortlisted cities, Varanasi has been selected as the first Partner city for BASIIC. As a part of the technical assistance to cities, TASU has identified a 5-point engagement strategy –

(1) Review of DPRs, Project Specific Report, Policy Brief for planning, and designing cities 'accessible for all'

(2) Capacity development of the City Stakeholders on universal design/inclusive planning and design principles

(3) Implementation of the pilot interventions in the cities

(4) Cross learning from other smart cities about similar interventions

(5) Setting up of Monitoring, Learning and Evaluation Mechanism

6 CITY AUDITS ON BASIIC TENETS

A comprehensive audit is also planned to be conducted in the partner cities. This will assist in drawing insights on the current status of accessibility, safety and inclusivity of city-level infrastructure. The audits will support th Urban Local Bodies (ULBs) in –

- Understanding the major gaps around the accessibility value chain
- Planning for the demonstration of innovative solutions in the ULBs
- In developing a sound monitoring system for accessibility in the city
- Bridging the gap between policy/guidelines and implementation at a city level

7 CONCLUSION:

The process of co-creation will also bring in a sense of ownership among the stakeholders. Addressing equitable participation by ensuring information is available in accessible formats, accessibility of public and private transportation, inclusive opportunities for civic, cultural, education and voluntary engagement and barrier-free and enabling interior and exterior spaces, which will trigger the cyclic effect of the tenets of accessibility, safety, and inclusivity and ensure all persons can participate in urban transformation and make productive contributions to society, thereby creating "Cities for All" in its pristine form.

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Folgen des Corona-Lockdowns in Innenstädten und die kreativen Ideen von Einzelhandel, Gastronomie und Dienstleistung

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(Prof. Dr. Silke Weidner, BTU Cottbus Senftenberg, Fachgebiet Stadtmanagement; Cottbus, DE, weidner@b-tu.de)

Folgen des Corona Lockdowns in deutschen Innenstädten

und die kreativen Reaktionen von Einzelhandel, Gastronomie und Dienstleitungstreibenden

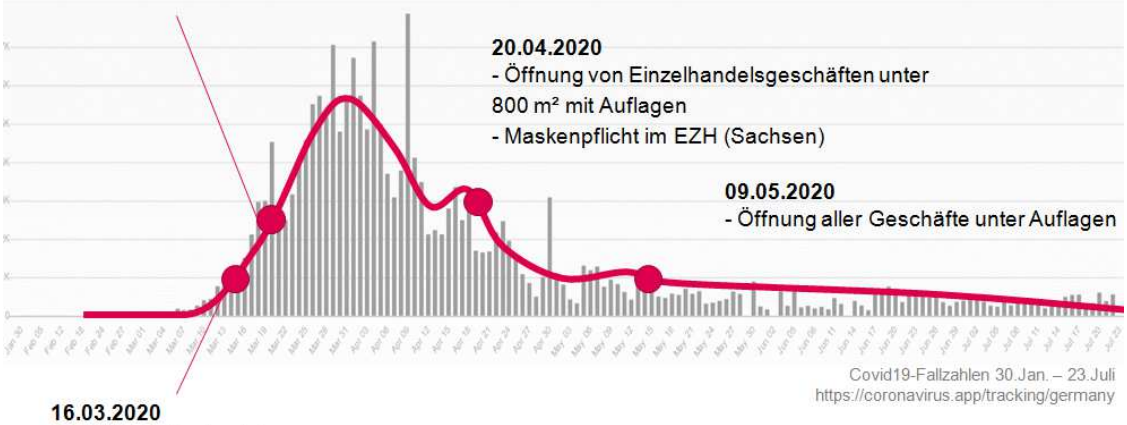
eine Slideshow mit Bild + Zahl

Prof. Dr. Silke Weidner und
Juliane Ribbeck-Lampel
Fachgebiet Stadtmanagement
BTU Cottbus - Senftenberg

Prof. Dr. Silke Weidner und Juliane Ribbeck-Lampel
Fachgebiet Stadtmanagement BTU Cottbus - Senftenberg

Einschränkungen im Lockdown

22.03.2020
- Umfassende Ausgangs-/Kontaktbeschränkung
- Schließung div. Dienstleistungseinrichtungen sowie gastronomischer Einrichtungen



20.04.2020
- Öffnung von Einzelhandelsgeschäften unter 800 m² mit Auflagen
- Maskenpflicht im EZH (Sachsen)

09.05.2020
- Öffnung aller Geschäfte unter Auflagen

Covid19-Fallzahlen 30.Jan. – 23.Juli
https://coronavirus.app/tracking/germany

16.03.2020
- Bundesweiter Lockdown
- u.a. Schließungen der Außengrenzen, von Freizeit- und Kultureinrichtungen, Spielplätzen und Geschäften

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Prof. Dr. Silke Weidner und Juliane Ribbeck-Lampel
Fachgebiet Stadtmanagement BTU Cottbus - Senftenberg

Snapshots ausgewählter Innenstädte:

Monofunktionalität und Nutzungsmischung; Öffentlicher Raum, Frequenzen und Belebung

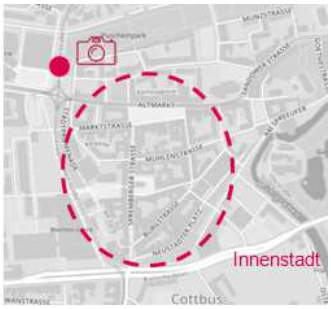
Prof. Dr. Silke Weidner und Juliane Ribbeck-Lampel
Fachgebiet Stadtmanagement BTU Cottbus - Senftenberg

Cottbus

Gastronomie: Friedrich-Ebert-Straße

sehr zurückhaltende Nutzung der wiedereröffneten Einrichtungen

erhoffte Besucherfrequenz bleibt aus



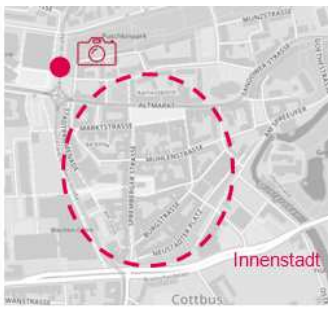
25.03.2020 Ausgangsbeschränkung und geschlossene Gastronomie

19.05.2020 Öffnung Gastronomie unter Auflagen

Prof. Dr. Silke Weidner und Juliane Ribbeck-Lampel
Fachgebiet Stadtmanagement BTU Cottbus - Senftenberg

Cottbus
Gastronomie: Friedrich-Ebert-Straße

Angebote zur Vorbestellung und Abholung werden angenommen



25.03.2020 Ausgangsbeschränkung und geschlossene Gastronomie

19.05.2020 Öffnung Gastronomie unter Auflagen

Prof. Dr. Silke Weidner und Juliane Ribbeck-Lampel
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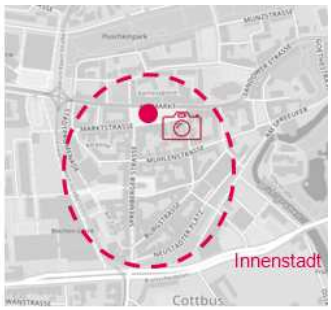
Cottbus
Gastronomie: Altmarkt

Hotspots der Gastronomie leiden gleichermaßen wie Nebenlagen



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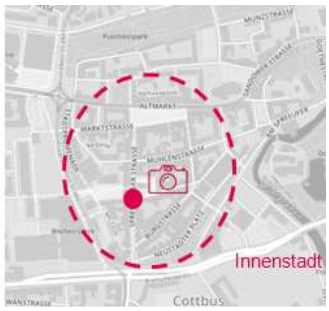
Cottbus
Einzelhandel: Spremberger Straße

Einzelhandel läuft auch in der 1A-Lage nur schleppend an; temporärer Handel (Markt) belebt etwas



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19.05.2020 Öffnung von EZH unter Auflagen

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Forst (Lausitz)
Einzelhandel: Cottbuser Straße

Frequenzsteigerung durch Aufhebung der Ausgangs- und Kontaktbeschränkungen belebt stationären Einzelhandel in Kleinstädten gering

27.03.2020 Ausgangsbeschränkung und geschlossene Gastronomie

23.04.2020 Öffnung von EZH unter 800m²

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Fachgebiet Stadtmanagement BTU Cottbus - Senftenberg

Forst (Lausitz)
Einzelhandel: Cottbuser Straße

Einzelhandel in den Randlagen leidet stark

27.03.2020 Ausgangsbeschränkung und geschlossene Gastronomie

23.04.2020 Öffnung von EZH unter 800m²

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Luckenwalde
Einzelhandel: Breite Straße

bereits schwache Handelslagen leiden unter dem Lockdown am stärksten
nach der Aufhebung von Ausgangs- und Kontaktbeschränkungen bleiben viele Innenstädte verwaist

26.03.2020 Ausgangsbeschränkung und geschlossene Gastronomie

23.04.2020 Öffnung aller Geschäfte unter Auflagen

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Leipzig
Einzelhandel: Höfe am Brühl

am Rande der innerstädtischen Shopping Center bleibt es zunächst eher ruhig

25.03.2020 Ausgangsbeschränkung und geschlossene Gastronomie

28.04.2020 Öffnung aller Geschäfte unter Auflagen

20.07.2020 Öffnung aller Geschäfte unter Auflagen

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Leipzig
Einzelhandel: Altes Rathaus / Marktplatz

der Marktplatz: selbst nach mehreren Lockerungen leer – die Touristen fehlen!

25.03.2020 Ausgangsbeschränkung und geschlossene Gastronomie

20.04.2020 Öffnung von EZH unter 800m²

20.07.2020 Öffnung aller Geschäfte unter Auflagen

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Leipzig
Gastronomie: Katharinenstraße

auch in der Gastronomie fehlen die Touristen

28.04.2020 Öffnung aller Geschäfte unter Auflagen; Gastronomie nur außer Haus Verzehr

25.03.2020 Ausgangsbeschränkung und geschlossene Gastronomie

20.07.2020 Öffnung aller Geschäfte unter Auflagen

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Leipzig
Gastronomie: Barfußgäschen

monofunktionale Bereiche sind erst völlig verwaist und warten nach wie vor auf die Touristen…

20.04.2020 Öffnung von EZH unter 800m²

25.03.2020 Ausgangsbeschränkung und geschlossene Gastronomie

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kreative Reaktionen

von Einzelhandel, Gastronomie und Dienstleitungstreibenden

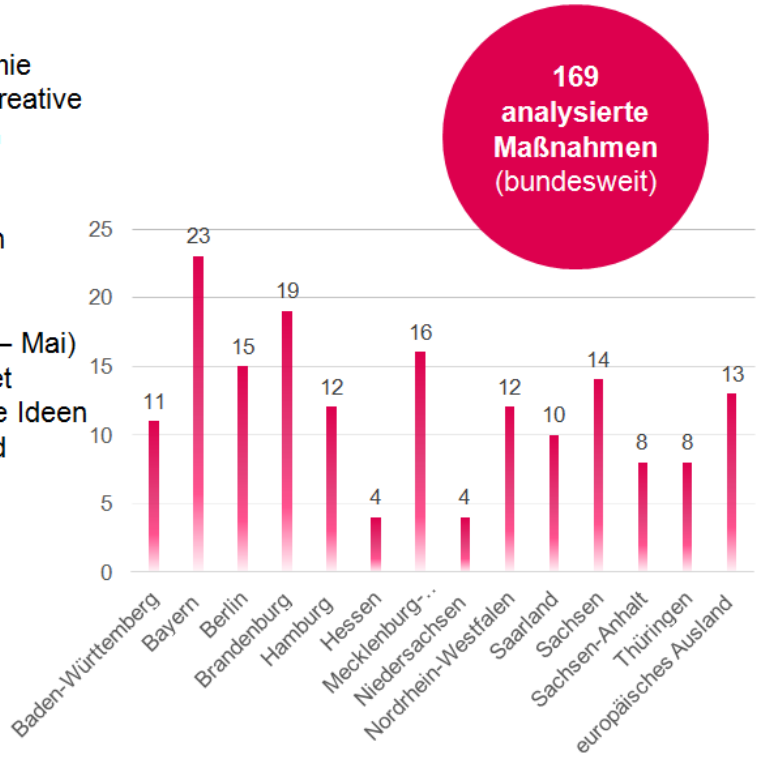
Prof. Dr. Silke Weidner und Juliane Ribbeck-Lampel
Fachgebiet Stadtmanagement BTU Cottbus - Senftenberg

Kreative Reaktionen

von Einzelhandel, Gastronomie und Dienstleistungstreibenden

Im Rahmen der Covid-19 Pandemie haben zahlreiche Unternehmen kreative Ideen entwickelt und Maßnahmen ergriffen, um trotz der Ausnahmesituation den zumeist unumgänglichen Umsatzeinbußen entgegen zu wirken.

Im Sommersemester 2020 (April – Mai) haben Studierende am Fachgebiet Stadtmanagement der BTU, diese Ideen und Maßnahmen recherchiert und analysiert.



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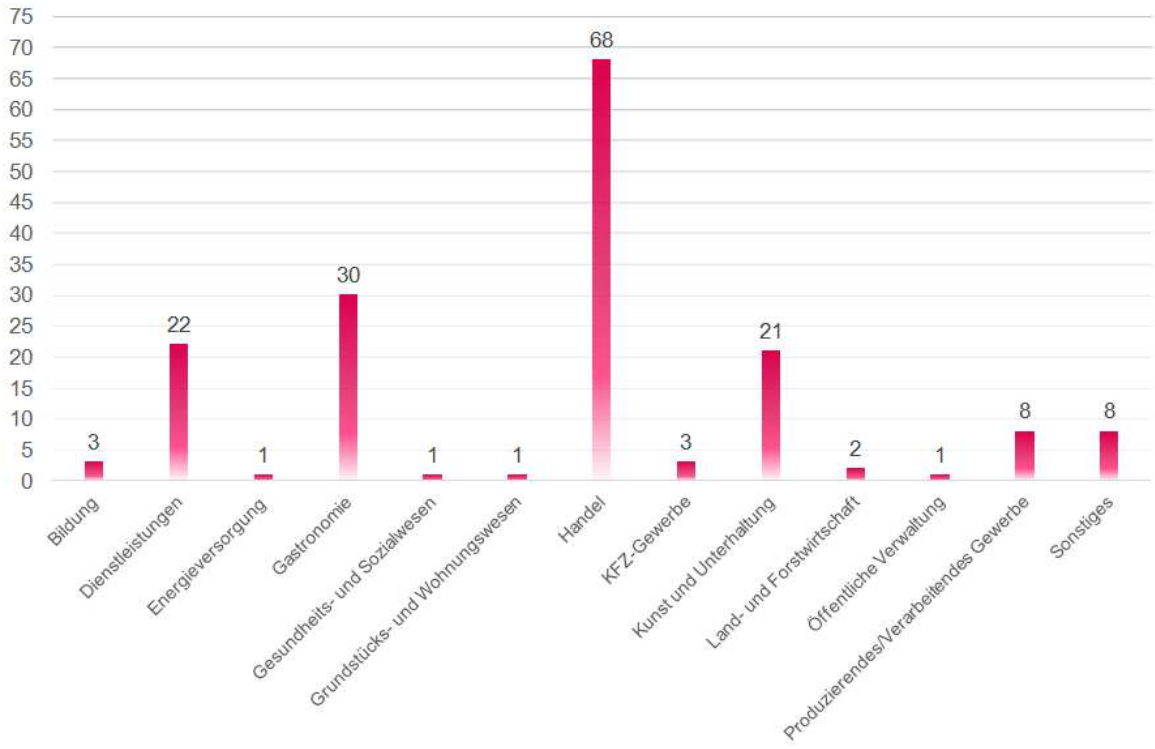
Wirtschaftszweige der analysierten Beispiele



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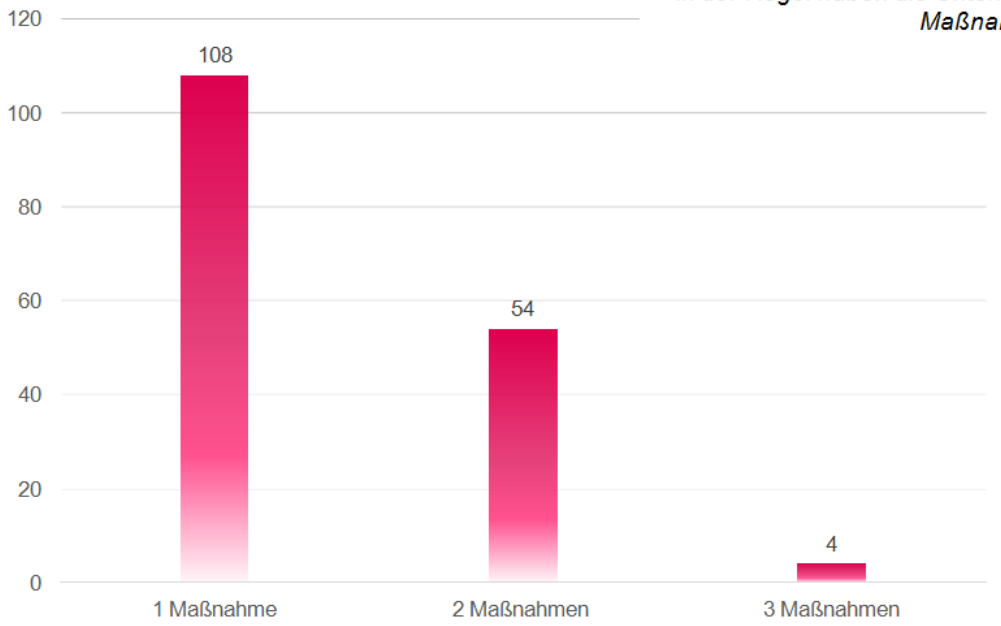
Anzahl der getroffenen Maßnahmen
je Unternehmen

in der Regel haben die Unternehmen eine Maßnahme ergriffen



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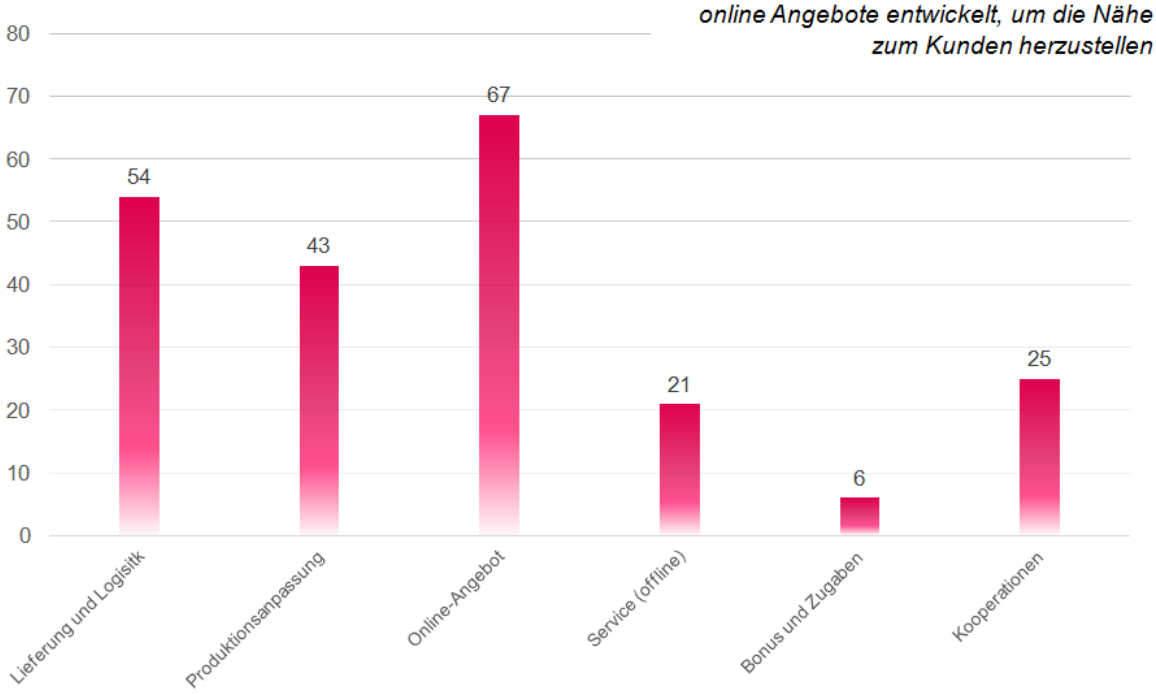
Maßnahmenvielfalt
Kategorien

viele stationäre Anbieter haben online Angebote entwickelt, um die Nähe zum Kunden herzustellen



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Maßnahmepakete
Abholung, Lieferung und Logistik

→ Lieferung und Logistik

- Spezialisierung/Umstellung auf Außer-Haus-Lieferung von Restaurants oder Läden
- Umstellung auf Versand von Artikeln
- Spezielle Angebote zur Abholung von Produkten

Sonntags-Lieferung von Lebensmitteln
Foto: Picnic (2020).

https://logistra.de/news/nfz-fuhrpark-lagerlogistik-intralogistik-corona-krise-sonntagslieferung-fuer-lebensmittel-geplant-48888.html

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Maßnahmepakete
Anpassung / Umstellung der Produktion

→ Erweiterung des Sortiments

- Unternehmen (z.B. Tischlerei), die sich nun auf die Produktion von Ladeneinrichtung (z.B. Glas- und Plexiglasscheiben, Abstandsaufkleber, etc.) spezialisieren oder Textilunternehmen, die nun Schutzmasken nähen
- Brauereien, die Desinfektionsmittel herstellen
- Restaurants, die Gerichte zum „zuhause-selber-fertig-kochen" zubereiten

Erzieherinnen nähen Schutzmasken für Senior*innen
Foto: Achtermann (2020).

https://www.dieharke.de/Nachrichten/Naehen-statt-Kinderbetreuung-93710.html

Bierbrauerei stellt Desinfektionsmittel her
Foto: Seidel (2020)

https://www.freiepresse.de/desinfektionsmittel-und-bier-brauerei-erweitert-produktion-artikel10769078

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Maßnahmepakete
Online Angebot

→ Neue Online Angebote

- Unternehmen, die nun einen Online-Shop gründen / ausbauen
- Fitness-Studios, Tanz- und Musikschulen bieten Online-Kurse
- Gründung von Onlinep-Portalen z.B. für Homeschooling
- …

Tanzschule geht online
Foto: Julia (2020).

https://www.butenunbinnen.de/nachrichten/aktionen/coronageschichten/coronageschichten-tanja-100.html#&gid=coronageschichten-tanja-100&pid=2

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Maßnahmepakete
Persönlicher Service

→ Service und Individualität

- Ladenöffnungen auf Anfrage
- Persönliche Beratungen per Telefon / Videochat
- Künstler, die nach Hause kommen und dort ein persönliches Konzert geben
- …

Kundenberatung am Telefon und per Whatsapp
Foto: Gebhard (2020).

https://m.westfalen-blatt.de/OWL/Kreis-Herford/Vlotho/4181465-Vlothos-Geschaeftsleute-sind-auch-in-der-Corona-Krise-fuer-die-Kunden-da-Beratung-per-WhatsApp-und-Telefon

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Maßnahmepakete
Vergabe von Werbegeschenken

→ Bonus und Zugaben

- Zugaben zu den Einkäufen als Lockmittel (Klopapier als Giveaway, Gutscheine je 10 € Einkaufswert,..)
- Gutscheine für bestimmte Personen/Berufsgruppen
- …

Fleischer will mit einer Rolle Klopapier pro Einkauf als Giweaway punkten
Foto: Essler (2020).

https://www.mdr.de/sachsen/bautzen/goerlitz-weisswasser-zittau/fleischer-spitzkunnersdorf-gibt-klopapier-gratis-dazu-100.html

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Maßnahmepakete

Zusammenschluss / Gegenseitige Unterstützung

→ Kooperationsansätze

- Unternehmenskooperationen, um mehr Kunden zu erreichen
- Online-Portale zur Vermittlung (z.B. Erntehelfer und Bauern)
- Spenden, Crowdfunding o. Ä.
- …

Onlineportal Erntehelfer daslandhilft.de (2020).

https://www.mdr.de/sachsen/corona-hilfe-portale-100.html

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Lessons Learned

- Lockdown wirkt langfristig auf Einzelhandels- und Gastronomielagen und damit auf die Innenstädte und den öffentlichen Raum
- Rückbesinnung auf Tugenden im Handel: Kreativität und Service machen den Unterschied
- der Händler sucht wieder die Nähe zum Kunden
- Beschleunigung der Verschmelzung von stationären und Online-Angeboten
- Kooperationen werden gestärkt

Hygieneartikel anstelle von Getränkelieferung kreative Lösungen helfen über den Lockdown

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