

**SMART AND SUSTAINABLE CITIES INCLUSIVE OF PEOPLE WITH
DISABILITIES - AN EXPLORATORY STUDY USING DIGITAL TOOLS AND
PARTICIPATORY PRACTICES**

“SMART CITIES”, MET INCLUSIE VAN MENSEN MET EEN HANDICAP - EEN VERKENNENDE
STUDIE MET BEHULP VAN DIGITALE INSTRUMENTEN EN PARTICIPATIEVE PRAKTIJKEN

by

Nataša Rebernik

A dissertation submitted in fulfilment of the requirements for the joint degree of Doctor of Philosophy, within the PhD program in Engineering for the Information Society and Sustainable Development (University of Deusto, Bilbao, Spain) and PhD program in Communication Studies (University of Antwerp, Belgium).

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Bilbao, June 2020

Smart and Sustainable Cities Inclusive of People with Disabilities – An Exploratory Study Using Digital Tools and Participatory Practices

“Smart cities”, met inclusie van mensen met een handicap – een verkennende studie met behulp van digitale instrumenten en participatieve praktijken

Ciudades inteligentes y sostenibles que incluyan a las personas con discapacidad – Un estudio exploratorio utilizando herramientas digitales y practicas participativas

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Abstract

Cities are still not conducive to the needs of people with disabilities, and even modern conceptualisations of smart and sustainable cities seem to be to some extent unprepared to meet the requirements of disability inclusion. Thus, inclusion is still not reflected in the real lives of people with disabilities. The main research questions explored in this thesis are the issues of what a disability-inclusive city truly means, and how can we make its complexity more comprehensive to relevant stakeholders, allowing them to respond with informed measures. In this context, potential approaches, methods and tools that can be used to enhance disability-inclusive city planning, design and governance are explored. The objective is to design a novel methodological framework and useful practical tools for future urban research, practice and decision making. A city is a complex system of subsystems that need to work together as a whole. It is argued here that due to the complex and diverse nature of both disability inclusion and the city itself, and due to the overwhelming complexity of current political, legislative and standardisation frameworks in the disability domain, new holistic, integrative and participatory models are needed to help stakeholders tackle this complexity. Previous research has shown that cities still face an insurmountable number of societal challenges, especially when considering the design of cities that are inclusive of all their inhabitants. In order to tackle these challenges, a vision is put forward of a holistic approach to disability-inclusive city design. A disability-inclusive city is conceptualised as a holistically designed and purposeful system of subsystems that respects disability inclusion as a basic principle. Using participatory research grounded in deep, slow and small-data-oriented ethnographic techniques, the way in which these challenges appear and interact via the dimensions of human-space-technology is explored. An exemplary novel methodological framework is developed with a four-dimensional model and a corresponding combined methodological approach that is designed to help cities explore the needs, characteristics, opinions, aspirations, desires, constraints and attitudes of people with disabilities towards their disability, the governance of the city, the spaces they use and the technology that could help make the city more accessible. In the context of the contemporary digitalised world, in which technology penetrates our everyday lives, an exploration is carried out of the currently available digital tools that can help people with disabilities, city authorities and researchers in paving the way towards more disability-inclusive cities. Within this exploration, I also investigate what these tools can do, how they can be used, what benefits they bring to disability-inclusive design and how they impact the lives of people with disabilities in the city. The fieldwork presented here shows that technology can both enable and disable people with

disabilities in terms of using space, meaning that it may be of great use and can augment the physical world by adding additional layers of immaterial information for people with disabilities but it cannot magically remove barriers for them. It may also change the disability itself, and thus limit both the use of the space and the technology. This in-depth participatory work shows how important it is to understand the complexity, diversity and individuality among citizens to enable the informed, responsive, disability-inclusive design of both cities and technology. The proposed methodological framework specifically responds to this gap, and provides a methodological contribution that goes beyond this research. Finally, by designing a novel Disability Inclusion Evaluation Tool (DIETool) with a Disability Inclusion Performance Index (DIPI) component, I attempt to close the circle and to respond to the initial vision of a holistically designed disability-inclusive city. The proposed tool translates complex political, legislative and standardisation requirements into a simple, comprehensive form that can guide cities towards an improved understanding of where they are in terms of disability inclusion performance in 20 different areas of city life. As an evaluation and monitoring tool that is unique in the disability domain, it represents the final contribution of this research.

Abstract

Steden staan nog steeds niet sympathiek tegenover de behoeften van mensen met een handicap. Zelfs conceptualisaties van moderne en duurzame steden zoals “Smart Cities” lijken niet helemaal klaar te zijn om aan de eisen van een handicap-inclusieve stad te voldoen. De inclusie van mensen met een handicap wordt dus nog steeds niet weerspiegeld in het echte leven van mensen met een handicap. De belangrijkste onderzoeksvraag die binnen dit onderzoek wordt onderzocht, is wat een stad voor mensen met een handicap werkelijk betekent, en hoe we de complexiteit van de stad begrijpelijker kunnen maken voor de relevante belanghebbenden, zodat zij kunnen reageren met weloverwogen maatregelen. In deze context stel ik de vraag welke benaderingen, methoden en instrumenten kunnen worden gebruikt om de inclusieve stadsplanning, het ontwerp en het bestuur van de stad te verbeteren. Het doel hiervan is om een nieuw methodologisch kader en nuttige praktische instrumenten te ontwerpen voor toekomstig stedelijk onderzoek, de praktijk en de besluitvorming. De stad is een complex systeem van subsystemen die als geheel moeten samenwerken. Ik argumenteer dat door de complexe en diverse aard van de inclusie van personen met een handicap en de stad, en door een overweldigende complexiteit binnen de huidige politieke, wetgevende en standaardisatiekaders in het domein van personen met een handicap, nieuwe holistische, integratieve en participatieve modellen nodig zijn om de belanghebbenden te helpen om deze complexiteit aan te pakken. Vroeger onderzoek heeft aangetoond dat steden nog steeds geconfronteerd worden met een onoverkomelijke hoeveelheid aan maatschappelijke uitdagingen, vooral als het gaat om het ontwerp van steden die al hun inwoners omvatten. Om steden te helpen in het aanpakken van deze uitdagingen, heb ik vooraleerst een visie geformuleerd voor een holistische benadering van het ontwerp van steden voor mensen met een handicap. Ik benader een handicap-inclusieve stad als een holistisch ontworpen doelgericht systeem van subsystemen dat de integratie van gehandicapten als basisprincipe respecteert. Met behulp van participatief onderzoek op basis van “in-depth”, “slow” en “small-data”-georiënteerde etnografische technieken, onderzoek ik verder hoe deze uitdagingen zich voordoen en hoe ze op elkaar inwerken op de premisse van mens-publieke-ruimte-technologie. Ik bied een nieuw methodologisch kader aan dat als voorbeeld kan dienen, namelijk een 4-dimensionaal model en een bijbehorende “Combined Methodological approach” die ontworpen is om steden te helpen om de behoeften, kenmerken, meningen, aspiraties, verlangens, beperkingen en houdingen van mensen met een handicap ten opzichte van hun handicap, het stadsbestuur, de publieke ruimtes die ze gebruiken en de technologie die een stad toegankelijker kan helpen maken, te onderzoeken. In

de context van de hedendaagse digitaliserende wereld, waarin technologie die ons dagelijks leven binnendringt, onderzoek ik verder welke digitale instrumenten er vandaag de dag bestaan die mensen met een handicap, stadsbestuur en onderzoekers helpen om de weg vrij te maken naar inclusievere steden voor mensen met een handicap. Ik onderzoek wat deze instrumenten kunnen doen, hoe ze kunnen worden gebruikt, welke voordelen ze bieden voor het ontwerpen van een stad voor mensen met een handicap, alsook de manier waarop ze het leven van mensen met een handicap in de stad beïnvloeden. Mijn veldwerk toont aan dat technologie mensen met een handicap zowel kan ondersteunen als verhinderen in het gebruik van de publieke ruimte. Technologie kan van groot nut zijn en doordringen tot de fysieke wereld door extra lagen van immateriële informatie toe te voegen aan mensen met een handicap, maar het niet op magische wijze barrières voor hen wegnemen. Het kan ook de handicap zelf veranderen en als zodanig het gebruik van de ruimte alsook de technologie zelf beperken. Diepgaand participatief veldwerk toont aan hoe belangrijk het is de complexiteit, diversiteit en individualiteit onder burgers te begrijpen voor de ontwikkeling van een geïnformeerd en responsief handicap-inclusief ontwerp van zowel de stad als de technologie. Het voorgestelde methodologische kader beantwoordt precies aan deze hiaat, en levert een methodologische bijdrage die verder gaat dan dit onderzoek. Tot slot poog ik door het ontwerpen van een nieuwe Disability Inclusion Evaluation Tool (DIETool) met zijn component Disability Inclusion Performance Index (DIPI) de cirkel te sluiten, en beantwoorden aan mijn oorspronkelijke visie van een holistisch ontworpen handicap-inclusieve stad. Het instrument vertaalt complexe politieke, wettelijke en standaardisatie-eisen in een eenvoudig, uitgebreid instrument dat steden begeleidt naar een beter begrip van waar ze staan in termen van prestaties op het gebied van integratie van gehandicapten in elk van de 20 gebieden van het stadsleven. Deze tool is een uniek evaluatie- en monitoringinstrument op het gebied van handicaps, en vormt de uiteindelijke bijdrage van dit onderzoek.

Resumen

Las ciudades todavía no se muestran comprensivas con las necesidades de las personas con discapacidades. Incluso las concepciones modernas de ciudades inteligentes y sostenibles parecen no estar totalmente preparadas para cumplir con los requisitos de una ciudad inclusiva con la discapacidad. Así pues, la inclusión de la discapacidad todavía no se refleja en la vida real de estas personas. La principal cuestión de investigación que se explora en esta tesis es qué significa realmente la ciudad inclusiva para la discapacidad y cómo podemos hacer que su complejidad sea más amplia para que las partes interesadas puedan responder con medidas informadas. En este contexto, me pregunto qué enfoques, métodos e instrumentos podrían utilizarse para mejorar la planificación, el diseño y la gobernanza de las ciudades inclusivas para las personas con discapacidad. El objetivo es diseñar un marco metodológico novedoso e instrumentos prácticos útiles para la investigación, la práctica y la adopción de decisiones urbanas en el futuro. La ciudad es un sistema complejo de subsistemas que necesitan trabajar juntos en conjunto. Sostengo que, debido a la naturaleza compleja y diversa de la inclusión de la discapacidad y la ciudad, y debido a la abrumadora complejidad de los actuales marcos políticos, legislativos y de normalización en el ámbito de la discapacidad, se necesitan nuevos modelos holísticos, integradores y participativos para ayudar a las partes interesadas a hacer frente a esta complejidad. Investigaciones anteriores han demostrado que las ciudades siguen enfrentándose a una cantidad insuperable de problemas sociales, especialmente cuando se considera el diseño de ciudades que incluyan a todos sus habitantes. Para ayudarles a hacer frente a esos desafíos, en primer lugar, establecí una visión de un enfoque holístico del diseño de ciudades inclusivas para los discapacitados. Conceptualizo una ciudad inclusiva para los discapacitados como un sistema de subsistemas con un propósito holístico que respeta la inclusión de los discapacitados como un principio básico. Utilizando la investigación participativa basada en técnicas etnográficas profundas, lentas y orientadas a los datos pequeños, exploro más a fondo cómo estos desafíos aparecen e interactúan bajo la premisa de la tecnología del espacio humano. Proporciono un marco metodológico novedoso y ejemplar, un modelo cuatridimensional y el correspondiente enfoque metodológico combinado, concebido para ayudar a las ciudades a explorar las necesidades, características, opiniones, aspiraciones, deseos, limitaciones y actitudes de las personas con discapacidad con respecto a su discapacidad, la gobernanza de la ciudad, los espacios que utilizan y la tecnología que puede ayudar a hacer una ciudad más accesible. En el contexto del mundo contemporáneo de la digitalización, con la tecnología penetrando en nuestra vida cotidiana, continúo explorando qué herramientas digitales existen hoy en día y pueden ayudar a las

personas con discapacidad, las autoridades de la ciudad y los investigadores a allanar el camino hacia ciudades más inclusivas para los discapacitados. Exploro lo que pueden hacer estas herramientas, cómo pueden utilizarse, qué beneficios aportan al diseño inclusivo de la discapacidad y cómo repercuten en la vida de las personas con discapacidad en la ciudad. El trabajo de campo muestra que la tecnología puede tanto habilitar como deshabilitar a las personas con discapacidad mientras utilizan el espacio. Puede ser de gran utilidad, y penetrar en el mundo físico, si añadimos capas adicionales de información inmaterial a las personas con discapacidades, pero no se puede eliminar mágicamente las barreras para ellas. También puede cambiar la discapacidad en sí misma y, como tal, limitar tanto el uso de los espacios como la tecnología. Esa profunda labor participativa muestra lo importante que es comprender la complejidad, la diversidad y la individualidad de los ciudadanos para lograr un diseño inclusivo de la discapacidad, informado y receptivo, tanto de las ciudades como de la tecnología. El marco metodológico propuesto responde exactamente a esta laguna y ofrece una contribución metodológica que va más allá de esta investigación. Por último, al diseñar una novedosa Herramienta de Evaluación de la Inclusión de la Discapacidad (DIETool) con su componente Índice de Desempeño de la Inclusión de la Discapacidad (DIPI), intento cerrar el círculo y responder a mi visión inicial de una ciudad inclusiva de la discapacidad diseñada holísticamente. La herramienta traduce los complejos requisitos políticos, legislativos y de normalización en una herramienta sencilla y completa que guía a las ciudades hacia una mejor comprensión de dónde se encuentran en cuanto a los resultados de la inclusión de la discapacidad en cada una de las 20 áreas de la vida de la ciudad. Como instrumento único de evaluación y vigilancia en el ámbito de la discapacidad, representa la contribución final de esta tesis.

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Contents

1.	Introduction	1
1.2.	Research topic and scope.....	5
1.3.	Research aims and objectives	8
1.4.	Research hypotheses and questions.....	10
1.5.	Research methodology	12
1.6.	Research structure	13
1.7.	Publications	14
2.	Reflections on the Disability-Inclusive City: From Complexity Towards Simplicity for Improved Urban Policy and Practice.....	17
3.	A Vision of a Smart City Addressing the Needs of Disabled Citizens	46
4.	Understanding the Complexity of Inclusive Public Space Design – Reflections on the Case study of Slovenia.....	58
5.	A 4-dimensional Model and Combined Methodological Approach to Inclusive Urban Planning and Design for ALL.....	70
6.	Using Digital Tools and Ethnography for Rethinking Disability-Inclusive City: Exploring Material and Immaterial Dialogues.....	92
7.	Measuring Disability Inclusion Performance in Cities Using Disability Inclusion Evaluation Tool (DIETool).....	122
8.	Discussion and Conclusions.....	149
9.	References.....	159

List of Figures

Figure 1: The multidisciplinary nature of this research	5
Figure 2: The specific scope of this research – (smart) disability-inclusive cities	6
Figure 3: The specific scope of the research – interactions between citizens, cities and digital tools.....	7
Figure 4: Research structure and main results delivered by Papers 1–6.....	15

Abbreviations

BM – Behavioural Mapping

CMA – Combined Methodological Approach

DIETool – Disability Inclusion Evaluation Tool

DIPI – Disability Inclusion Performance Index

EC – European Commission

EHSIS – European Health and Social Integration Survey

EU – European Union

ICT – Information and Communication Technologies

PDCA Approach – Plan, Do, Check, Act Approach

POE – Post-Occupancy Evaluation

PWD – Persons with Disability/Disabilities

SDGs – Sustainable Development Goals

UN – United Nations

UNCRPD – United Nations Conventions on the Rights of Persons with Disabilities

UNPF – United Nations Populations Fund

“And suddenly you know: It's time to start something new and trust the magic of beginnings.”

Meister Eckhart

1. Introduction

Cities are complex systems that face a growing number of societal challenges. According to the United Nations Population Fund (UNPF, 2017), the urban population has already exceeded 50% of the global population, and is expected to increase rapidly in the coming years. Cities are becoming increasingly complex, and city governments are struggling to address both this complexity itself and the variety of needs of their citizens. As a result of this growing urban population, cities also face an increase in the number of people with diverse impairments, whether physical, sensory or cognitive. As reported by Eurostat, based on the European Health and Social Integration Survey (EHSIS), there were 70 million people aged 15 and over in the EU-27 in 2012 (Eurostat, 2018), a figure which does not take into account children with special needs. Additionally, the European Commission predicts that by 2025, more than 20% of Europeans will be 65 or over (Eurostat, 2018), which will add to the already high number of people living with impairments. Since the population is ageing, it is of great importance to acknowledge the elderly as a part of this vulnerable group of citizens, and to take them into account when considering the relevance of designing inclusive and accessible cities.

Vulnerable groups are particularly exposed to exclusion from social activities and the full enjoyment of their rights and duties as citizens and urban dwellers. An individual's ability to integrate into the city, navigate the environment and understand the information provided affects their health, well-being, ability to work and overall quality of life. By improving or eliminating barriers within society, it should be possible to decrease the level of disability and empower individuals towards personal and collective management. However, current urban research, policy and practice has not been keeping pace with these challenges. Cities are changing too slowly, and people with disabilities still face insurmountable barriers in terms of accessing urban spaces, services, products and information. Even the contemporary concept of a smart city, grounded in the principles of social, economic and environmental sustainability and conceptualised as a consciously organised, purposeful system of subsystems, components

and processes, may not be fully ready to meet the requirements for a fully disability-inclusive environment.

An inclusive city should be “a place where everyone, regardless of their economic means, gender, race, ethnicity or religion, is enabled and empowered to fully participate in the social, economic and political opportunities that cities have to offer” (UN Habitat, 2001, cited in Asian Development Bank, 2017, p. 4). However, research has shown that the inclusive city is mostly perceived in general terms of poverty and social inclusion, while disability inclusion is neglected. For instance, although social inclusion is at the heart of the 2030 Agenda for Sustainable Development, with its Sustainable Development Goals (SDGs) (UN Habitat, 2015), it lacks disability-specific goals, indicators and measures.

On the other hand, some disability-specific political, legislative and standardisation frameworks have been put in place (for example the UN Convention on the Rights of Persons with Disabilities (UN General Assembly, 2007), the UN Standard Rules (UN General Assembly, 1993), the European Disability Strategy 2010-2020 (EC, 2010a), and the European Accessibility Act (EC, 2015)). However, there is a lack of applicable approaches and tools that can help relevant stakeholders to translate these frameworks into more pragmatic terms and to better understand the overall complexity of their requirements.

Thus, in practice, design standards in the public realm still seem to relate to active, fully able-bodied males. As a result, vulnerable groups with a set of needs that differ from this norm are excluded. Disability inclusion is also too often perceived in terms solely of physical accessibility to the built environment, which overlooks factors such as access to information, communication and services for individuals with visual, hearing or intellectual impairments, for example.

Furthermore, there is a lack of academic dialogue across the disciplines that impact on disability-inclusive urban domains. This is also reflected in practice, resulting in an insufficient understanding of what disability inclusion really means, how complex and important it is, how it can contribute to the quality of life of residents, and finally, how it can be applied to their real lives. Among other aspects, there is a lack of communication among all the relevant urban stakeholders (urban dwellers, decision makers, architects, urban planners, designers etc.), which greatly contributes to the low overall level of awareness of disability inclusion. Consequently, this hinders the city’s capacity to respond to the overwhelming complexity of inclusive city design. This research therefore attempts to enhance communication across the intersection of multiple disciplines, such as disability studies, urban studies, anthropology,

information science, and others. As a response to the problems that have been identified, one of the main concerns of this thesis is an attempt to bridge the theoretical and practical understandings of a disability-inclusive city within such a highly multidisciplinary domain. Mediation between and across disciplines, and the promotion of disability-inclusive design within non-disability studies, have been some of the main challenges thus far. This dissertation therefore makes a unique contribution to the study of inclusive city design.

The growing urban population, its ageing and diversity introduce additional complexity to cities and demand carefully developed, holistic, integrative and participatory approaches to urban research, policy and practice. However, there is still a lack of such approaches, participatory practices and strong communication channels, and this contributes to unconnected, dispersed and fragmented inclusive planning and governance in cities.

In addition, due to the recent Covid-19 pandemic, and in the light of the economic, political, environmental and social crises that seem to mark contemporary times, challenges for cities and citizens are becoming even greater. Many people with disabilities and the elderly have reached points of personal crisis, and face greater risk of social exclusion on many levels. The social distancing rules and lockdowns imposed by countries, provinces and cities have meant not only limits on physical activity and a lack of psychosocial support, but also limits on personal assistance and access to essential medical services, products and equipment. They have shown that our systems are still very fragile in terms of responses to the needs of vulnerable groups. These sudden measures took away the means and tools for independence from those who needed them the most, and in the long term, may also influence vulnerable groups in an economic sense. These undoubtedly complex challenges will need to be addressed in the coming years, and new systems will need to be built.

The exploration presented in this dissertation does not tackle Covid-19 or any other specific crisis-related situation; however, it may offer tools and methods that can help to address new and emerging situations in cities in a deep, qualitative and holistic way, allowing cities to become readier to respond to such challenges in a citizen-centric way. Initially, this thesis contributes to the re-emerging question of how we can integrate people with disabilities more fully into society by building partnerships with them, understanding their needs and holistically integrating suitable solutions into city planning, design and governance systems from the ground up. It addresses questions of inclusion from the specific angle of a (smart) disability-inclusive city. The main research question of this work is: *What does a disability-inclusive city really mean, and how can we make its complexity more comprehensible to the relevant*

stakeholders, to allow them to respond with informed measures for improved disability inclusion in cities?

For this reason, a review is initially carried out of current urban academic research and practice to explore how it has responded to this question. Following an overview of this background, a list is drawn up of the societal challenges faced by cities when considering disability inclusion. An outline is given of potentially interesting approaches that are later combined, used and tested as a novel methodological approach for creating more inclusive cities. In addition, I explore the potential of contemporary city models as outlined in modern urban agendas (e.g. smart, sustainable and inclusive cities) in terms of disability-inclusive city design. An attempt is made to demonstrate that communication between diverse stakeholders should be enhanced, as this can improve the understanding of what disability inclusion truly means. With this aim, the focus is on participatory, in-depth, qualitative research practices, and specifically ethnography, a methodology that originates in anthropology, the scientific study of humans, human behaviour and societies. Information science is also considered, and diverse digital tools are investigated as possible solutions that may lead to a greater understanding of citizens' needs and thus have positive implications for the real lives of people with disabilities, particularly in these challenging times in which various crises may arise again in the future.

Digital tools and ethnography are used as part of a qualitative, deep, slow and small-data-oriented methodology, and a set of research questions is explored based on the premise of *human-space-technology* in order to better understand the reasons behind the gaps identified in current inclusive urban practices. In response to the findings, I propose a simplified view of the complex phenomenon of (smart) disability-inclusive cities, and I offer several empirical solutions to address the social challenges in cities that are identified here in relation to disability inclusion. These solutions include an in-depth participatory methodological framework and an evaluation tool designed to support cities in disability-inclusive city planning, design and governance.

1.2. Research topic and scope

As can be seen from Figure 1, the research presented here is located at the intersection of multiple disciplines, and has a highly interdisciplinary character. The core disciplines covered in this dissertation are information science, urban studies, disability studies, social sciences, and policy studies.

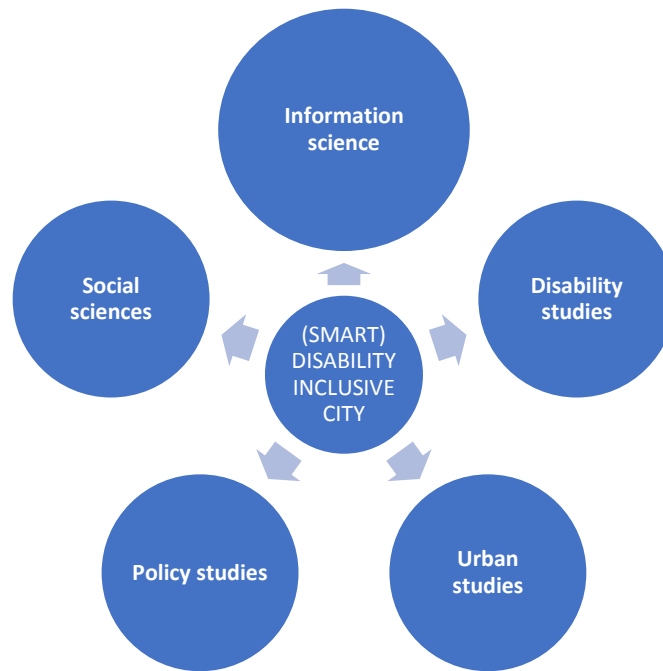


Figure 1: The multidisciplinary nature of this research

This research is aligned with the aims, goals and vision of the main global, European and national agendas for urban development, social inclusion, sustainable societies and disability rights. It builds upon the pillars of Europe 2020, e.g. *A digital agenda for Europe* (EC, 2010b), and *H2020 Societal challenges work programme: Europe in a changing world - inclusive, innovative and reflective societies* (EC, 2019).

The research goes further by addressing a specific set of societal challenges. It explores from an ethnographical point of view the ways in which contemporary cities are attentive, agile and responsive to the diversity of citizens' needs. Specifically, it focuses on current challenges in terms of responding to the needs of persons with disabilities when using city services, spaces and information.

As such, it is on the one hand aligned with urban agendas, such as the *2030 Agenda for Sustainable Development* (UN Habitat, 2015), while on the other it follows numerous disability

rights agendas, such as the *UN Convention on the Rights of Persons with Disabilities* (UNCRPD) (UN General Assembly, 2007) and the *European Disability Strategy 2010–2020* (EC, 2010a), and especially the three priority areas of accessibility, participation, and equality.

When questioning urban systems from the perspective of people with disabilities in the contemporary world, we need to speak about (smart) disability-inclusive cities. Figure 2 illustrates how this research gradually narrows down the scope from a city as an urban form to a (smart) disability-inclusive city, as a meaningful concept for respecting the needs of people with disabilities. A city is not necessarily a smart city; a smart city is not necessarily an inclusive city; and an inclusive city is not necessarily a disability-inclusive city.

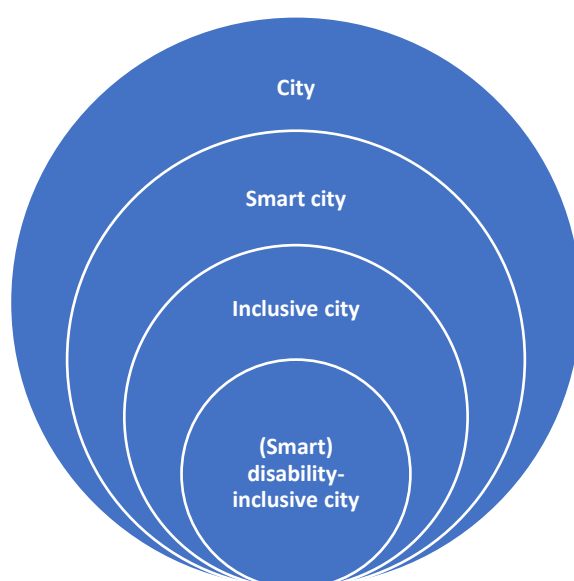


Figure 2: The specific scope of this research – (smart) disability-inclusive cities

However, the question remains as to what a ‘disability-inclusive city’ is. A few terminological clarifications are therefore needed. *Inclusion* is a relative concept and is dependent on the context. In broad terms, it may refer to social, economic or spatial inclusion, while in more specific terms, it may refer to racial, gender-based, ethnicity-based, age-based or disability inclusion. The ambiguous nature of the term ‘inclusion’, among others, led me to focus on the importance of disability inclusion, as well as on the questions of how disability inclusion is reflected in cities and how can we bring its understanding closer to policy makers who have the power to make real systemic changes. However, the term *disability* still does not say much about what a disability-inclusive city should look like. In practice, disability is often perceived only in terms of physical disability, or even only wheelchair use. These assumptions exclude a number of people that live with visual, hearing, intellectual, learning or even combined impairments. Furthermore, this overlooks a range of elderly and other people who may also

face one or more impairments. The role of individuality also appears to be fundamental when scholars and practitioners try to understand the needs of citizens and to design cities for people in accordance with their needs.

The main target groups involved with and benefiting from this research are therefore:

- 1) **Citizens**, and specifically **persons with disabilities and diverse impairments**, e.g.:
 - People with physical impairments;
 - People with visual impairments;
 - People with hearing impairments;
 - People with intellectual, learning and/or speech impairments;
 - People without an officially recognised disability status, e.g.:
 - Elderly people;
 - Individuals with short-term or long-term illnesses;
 - Individuals with short-term or long-term injuries;
 - Parents with children,
 - Any active citizen with a slight or moderate physical, visual or hearing impairment.
- 2) **City policy makers and practitioners** such as urban planners, designers, architects, community agents, maintenance workers, public administrative workers etc., who face challenges in terms of addressing citizens' needs.

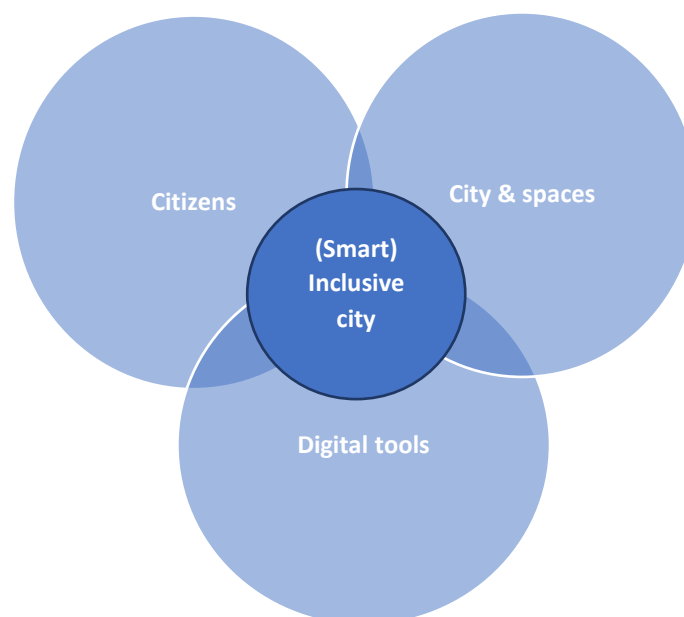


Figure 3: The specific scope of the research – interactions between citizens, cities and digital tools

With these targeted groups in mind, I further on observe, how modern technologies and participatory techniques can impact on a more disability-inclusive city planning, design and governance. Thus, I explore the interactions between these three dimensions as illustrated in Figure 3: (i) human (citizens with disabilities); (ii) spatial (cities as both organisational structures and spaces); and (iii) technological (new technologies and digital tools). As discussed in a later section, I have been specifically interested in how these interactions impact disability inclusion performance in cities in various ways.

1.3. Research aims and objectives

This dissertation carries out a holistic and qualitative exploration of the meaning, understanding and realisation of a disability-inclusive city as a vision. It examines how this issue is perceived among the relevant stakeholders, how it can be enhanced using participatory ethnographic research, and finally how modern digital tools and technologies such as smartphones can be used to support disability-inclusive city planning, design and governance.

This research provides a vision of a disability-inclusive city, discusses the associated conceptual, theoretical and terminological aspects, and offers a methodological and empirical framework based on digital tools and ethnographic participatory practices. Finally, it responds with an evaluation tool that serves as guidelines for city policy makers and practitioners to enhance the understanding of disability inclusion among those who have the power to make decisions and take action, thus helping them to design more disability-inclusive cities in the future.

The main aim of this dissertation is to enhance the overall understanding among city officials and other stakeholders of what a disability-inclusive city truly means and how to apply it in practice. It aims to stimulate a dialogue across multiple disciplines that meet in the domain of disability-inclusive cities, in both theory and practice. It also aims to offer conceptual and methodological tools that could stimulate communication between diverse city stakeholders to enable an enhanced understanding of the complex nature of disability-inclusive city design.

The main objective of the research is to design a novel methodological framework and useful practical tools for cities that can be applied in future research, practice and decision making, to

create an enhanced understanding of the needs of people with disabilities and consequently informed, disability-inclusive urban governance.

The **specific objectives** are as follows:

- 1) **To map, categorise and understand the barriers and needs** that people with disabilities face in terms of accessing city spaces, processes, services, products and information.
- 2) **To map, prioritise and understand the challenges** faced by city policy makers and practitioners, such as urban planners, designers, architects, community agents, maintenance workers and public administrative workers, in regard to understanding the needs of people with disabilities.
- 3) **To map, categorise and select the cities involved in the study** in order to ethnographically explore the people-spaces-technology triad and to test (a) the novel methodological framework; (b) the identified set of digital tools; and (c) the newly proposed monitoring-evaluation tool designed with the aim of enhancing disability inclusion in cities.
- 4) **To design, test and analyse a methodological framework** for future research on disability-inclusive cities that can help researchers, practitioners and decision makers to explore citizens' needs in a participatory way, grounded in ethnography as the main methodological approach.
- 5) **To map, categorise, analyse and test the digital tools** that are currently available for inclusive urban research, practice and decision making and which can support people with disabilities in terms of accessing city spaces, services, products and information.
- 6) **To design, implement and test the Disability Inclusion Evaluation Tool (DIETool) and Disability Inclusion Performance Index (DIPI)**, which will help cities to identify their strengths and weaknesses and improve their overall disability inclusion performance in the long term.
- 7) **To draw up a simplified view and a set of recommendations for cities** on how to enhance their understanding of the needs of citizens with disabilities, how to create better partnerships with them and how to enhance disability inclusion in their cities in general.

- 8) **To disseminate the findings of this research** in scientific journals, conferences, academic and professional networks, projects, public events, lectures and seminars, and through practical work.

1.4. Research hypotheses and questions

Ethnography builds on the openness of the researcher in order to identify new questions to ask. As the research proceeds, new questions are incorporated in the pursuit of understanding what is going on, how and why. Grounded in complex challenges within the multidisciplinary domain of (smart) disability-inclusive city design, this thesis embraces ethnography as the core methodological approach. As such, it focuses on answering the research questions rather than testing specific hypotheses. Nevertheless, based on the gaps identified here, several hypotheses were outlined that helped to narrow down the research questions that emerged on an ongoing basis during the exploratory ethnographic work. These hypotheses should not be seen as statements of linear observations of relations between variables, but rather as guidelines for the research process towards the main research objective.

Hypothesis 1: Due to its complexity and diversity, there is a poor understanding among the relevant stakeholders as to what a ‘disability-inclusive city’ means and how to apply it to practice.

Research question 1: What does a ‘disability-inclusive city’ mean, and how can its complexity be made more comprehensible to the relevant stakeholders?

Hypothesis 2: The relevant stakeholders are overwhelmed by the complexity of legislative, political and standardisation frameworks, preventing them from fully understanding what a disability-inclusive city really means and how to make it a reality.

Research question 2: How can we translate the complex legislative, political and standardisation frameworks into simplified, comprehensible models that can help city officials better understand the complexity and diversity of disability inclusion and reflect their numerous positive aspects in practice?

Hypothesis 3: New holistic and participatory governance models are required that can help urban stakeholders understand the need for disability-inclusive urban design, since the current

(smart) city governance models have paid insufficient attention to people with disabilities, meaning that cities are still designed to fit the 'norm' of a fully able 40-year-old man.

Research question 3: What new methods, approaches and tools could improve the current (smart) city governance models and help urban stakeholders understand the need for disability-inclusive urban research, policy and practice?

Hypothesis 4: Community engagement can enhance the understanding of the complex nature of a disability-inclusive city, and can significantly contribute to the inclusive planning, design and governance of cities.

Research question 4: As a deep, slow and small-data-oriented participatory approach, can ethnography help enhance community engagement and strengthen communication between urban stakeholders, create partnerships for inclusion, and improve the understanding of citizens' needs and overall disability-inclusive design?

Hypothesis 5: Modern digital tools and technologies offer a huge, untapped potential for community engagement and thus the production of accessible, inclusive and cohesive cities. They can help in an understanding of citizens' needs by providing immaterial ways of exchanging information, serving as multiple-purpose communication channels, automating urban processes and supporting advanced data analytics, and hence can create overall benefits for disability-inclusive city planning, design and governance.

Research question 5: What digital tools exist for disability-inclusive research, practice and governance, and how do they impact the ways in which people with disabilities access and use city spaces, services and information?

Hypothesis 6: There are no disability-specific tools for evaluation, monitoring and implementation that can help city officials to translate political and legislative requirements into broad principles for inclusion and accessibility, and to encapsulate the understanding of disability inclusion as a complex phenomenon across (a) types of disability; (b) city subsystems; and (c) city infrastructures, services, processes, products and information.

Research question 6: What kinds of tools could be used to translate a complex set of accessibility and disability inclusion requirements into a simplified understanding of disability inclusion and a practical set of indicators at the city level, which could help city officials identify strengths and weaknesses, motivate them to design appropriate corrective measures and bring disability-inclusive cities closer to reality?

1.5. Research methodology

In line with the aims, objectives and research questions introduced above, this research seeks to address these multi-faceted problems and needs, through a well-thought-out integration of different methods and tools.

A combination of approaches and methodologies from the humanities, the social sciences, urban studies and information studies were used in this work, with a main focus on qualitative research methods. This multi-stranded methodology included several complementary methods to ensure interdisciplinary coverage and adequate collection of data when carrying out the research. With regard to the exploratory nature of this research, the main methodological approaches were as follows:

1. A literature review and desktop research;
2. Ethnography (e.g. interviews, focus groups, participant observation, participatory fieldwork, diary writing, participatory digital tool testing);
3. Case studies (exploratory and experimental testing);
4. Behavioural analysis, mapping and categorisation of users and their needs (e.g. interviews, participant observation);
5. A mapping and analysis of existing digital solutions, systems, applications and their current usage (e.g. desk research, field research, contextual interviews with researchers, practitioners and users, comparative analysis etc.);
6. Qualitative content analysis and interpretation;
7. Measuring, scoring and indexing;
8. Evaluation and iterative work (e.g. experimental testing, iterative design).

Grounded theory research was used to complement these approaches, which also proved to be interesting; however, the main focus was on ethnography, combined with digital tools, techniques of behavioural mapping (BM) and post-occupancy evaluation (POE), originating from urban studies. Digital tools were used both in the implementation of this research and as a research subject.

In addition, a PDCA (Plan-Do-Check-Act) approach was used in combination with iterative design and an on-going evaluation process, with the close cooperation, involvement and participation of citizens with disabilities and city officials.

The methodology is elaborated in detail in each of the publications making up this dissertation. Paper 4 is specifically methodology-oriented, and explains in detail the four-dimensional model and the combined methodological approach (CMA) used. It discusses their strengths, weaknesses, opportunities and limitations for future research and practice. Additionally, Paper 5 demonstrates the ethnographic methods used and their application in practice.

1.6. Research structure

This thesis is divided into eight chapters. In addition to the **Introduction (Chapter 1)** and **Discussion and Conclusions (Chapter 8)**, there are six self-contained chapters that represent the six publications making up this thesis. Each of these chapters contains a brief introduction and a discussion of the motivation, relevance, context, main contribution and publication details of the relevant paper.

Chapter 2 relates to the only non-published manuscript, which is currently under revision. It focuses on the disability-inclusive city from a conceptual and terminological view, provides academic, legislative and political frameworks for disability-inclusive city design and discusses challenges relating to its application in practice.

Chapter 3 discusses a conference paper, and summarises the current state of the art in smart cities in regard to the needs of people with disabilities. In view of the gaps that have been identified in this field, this chapter first introduces a new vision of a smart disability-inclusive city. Next, a draft is presented of a four-dimensional model for conducting disability-inclusive urban research in order to better understand citizens' needs and their being in space. Finally, it outlines a holistic approach to disability-inclusive city design. This sets the stage for the main methodological and conceptual proposals elaborated in later chapters.

Chapter 4, which relates to a book chapter, attempts to provide an insight into the research framework, positioning it at the intersection between social sciences, engineering and urban studies. It also provides a preliminary report on the exploratory ethnographic fieldwork conducted in Maribor and Ljubljana, Slovenia, using the four-dimensional model.

Chapter 5 discusses a journal paper that further elaborates on the four-dimensional model introduced in the previous chapters. It demonstrates how we can study complex and varied societal challenges and research questions through ethnographic practice, complemented with

digital tools and complementary techniques from urban practice, such as behavioural mapping and post-occupancy evaluation.

Chapter 6 describes a journal paper focusing on the digital dimension. It divides the currently available digital tools into three contexts: (a) disability inclusion and accessibility; (b) smart inclusive cities; and (c) inclusive and participatory city research. From an ethnographic perspective, it explores how these tools are used and their impacts on people with disabilities and their use of city spaces.

Chapter 7 discusses a journal paper that summarises the findings of the previous exploratory study and proposes a holistic and integrative evaluation tool (DIETool) with a performance index (DIPI) that can help authorities in moving towards more disability-inclusive city governance. It presents the conclusions of pilot testing from two small cities - Maribor, Slovenia and Pułtusk, Poland.

1.7. Publications

This thesis is based on a collection of six publications. Three of them (Papers 4, 5, 6) have been published as journal articles in highly ranked scientific journals: *Sustainable Cities and Society (Q1)*, *Sustainability (Q2)* and *Disability & Society (Q2)*. Paper 2 is a conference paper, Paper 3 is book chapter and Paper 1 has been submitted to a scientific journal, the *Journal of Urban Affairs (Q4)*, and is currently under revision.

In this section, these publications are briefly introduced and contextualised within the research framework (Figure 4).

The research flow shown in Figure 4 can be summarised as follows:

- 1) First, the concept of a smart inclusive city is envisioned to address the needs of people with disabilities (Paper 1).
- 2) Next, the disability-inclusive city is discussed as a meaningful concept, and a pragmatic view is outlined with the aim of overcoming the complexity of the existing political, legislative and standardisation frameworks and to help stakeholders better understand the meaning of disability inclusion in cities (Paper 2).
- 3) A theoretical framework (four-dimensional model) is designed to explore the interrelations within the human-space-technology triad. Based on the preliminary

- conclusions case studies, I discuss alternative methodological techniques and digital tools that can contribute to improved disability-inclusive city design (Paper 3).
- 4) Based on the four-dimensional model, a methodological approach (CMA) for participatory research is designed and tested to help researchers, practitioners and policy makers to understand the needs of people with disabilities, to understand the real meaning of disability inclusion and to guide them in the design of disability-inclusive cities (Paper 4).
 - 5) Then, an exploration is carried out of the existing digital tools that can help (a) persons with disabilities to access the city; (b) researchers conducting inclusive participatory research with people with disabilities; and (c) practitioners and decision makers in achieving the overall goal of disability-inclusive cities (Paper 5).
 - 6) Finally, an evaluation and monitoring tool called the Disability Inclusion Evaluation Tool (DIETool) with Disability Inclusion Performance Index (DIPI) is proposed and tested. This can help decision makers to understand where they stand in regard to disability inclusion across 20 areas of city life, and can support them in identifying the strengths and weaknesses of their city for further planning, design and governance (Paper 6).

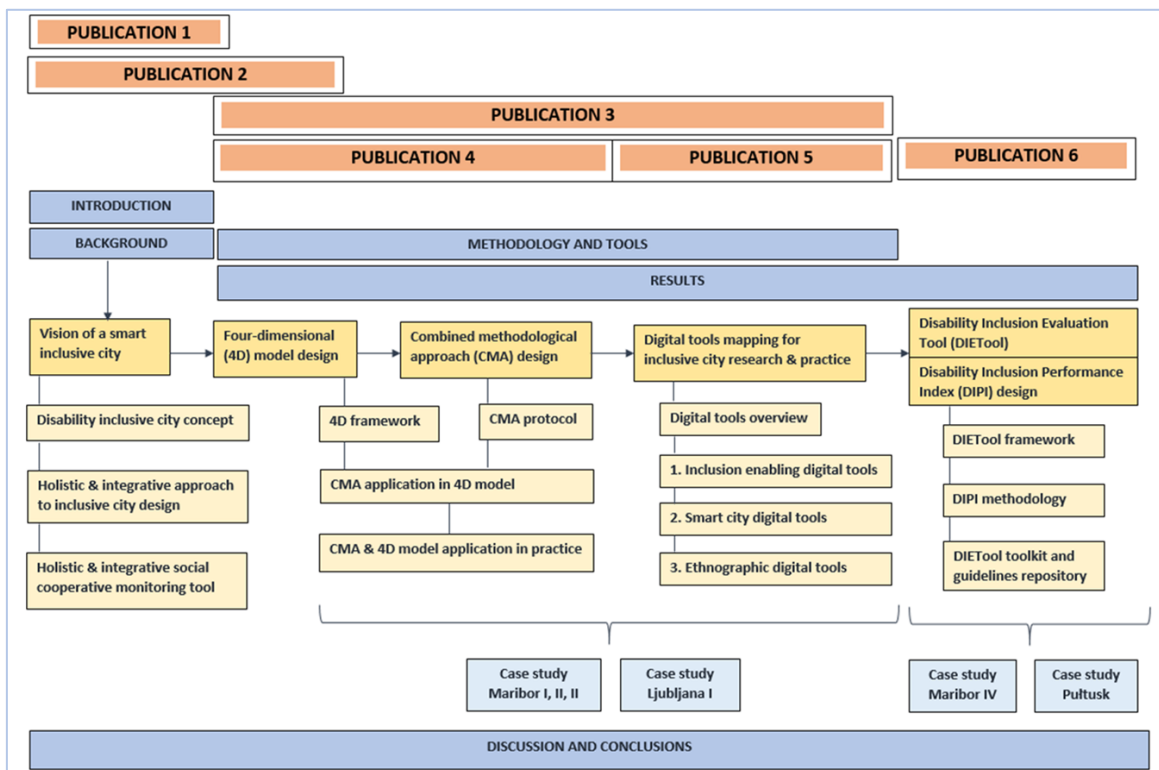


Figure 4: Research structure and main results delivered by Papers 1–6

Papers 1 and 2 outline the research background and the state of the art within the main research domains related to disability-inclusive cities, and discuss the theoretical and conceptual elements of the study.

Papers 3, 4 and 5 contribute by outlining the methodological framework and testing novel methodological approaches (four-dimensional model, CMA) and digital tools.

Finally, Paper 6 responds to the identified gaps, and outlines an initial vision of a holistic approach towards the design of smart disability-inclusive cities using DIETool with DIPI as guidelines for cities.

“The definition of genius is taking the complex and making it simple.”

Albert Einstein

2. Reflections on the Disability-Inclusive City: From Complexity Towards Simplicity for Improved Urban Policy and Practice

Paper 1 is entitled *Reflections on the disability-inclusive city: From complexity towards simplicity for improved urban policy and practice*. It has been submitted for consideration to the *Journal of Urban Affairs*. The manuscript is currently under revision before being resubmitted.

This paper is of a theoretical and conceptual nature. It contributes to discussions around the theory and practice of building disability-inclusive cities based on the well-founded paradigms of the “right to the city” (Lefebvre, 1996), “cities for people” (Gehl, 2010) and “placemaking” (Jacobs, 1961; Whyte, 1980, 1988; de Certeau, 1984; Lebevre, 1991). It responds to a gap relating to the growing complexity, diversity and rapid socio-technical developments of cities, poor understanding of disability inclusion among the relevant stakeholders, misconceptions around disability-inclusive cities, and complexity within political, legislative and standardisation frameworks. All of these place cities before the challenging issues of inclusivity, particularly with regard to the needs of citizens with disabilities.

The following research questions are addressed in this paper:

Research question 1: What does a ‘disability-inclusive’ city mean, and how can its complexity be made more comprehensible to the relevant stakeholders?

Research question 2: How can we translate the complex legislative, political and standardisation frameworks into simplified, comprehensible models that can help city officials better understand the complexity and diversity of disability inclusion and reflect their numerous positive aspects in practice?

This paper first investigates the current academic discussions of inclusive urban practice and contemporary political and legislative frameworks related to disability-inclusive city planning, design and governance. Its aim is to demonstrate how the complexity and diversity of disability

inclusion can be viewed in a more pragmatic and comprehensive way. It also provides a critique of the overwhelming number and depth of current legislative and standardisation systems, and attempts to explain why their complexity prevents stakeholders from bringing inclusive cities into being. Finally, as a counterbalance, its key contribution is a synthesised, plain and pragmatic view of the disability-inclusive city, which emphasises the importance of three core dimensions: (a) the diversity of citizens' needs; (b) the city as a system of subsystems; and (c) the city as an organic form composed of infrastructures, services, processes, products and information. Based on these three pillars, the paper discusses what a disability-inclusive city is and how it can be understood more pragmatically for improved application in practice.

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Reflections on the disability inclusive city: From complexity towards simplicity for improved urban policy and practice

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Reflections on the disability inclusive city: From complexity towards simplicity for improved urban policy and practice

Abstract

This paper discusses current issues of inclusive city design in respect to the needs of persons with disabilities. It explores contemporary academic work and current urban and disability rights agendas, reflecting them through notions of “the right to the city” and “cities for people”. It questions an overwhelming complexity of requirements encapsulated in political and legislative frameworks, and its implications onto disability inclusive urban policy and practice. The critique herein is followed by a simplified and pragmatic view on disability inclusive city through three core dimensions: a) diversity of disabled citizens’ needs; b) the city as a system of subsystems; and c) the city as an organic entity composed of infrastructure, services, processes, products and information. This may advance discussions and offer insights into how urban policy and practice could overcome current struggles with understanding what disability inclusive city truly means and how it can be brought closer to reality.

Keywords: Disability inclusive city; Inclusive urban design; Persons with disabilities; The right to the city; Cities for people; Placemaking.

Introduction

According to United Nations Habitat, the inclusive city "is a place where everyone, regardless of their economic means, gender, race, ethnicity or religion, is enabled and empowered to fully participate in the social, economic and political opportunities that cities have to offer" (UN Habitat, 2001 cited in Asian Development Bank, p. 4). The inclusive city can be the "great city" (Jacobs, 1961; Garvin, 2016) that belongs to all of us. It allows us to practise our rights, enjoy opportunities and prosper within the urban realm. But how to plan such an inclusive city? How to create a city of equal rights and opportunities? Modern concepts of the smart and sustainable city claim to be human-centred and inclusive. But does this really mean that they are inclusive for all?

Our previous academic work, including ethnographic exploration in several cities in Europe, has shown that the inclusive city is mostly perceived in general terms of poverty and social inclusion, while disability inclusion is neglected. Furthermore, the disability inclusive city is too often perceived in terms solely of accessibility to the built environment, that is, as architectural accessibility mainly for the physically impaired. In fact, a lack of accessible information, communication and services affects a wider population of persons with diverse impairments, such as those with visual, hearing or cognitive impairment. What Hanson (2004) suggested fifteen years ago remains the case today. Urban environments are still "not sympathetic to the needs of older people and people with disabilities" (p. 2), although a "greater stress is being placed upon the importance of inclusive design, universal design or design for all" (p. 13). There is a want of holistic and systemic approaches to the issue of disability inclusion. Moreover, cities struggle with understanding the diversity of citizens' needs. They neither fully understand what disability inclusion means, how complex and important it is and how it can contribute to the quality of lives of the wider population of citizens, and not only those with impairments. Poor awareness of disability inclusion is

apparent amongst relevant stakeholders, such as politicians, local authorities, architects, designers, planners and so on (Rodrigues & Cardoso, 2019). Finally, the standard for designing the public realm still seems to be “an active, fully abled person” (Rebernik et al, 2017, p. 70), which would be an average thirty or forty-year-old male. As a result, vulnerable groups with a set of needs that differ from such norms are excluded. The message is clear: “cities for people” are still difficult to design. But why, and what have we been missing? A truly inclusive city “involves a complex web of multiple spatial, social and economic factors” (Phoram et al, 2015, p. 11) that is hard to negotiate for some.

This paper attempts to explain that this web can be made accessible, but only in a holistic, integrative and bottom-up way. Perhaps paradoxically, we also believe that the solution lies in greater simplicity than legally burdensome complexity. With the critique applied to the overwhelming amount and depth of current systems we attempt to explain why this complexity prevents stakeholders to bringing inclusive cities into being. Building upon well-founded city paradigms, such as “the right to the city” (Lefebvre, 1996), the design of “cities for people” (Gehl, 2010) and “placemaking” (Jacobs, 1961; Whyte, 1980, 1988; de Certeau, 1984; Lefebvre, 1991), we investigate current academic discussions on inclusive urban practice and contemporary political and legislative frameworks for cities in general and for people with disabilities in particular, and we provide a critique of the convolutions of these frameworks. The critique calls for a synthesised, plainer and pragmatic view of the disability inclusive city, one that emphasises the importance of three core dimensions: a) the diversity of disabled citizens’ needs, b) the city as a system of subsystems, and c) the city as an organic form composed by infrastructure, services, processes, products and information. Accordingly, the key contribution of this paper is a synthesised view on how the disability inclusive city can be created in the context of urban practice, and how this view should be incorporated into discussions amongst scholars, practitioners, and city authorities.

Background

This section reflects on classical and contemporary discussions around placemaking, cities and new urban agendas on the one hand, and disability inclusion on the other. Scholars have long been interested in the phenomena of city life. The pioneers of the placemaking paradigm, Jacobs (1961) and Whyte (1980, 1988), have left a significant mark in their observations of how people use the city, and have provided lessons to urban planners for decades to come on what makes a good city. For instance, Whyte's observations of New York City parks, plazas, playgrounds and streets outlined reasons behind crowded and empty spaces, the ways spatial elements influence activity generation and how they generate different patterns of use by diverse groups of people. Among other Whyte showed that spaces that are highly functional for mothers, older people and other vulnerable groups attract all people in general (Whyte, 1980). The concept of placemaking was based around the notion that places are made by people and their presence in space, which allows for sociability, comfort, access and activity (MacKenzie, 2015). Scholars have also argued that public spaces (cities) should be safe, attractive, liveable, healthy, sustainable (e.g. Abdel-Aziz, Abdel-Salam, & El-Sayad, 2016) and inclusive (e.g. Hanson, 2004; Rebernik et al, 2017), so that people can practice both their rights and their responsibilities as city dwellers.

De Certeau (1984) viewed the city's main challenge as "managing a growth of human agglomeration or accumulation" (p. 94). He described city planning in terms of "the very plurality of the real" and the ability to make that "plural effective," which means knowing "how to articulate it and be able to do it" (p. 94). Herein lies the problem. To make the "plural effective", the city must be seen as an intricate interplay of places, people and power, which shape and are shaped by the dynamics of technologies, materials, and economic, political, social and cultural processes (Barrett, Horne, & Fien, 2016). We believe it is necessary for urban plurality and complexity to be recognised but simplified in practical

terms. Only then cities will experience true urban revolution that is based on placemaking principles and enforces the right to the city for all (Harvey, 2012; Gilderbloom, 2014).

New global agendas aim at guiding cities in managing these complex urban phenomena so that the dream of “the right to the city” might be realised, with nobody left behind (Lefebvre, 1996; Purcell, 2002). Firm political, legislative and standardisation frameworks have been put in place both in the disability rights arena as well as in the urban sphere, and countries have been gradually translating them at a national level. The documents that contained the blueprints in a sense renewed the idea of the right to the city, and introduced a shared vision of urban prosperity underpinned by the principles of equality, accountability, sustainability, participation, liveability and safety as part of a new wider urban agenda. For instance, social inclusion is at the heart of the 2030 Agenda for Sustainable Development, with its Sustainable Development Goals (SDGs) (UN Habitat, 2017). Several SDGs (nos. 4, 8, 9, 10, 11, and 16) place the focus on social inclusion, while others include it as an important component. For example, Goal 11: Sustainable Cities and Communities (UN Habitat, 2016b) states that cities are to be made inclusive, safe, resilient and sustainable. However, these plans lack disability specific inclusion goals, indicators and measures, and they have yet to be implemented in any meaningful way.

For instance, studies exploring the extent to which the world is aligning with these ambitious goals show that there is a lack of statistics measuring disability inclusion on the one hand. On the other, they demonstrate overall progress in most essential indicators (e.g., decreases in maternal mortality and under-five mortality rates, increased access to electricity and higher employment rates and labour productivity). However, vulnerable groups, such as youths and persons with disabilities, are more likely to be exposed to unemployment, social deprivation and poverty. Growing inequality, which tends to deprive the weak of basic rights and opportunities, is unfortunately still a reality (UN Habitat, 2018).

One may think that disability rights frameworks would provide an answer to the question of how growing inequality might be overcome. Undoubtedly, making these rights a constitutional fact is of paramount importance. They have been acknowledged at the global level and have gradually filtered downwards. The UN Standard Rules for the Equalisation of Persons with Disabilities (United Nations General Assembly, 1993), the UN Convention on the Rights of Persons with Disabilities (UNCRPD) (United Nations General Assembly, 2007), the UN Disability Inclusion Strategy (UNDIS) (United Nations General Assembly, 2018), Americans with Disabilities Act (ADA) (1990) and the ADA Amendments Act (ADAAA) (2008), the European Disability Strategy 2010-2020 (European Commission, 2010), the European Accessibility Act (European Commission, 2015) and standards, such as ISO 21542:2011 for accessibility and usability of the built environment (ISO, 2011), are some of the documents that provide a solid framework for ensuring that cities take the path towards disability inclusive communities. But the reality is somewhat different. Drawing from our ethnographic observations while meeting people with disabilities across cities, countries and cultures, we believe that having such frameworks brings a general commitment to inclusion, but this is not manifested in people's everyday lives.

Many scholars addressing the issue of disability inclusive city design (Gleeson, 2001; Imrie & Hall, 2001; Hanson, 2004; Imrie, 2012, 2014, 2015; Oliveira Neto & Kofuji, 2016; Rebernik et al, 2017, 2020) agree that in the last decades cities have faced the greatest challenges in breaking down the barriers that disabled people face in everyday life. How can their needs be met without segregating them from fully abled people? Making a distinction between general and special needs is problematic, as it suggests that urban design should be based on drawing distinctions. Conversely, the attempt to avoid segregation brings with it the danger of not understanding the diversity of needs. Clearly, the latter is of utmost importance if we are to respond to those needs. Therefore, a significant shift in the current urban

consciousness is needed, towards an simplicity-based emphasis on the human dimension, while at the same time exploring complexity, diversity and individuality.

Finally, could the smart city concept pave the way for disability inclusive cities? The British Standards Institution (BSI, 2014) defines smart cities as cities that should “deliver a sustainable, prosperous and inclusive future for its citizens” (p. 3, 12). Smart city system is a “system of digital infrastructure and digital services to monitor, manage and control physical and social resource” (p. 13). As such it should enable policies and practices that support social inclusion “to ensure that all members and groups in society...can affordably access and use essential day-to-day rights and services” (p. 24). But is the smart city truly inclusive for all? Previous studies (Alexopoulos et al, 2019; Silva, Khan, & Han, 2018; Trindade et al, 2017; Mohanty et al, 2016; Cavada, Hunt, & Rogers, 2014; Nam & Pardo, 2011) demonstrate that the smart city concept may not yet be fully ready to meet the requirements for a disability inclusive city as envisioned by some authors (Rebernik et al, 2017, 2020; Oliveira Neto & Kofuji, 2016; Alessandria, 2016; Poethig et al, 2018; Phoram et al, 2015).

The smart city is a complex but consciously organised purposeful system of subsystems, components and processes (Rebernik et al, 2019, 2020; Boob, 2015; Cavada, Hunt, & Rogers, 2014; Nam & Pardo, 2011). As such it should make disability inclusion an organic element and a non-negotiable fact. However, it still confuses scholars, practitioners and decision makers with its different definitions and conceptualisations. With such a lack of cohesion, it is not surprising that disability inclusion has been neglected. Besides, the smart city concept was born on the wings of capitalism, promoting technology and profit (International Business Machines Corporation, 2009). Thus, it is neither surprising that it has in theory and practice been struggling with understanding the importance and complexity of inclusion for diverse groups of citizens (Rebernik et al, 2019). As a theoretical construct it may be still paying greater attention to technology over social aspects (e.g. Abdel-Aziz,

Abdel-Salam, & El-Sayad; 2016; Gehl, 2010). But as long as there are humans living in cities, we will be fighting for cities to be designed for people, not cars (Gehl, 2010), and neither merely for technological advancement (Rebernik et al, 2019) nor economic profit (Lefebvre, 1996; Purcell, 2002; Cavada, Hunt, & Rogers, 2014; Barrett, Horne, & Fien, 2016). Lefebvre (1991) questioned cities' existence; what if "the economic sphere ... may destroy their own foundation...and thus in effect self-destruct?" (p. 326). There is indeed a danger that economic and technological forces may cause the human dimension to be cast aside.

Conversely, when used with care, they can lead to prosperity and progress for all. Their potential contribution to disability inclusion should thus be acknowledged. Economically vibrant societies have the capacity to implement inclusive agendas, and technology can undoubtedly support the vulnerable in overcoming barriers and leading more fulfilling and better-quality lives (e.g., Oliveira Neto & Kofuji, 2016; Rodrigues & Cardoso, 2019; Pankau, 2019; Gleeson, 1999b). Hence, a smart city might be a step towards the inclusive city. For now, we will leave these challenges aside to discuss the importance of understanding the concept of a disability inclusive city, even if at an elementary level.

Towards disability inclusive city

This section is a critique of present circumstances. It offers a more pragmatic view by going back to the roots and outlining the core dimensions of inclusive city design. The political, legislative and standardisation requirements are a starting point for understanding what a disability inclusive city is. However, it also needs to be understood in context. For urban stakeholders (designers, architects, government officers, decision makers and so on) it can be difficult and confusing trying to satisfy all the requirements placed upon them. Here, we emphasise the importance of a disability inclusive city that holistically integrates inclusion and accessibility principles at three levels: a) the diversity of citizens' needs, b) the

city as a system of subsystems and c) the city as an organic body composed of infrastructure, services, processes, products and information (see Figure 1).

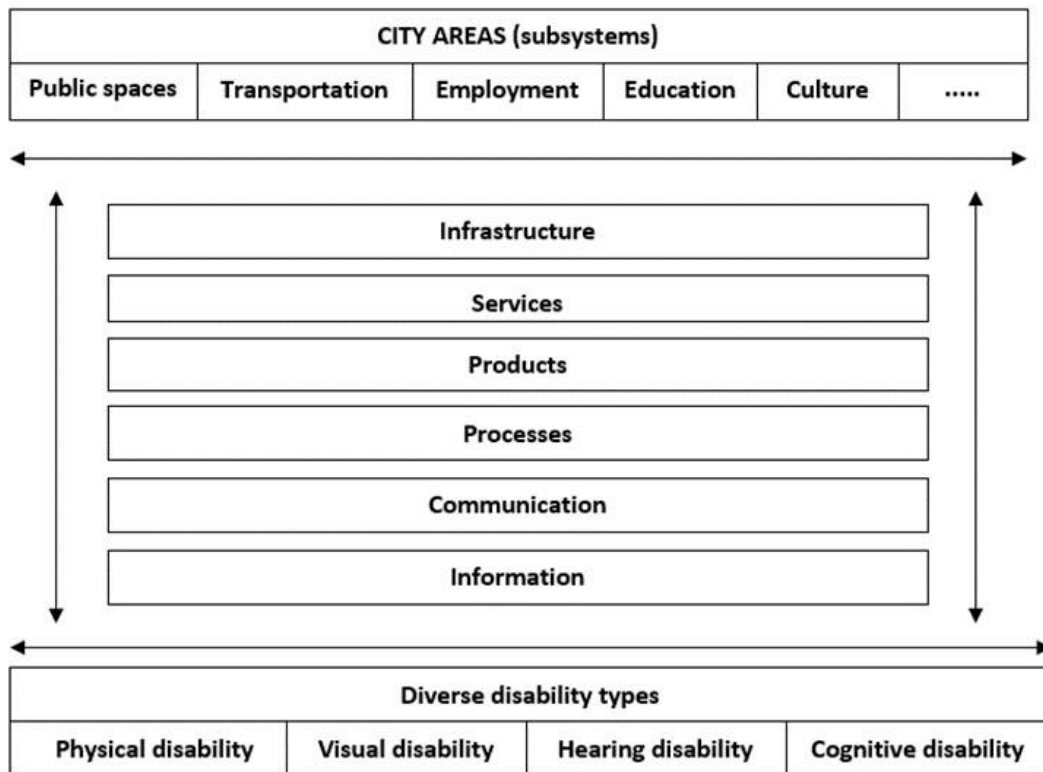


Figure 1: The disability inclusive city concept synthesized through three dimensions: a) diverse disabled citizens' needs; b) city subsystems; c) city components.

Having said that, a disability inclusive city will ensure that inclusivity principles respect all groups of disabled people, that they are integrated into all areas of urban life, and that they accommodate accessibility solutions across every element within each of the areas. It is hoped that this paper can illuminate the reader's understanding of disability inclusion and its complexity in a simplified way. This is not to diminish its importance but rather to synthesise the core principles of inclusive design and to categorise them using the rule of three, which should make them easier to comprehend, thereby leading to fruitful discussion, higher learning and sustained inclusive urban practice.

Diversity across disability types

This paper aligns with the social model of disability, the main principles of which were established in 1976 by the Union of the Physically Impaired Against Segregation (UPIAS) (1976). It was later described as the “social model” by a disability studies and rights pioneer Mike Oliver (1996, 2013), and it has been discussed by a number of scholars (e.g., Gleeson, 1999a; Freund, 2001; Oliver & Barnes, 2010). Accordingly, we perceive disability to be the result of the inability of society (or the city) to take into account the diverse needs of its citizens, rather than impairment itself.

However, if we are to understand what disability inclusion truly means and what measures society needs to enact to satisfy different needs, diversity within and across disability types needs to be explored. Disability is unfortunately still too often perceived within the narrow sense of physical disability. Thus, for many of those responsible for the urban realm, clarification may be required. Here we introduce in simple form the four main disability types following the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) (UN General Assembly, 2007):

- Physical disability/impairment
- Vision related disability/impairment (blindness and visual impairment)
- Hearing related disability/impairment (deafness and hearing impairment)
- Intellectual/cognitive impairment (including language-based and speech disorders)

Those with a physical disability require means of physical accessibility; these include ramps, lifts, solid walking surfaces without barriers, easy access to switches, handles, reception counters, toilets and parking spaces. Someone with a vision related disability may need surfaces and stairs equipped with tactile paving and guidance systems, an absence of barriers, good lighting, visually contrasting text and signage with large fonts and audio signalisation. A person with a hearing related disability may need a hearing loop or a sign

language interpreter. For them, the aural information could be transposed into visual forms, such as pictures and videos with captions, simple and easy-to-read contents or haptic signalling. Individuals with cognitive impairment may require long and complicated texts to be translated into easy-to-read versions and/or simple signage, complex building designs incorporating easy-to-use guiding systems and simplified information provision and more time, patience and understanding – and, by default, highly accommodating personal service.

Knowing the needs for these four groups may greatly enhance our understanding of disability inclusion. However, there are many variations within each of the four types. For instance, not all people with a physical impairment use a wheelchair. Some use crutches or have to walk slowly because of balance and muscle control issues. They may need handrails, benches, shelves and other support devices, and may face difficulties using their upper limbs; opening the door, ringing a bell or calling an elevator will thus be a challenge. Visually impaired people can have mild, moderate or severe vision loss. They may have distorted or narrowed vision field or they may be completely blind. Consequently, they might rely on particular forms of communication, such as audio, tactile, large fonts, braille and so on.

Deaf and hard of hearing may have mild, moderate or severe hearing loss. They may have been deaf from a young age. As such they may have learnt sign language but perhaps also have difficulties using written language. Many find it difficult to form speech. If they lost their hearing in adult age, it is more likely that they are less confident using sign language but more using written information. There are deaf–blind people, too, who rely on human assistance and haptic forms of communication with the world. Finally, diverse cognitive disabilities add to the outlined complexities. People can be born with a cognitive impairment or develop it due to illness, injury or mental health problems. It is important to consider also the possibility of multiple combined impairments that an individual may face, bringing an even greater diversity to the world of disability. Finally, disability can be

considered from a medical point of view (World Health Organization, 2001) but such detailed classification might cause unnecessary confusion. The four types should serve as the basic orientation in search for combinations of common denominators which can reflect the fact that when an urban environment is accessible and pleasant for the most vulnerable, then it is also suitable for everyone. To know the list of such denominators may be the first step towards the plural effective as described above.

The city as a system of subsystems

Our discussion is based on the holistic view of the city as a consciously organised, purposeful system. This matters especially when designing a city for the inclusion of the most vulnerable. Sustainable and inclusive society targets within the new urban agendas (UN Habitat, 2015, 2016a, 2017) include city subsystems such as public spaces, transportation, employment, education, culture, sports, health, family life, housing, assistive technology, economies, businesses and so on – all are important areas where citizens' can enjoy their rights and fulfil their duties. They are to a lesser or greater extent regulated by political and legislative frameworks. Some are considered as a public good and as such fall under the competence of the city, which needs to ensure that they are fully available and accessible to all inhabitants (UN General Assembly, 1993, 2007).

For instance, this means that only when public spaces are free of barriers and are fully accessible a person will have real access also to education, employment and to the enjoyment of culture and sport (so long as these are inclusive too). Furthermore, only when an abundance of solutions, such as audio, braille and tactile books, teachers with sign language skills and specialised pedagogies are the educational norm will visually impaired, hard of hearing children and children with learning and speech difficulties be empowered to become knowledgeable individuals. Once they grow up, they will not only be able to enjoy their full rights as citizens but will also be able to contribute further to society. These are just a few

examples. Our aim is to point out the importance of understanding that a city is much more than just a physical space, and that disability inclusion is not achieved simply by creating a physically accessible public spaces for wheelchair users. In fact, the city goes beyond spatial terms. It is also a rich socio-economic organisation. It is created by people and their presence, activities and interactions in space (de Certeau, 1984; Whyte, 1980; Lefebvre, 1991). They are the ones creating interdependencies across all areas of city life, and the challenges they face all need to be addressed holistically.

City components (infrastructure, services, products, processes, and information)

A city is created by infrastructures, services, products and processes, and is filled with information, communication and interactions among people. As such, inclusivity and accessibility within these features need to be considered. For instance, in the area of employment, these components might include employment opportunities, accessibility to work, accessible workplaces, accessible information about career and employment, available employment policy and governance, funding schemes, employment and professional rehabilitation provision, ergonomic solutions and assistive technology provision, training provision for employers and measures against attitudinal barriers. Beyond that, physically accessible buildings with easy to understand guiding systems and effective information–communication provision in the form of audio, video, tactility and contrasts will benefit diverse visitors (e.g., not only people with disabilities but also the elderly or temporarily injured people with reduced vision, hearing and/or mobility, children getting lost or persons in mental distress and so on). Within the inclusive city, digitally accessible websites, approachable officials and servants and administration processes allowing for accessibility and inclusion will be given, too. For this, public officials will be properly trained to be able to perform their work in line with best inclusion practices and standards. Finally,

all city processes will be designed in such a way as to enable full consideration of disability inclusion provision.

Discussion and conclusions

An individual's ability to integrate into the city, navigate the environment and understand the information provided affects health, wellbeing, the ability to work and the individual's quality of life. However, city governments have not been able to ensure that people with disabilities can fully enjoy their rights, even if these are regulated by firm political, legislative and standardisation frameworks (Hanson, 2004; Gleeson, 2001; Barrett, Horne, & Fine, 2016; Rodrigues & Cardoso, 2019; Rebernik et al, 2020). Inclusive city design has been the subject of new urban agendas (UN Habitat, 2015, 2017) and disability rights frameworks (UN General Assembly, 2007; European Commission, 2010; UN General Assembly 2018). Nevertheless, its theoretical and conceptual significance that may help advance it has been neglected (Gleeson, 2001; Hanson, 2004; Prince, 2008; Rebernik et al, 2019, 2020). Through our research, which has consisted of ethnographic observation and direct engagement with stakeholders and disabled people, we have found that cities are still not disability inclusive.

Thus, disabled people often show signs of distrust, scepticism and apathy; they feel excluded, forgotten and left behind. This has led us to the conclusion that disability inclusive city design should be discussed, not with more guidelines and more complexity, but rather with more simplicity. Building upon previous discussions, for example those led by Lefebvre (1991, 1996), de Certeau (1984), Jacobs (1961), Whyte (1980, 1988), and Gehl (2010), which have advocated citizens' "right to the city" and "cities for people" (not cars, technology or profits), we examine how contemporary academic discussions and new urban agendas are bringing cities closer to places where disabled people are included, too. As a response to the critique of a systemic complexity, we propose a simplified and a more practical view of the

disability inclusive city concept that may help advance disability inclusion in the field. Within this, we go back to the roots and outline three core dimensions. We believe that disability inclusive cities will really work when accessibility and inclusion are perceived across disability types, city subsystems and city components, and when interrelations among these three core dimensions are present. Using the understanding of such an approach, the city will also need to create partnerships for inclusion. It will need to advance by building collaborations and raising awareness among diverse city agents (e.g., citizens and governmental, non-governmental, tertiary and private institutions) and encouraging and promoting best practice to ensure an overall inclusive and accessible city. Having said that, participatory governance in the case of vulnerable citizens, such as those with disabilities, is of utmost importance: “Nihil de nobis sine nobis [Nothing about us without us]”. People who use the city will know best what their needs are. They are the ones who, with their presence in space, will create their human experiences and through them generate the space (the city) itself (de Certeau, 1984; Whyte, 1980; Lefebvre, 1991). Disabled people should be involved as no less than full co-creators of their cities.

Finally, the smart city with its technological advances can now contribute to inclusive city design. Technologies, if used with caution, can add value to disability inclusive cities by bringing services, products, and information closer to those who need them most. Obviously, there are limitations to be considered (Gleeson, 1999b). As technology contributes to globalisation which in turn creates a maelstrom of diverse values, ideas and interests (Lefebvre, 1991; Lefebvre, 1996; Molotch, 1993), growing competitiveness and capitalistic striving for gains and profits, ethical issues and cyber safety may exacerbate already existing inequalities, if cities do not go back to their roots of “cities for people” (Gehl, 2010). The synthesis of the disability inclusive city concept outlined herein may be perceived as representing such roots. With them, we attempt to offer a platform for further in-depth

exploration as to how disability inclusion in each of the subsystems and components of a city can be guaranteed, using a plethora of devices that are already well-established within political and legislative frameworks. Participatory research, practice and citizens' direct experience can all play a part. We believe that without such a synthesis, the complexity of legal requirements and ambitious agendas will continue to overwhelm mayors, urban planners, architects, designers, city officials and other decision makers, and this may in the end prevent disability rights being enforced and put into reality.

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Declaration of interest

Authors declare no conflicts of interest.

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“The only thing worse than being blind is having sight but no vision.”

Helen Keller

3. A Vision of a Smart City Addressing the Needs of Disabled Citizens

Paper 2 is titled *A vision of a smart city addressing the needs of disabled citizens*. It was presented as a conference paper on 27th September 2017 at an international conference entitled “Accessibility for All 4.0” in Malaga, Spain.

This paper responds to the growing need for new (smart) city models that will holistically and in a participatory way address the needs of people with disabilities. In essence, it offers insights into the complexity of challenges faced by modern cities when considering inclusive and accessible city design.

Although the paper explores the research topic relatively broadly, it responds mainly to the following research questions:

Research question 1: What does a ‘disability-inclusive’ city mean, and how can its complexity be made more comprehensible to the relevant stakeholders?

Research question 3: What new methods, approaches and tools could improve the current (smart) city governance models and help urban stakeholders understand the need for disability-inclusive urban research, policy and practice?

The paper first outlines the main research ideas, and provides a background to the broad multidisciplinary research nature of this problem, identifying some of the core gaps in the area of smart inclusive cities. It then introduces a new vision of a smart disability-inclusive city that encapsulates methodological directions and uses a holistic and integrative approach towards the design. As part of this vision, the paper also presents a draft of a holistic, social-cooperative monitoring tool, envisioned as a smart city platform that not only holistically integrates disability inclusion principles across the structures and processes of a city, but also incorporates solutions for diverse groups of people with impairments (whether physical,

sensory or intellectual) in a holistic way (later on, in Paper 6, this tool is developed to form the DIETool).

As a blend of a review and a vision paper, its main contribution is that it provides a background to the topic, introduces the main gaps and sets the stage for some of the core results of this research. It also outlines a number of challenges that are explored in more depth and elaborated further in subsequent publications.

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A Vision of a Smart City Addressing the Needs of Disabled Citizens

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Abstract

There were 42 million disabled people aged 15–64 in the EU-27 in 2012. The urban population is increasing, and has according to United Nations Population Fund already exceeded 50% of the global population. Cities are becoming more and more complex. City governments face challenges in designing fully inclusive city services, spaces and information. These still tend to be designed in a way to fit the needs of an active, fully abled person, thus excluding a great number of citizens with impairments. With this article we contribute to the issues raised; first, by proposing a four-dimensional model towards addressing the complexity of the societal challenges; second, by elaborating a holistic Vision of a Smart and Inclusive City, and finally as a part of this vision, by proposing a concept of a holistic modular digital tool, namely Social Cooperative Monitoring Tool to support the inclusiveness of the city.

En 2012, existían en la EU-27 42 millones de personas con discapacidad de entre 15 y 64 años. La población urbana se está viendo incrementada y, de acuerdo al United Nations Population Fund, ya supera el 50% de la población mundial. Los gobiernos municipales afrontan diferentes retos para diseñar espacios y servicios urbanos completamente inclusivos, si bien siguen tendiendo a orientar el diseño de estos aspectos a cumplir las necesidades de una persona totalmente capacitada. Este hecho excluye a un gran número de ciudadanos con algún

tipo de discapacidad. Con este artículo queremos contribuir a las cuestiones planteadas; proponiendo, primero, un modelo cuatridimensional que aborde la complejidad de los retos de la sociedad; elaborando, segundamente, una visión holística de una Ciudad Inteligente e Inclusiva, y finalmente, como parte de esta visión, proponiendo un concepto de herramienta digital holística y modular, concretamente “Social Cooperative Monitoring Tool”, que apoye el carácter inclusivo de una ciudad.

1. Introduction

This paper in its essence brings insights into complexity of the challenges in regard to planning, designing and governing inclusive public spaces, and creating smart, inclusive and fully accessible cities that respond to the needs of all their citizens. Specifically, it is focused on one of the most vulnerable groups of citizens, namely disabled persons, which are still facing barriers when trying to access public and private services, places and information. With this vision paper we aim at introducing our vision of a holistic approach towards understanding and responding to the complexity of inclusive city design, that also addresses the needs of disabled people. The vision sets its foundation on the findings delivered through researchers’ previous professional and academic work, a solid literature review of the past years, as well as some initial insights gathered through a small-scale participatory ethnographic field research, conducted in the city of Maribor, Slovenia in winter and spring of 2017.

The vision, presented here, is an integral part of a research “A Social Cooperative Monitoring Tool for the Production of Inclusive Public Spaces”, that has been designed as a response to the needs and challenges identified through our previous work in the areas of disability, inclusion, accessibility of public spaces, mobility, digital dimension and modern conceptualizations of a Smart City. The scope of the research goes beyond this paper, thus we will limit our academic contribution here to introducing a Vision of a Smart and Inclusive City that responds to the needs of disabled people. Within this vision first, a complexity of relevant societal challenges is being addressed through a *four-dimensional model*. Secondly, a holistic approach towards a fully inclusive and accessible city is introduced as a model that each city should strive for, and third a conceptualization of a Social Cooperative Monitoring Tool for the production of inclusive public spaces is drafted. Although still under development, we believe that by bringing the vision forth, we lay a strong foundation and provide a valuable contribution not only to our research, but also for rethinking the existing concept of a Smart City. The originality of our contribution is exactly the visionary approach taking into consideration a complexity of specific societal challenges, providing faith that such an ideal of an inclusive city can and in fact must be pursued.

The paper is structured as follows: The justification section provides some insights into understanding the challenges through four different dimensions / levels: a) individual, b) environmental, c) technological and d) relational level. Further on, related work of previous scholars is introduced in relation to the identified scope of disciplines that need to be studied for the purpose of our research. In the following section we explain our vision in more details and address the current challenges and opportunities provided by the modern Smart City paradigms, incorporating also the digital dimension by briefly tackling the role and diversity of digital tools within the introduced city concepts. Finally, we draft a concept of a Social Cooperative Monitoring Tool that is anticipated to be proposed as a part of a holistic approach towards smart and inclusive cities for all. In the final section we tackle some future challenges, in respect to the complexity of our research, and draw some insights into our future work.

2. Justification

If considering data, reported by Eurostat¹ there were 42 million disabled people aged 15–64 in the

¹ http://ec.europa.eu/eurostat/statistics-explained/index.php/Disability_statistics (October 2016)

EU-27 in 2012, if considering the EHSIS² definition of disability. Furthermore, according to European Commission by 2025 more than 20% of Europeans will be 65 or over, with a particularly rapid increase in numbers of over-80s. In Europe there is clearly a growing population of people facing barriers, be it in regard to physical, sensory, intellectual or mental impairment, thus resulting in a great need to make the services, spaces and information accessible, available and inclusive.

According to the United Nations Population Fund³, the urban population has already exceeded 50% of global population and is expected to rapidly increase in the upcoming years and decades. Cities are also becoming more and more complex, thus city governments are facing great challenges in addressing both, the complexity of cities themselves as well as a wide variety of citizens’ needs. When it comes to the needs of disabled people it is often so, that those who are in power to take action still show significant lack of awareness, resulting in non-inclusive city projects, places, services and information. An individual’s ability to integrate into the city, navigate around the environment and understand the information provided, affects health, wellbeing, ability to work and finally individual’s quality of life. Thus it is reasonable to say, that citizens should be the drivers of the city, and city governments should put the human dimension to the forefront of their efforts [8].

Our previous work, also applicable to real-life situations, shows that in spite of efforts made by all relevant stakeholders, an inclusive design is not yet fully a reality. Most relevant stakeholders involved have been open to collaboration, and even expressed interest, but have at the same time showed a great lack of knowledge, and finally, when needed to take action, a significant level of uncertainty. Consequently, disabled people showed signs of mistrust, scepticism and apathy. We realized at one point, that the needs of disabled people within the scope of inclusive cities and inclusive public spaces design should only be addressed by first and foremost, through understanding the complexity and holliness of the phenomena; secondly, by establishing participatory approach with firm, fluent and long-lasting channels of two-way communication; thirdly, raising knowledge and awareness among all relevant stakeholders; and last but not least, simplifying, automizing and mundanizing governance processes, thus bringing the reality of disabled people closer to those in power to take actions. Understanding the changeability of life, acknowledging the essence of a human being, respecting individuality and building empathy for others seem to be main directions we would need to follow when considering inclusive

² European Health and Social Integration Survey

³ www.unfpa.org (June 2017)

public spaces and accepting intertwining societies. Thus it is crucial to take significant steps towards creating holistic participatory models of city design and governance.

City is a complex system of subsystems and processes [8]. To address this complexity and improve city's functioning, safety, attractiveness, accessibility, inclusiveness and smartness in general, some holistic models have been considered already (e.g. Smart city⁴, Placemaking⁵). However, we have not been able to identify one that would address the whole array of challenges, at least not to the extent that we have identified them so far. Thus we use a Smart City concept as a generic platform on which we build our Vision of a Smart and Inclusive City, incorporating a *four-dimensional model* of societal challenges that we are tackling within the research. A digital dimension is incorporated, fitting the nature of a Smart City as a city of new digital era. Thus we propose a concept of a holistic modular digital tool to be integrated in the proposed holistic approach to inclusive city design.

3. Related work

The studied problem has been previously discussed from numerous angles and perspectives. The related work is thus introduced through the complexity of the studied phenomena, addressing the following research areas: a) inclusion and (dis)ability in relation to public spaces design, b) community engagement and open-government, c) Smart City, Placemaking, governance, and d) digital tools in relation to the studied problem.

Inclusion of public spaces, as a term, carries within a wide scope of meanings and interpretations. Often it is used to explicitly address the needs of disabled people, so to relevant stakeholders are reminded to pay special attention to creating physically, sensory, intellectually accessible places, services and information. In a broader sense, it refers to inclusion of all the people, regardless of their societal, economical, medical, cultural, religious etc. background [28].

Several authors [16], [18], [19] have addressed the issue of public spaces design in the last decades being put in front of the greatest challenges in breaking down barriers that disabled people face in accessing the public space. In fact, by segregating disabled from fully abled people, and by making a distinction between general and special needs, the "urban design has failed to rise to the challenge of an increasingly diverse society" [16].

The author's background [28] and extensive literature review available therein, show that

accessibility is still too often considered merely as architectural accessibility for physically and visually impaired, not considering the need for accessible information, communication and services, nor the needs of deaf and hard of hearing or intellectually and mentally impaired. As clearly stated by Hanson, one of the British authority researchers of inclusion and accessibility of public spaces to fit the needs of disabled people, urban environments are still "not sympathetic to the needs of older people and people with disabilities" although a "greater stress is being placed upon the importance of *inclusive design*, *universal design* or *design for all*" [16].

The shift from the *medical* to the *social* (and *biosocial*) model of disability is still being too slow thus resulting in a lack of holistically inclusive public spaces [16]. *Universal and Inclusive design* principles are paving the way to the more and more inclusive public spaces, however based on the observations of several authors [16], [18], [19], [27], [29], as well as own professional, academic and personal observations, inclusive design as a theoretical concept lacks applicability and the ability to encompass the wide variety of the needs of public space users. There will always remain some needs unsatisfied, which is why the interaction and communication with public space users, herein referred to as *community engagement / participation / co-creation*, is of even greater importance in order to "give a voice" to everyone and enhance the production of inclusive cities, and specifically inclusive public spaces for all.

Community engagement is even one of the priority principles, placed at the core of the eleven principles of a *Placemaking paradigm* [22], which started as an idea of designing "cities for people, not cars". In spite of a low number of cars at that time, this paradigm has developed in 1960s by the pioneers William H. Whyte and Jane Jacobs [36], who claimed people's rights towards the city. As such all these principles set the foundation for inclusive spatial design which now fits into the new *social* and *biosocial models* of disability [16].

By increasing the engagement and interaction between space-users and relevant space-stakeholders, integrating relevant methods, such as behavioural mapping [14] and ethnographic methods, it is clearly possible to understand the needs, behaviours and attitudes of users, and consequently the reasons for use and non-use of public spaces in the cities, as well as how the space is used. Combining this with non-segregation as an approach towards cities design, we are getting closer to Inclusive design which "aims to accommodate the broadest range of bodily shapes, dimensions and movements...", and should ensure "to address the needs of the widest possible audience" [16].

With the rise of the digital era and an increasing penetration, as well as rapid development of

⁴ https://en.wikipedia.org/wiki/Smart_city (June 2017)

⁵ <https://www.pps.org/blog/technology-brings-people-together-in-public-spaces-after-all/> (5th May 2017)

technologies and devices a huge potential is being given to the information and communication exchange between all the relevant stakeholders in the process of city planning, design and governance.

Community engagement and participation, co-creation and co-design have been discussed a lot in this context already. Be it in a context of a digital dimension [1], [6], [19], [30] or Smart City and Open-government concepts [4], [5], [6], [7]. Some studies [13], [15], [33] show that community engagement can in fact be encouraged by technological solutions. An extensive study of human behaviour in public spaces from early 1980s until now, implemented in USA by PPS project⁶ and W. H. Whyte [33], found that the use of public spaces increased with the digital era. However, in spite of this finding, the use of mobile devices in public spaces has been only 3-10% among all the people that were observed [15], [33]. This raises a question of readiness, motivations, reasons and barriers that people face in using digital tools while using public spaces.

Additionally, the phenomenon is too complex and multi-layered in order to simplify it with a claim that the technology encourages community engagement and the use of public spaces. Although technology is at the core of the Smart City conceptualization [17], it is clear that not even the best, and most user friendly of the technology will be of use and benefit if not incorporated appropriately into governmental systems, urban planning policies, adopted by stakeholders and recognized as beneficial by the users [7], [8], [20], [24], [32]. In fact, in addition to Smart City and related conceptualizations, some of holistic models to inclusive and engaging governance (Open-government) have been introduced already e.g. [7], especially after their studies had shown that cities still struggle to incorporate Smart City governance principles to improve the quality of life of their citizens.

By saying that, we need to agree with Stadler when claiming that »the quality of planning and design has always represented one of the key factors of success or failure of public spaces.« Furthermore, »nowadays, ICTs tools allow us to easier model architectural proposals, undertake better and more diverse analysis of the urban context and, last but not least, better communicate with communities and users of public spaces.« [32] Incorporating the digital dimension into city planning, design and governance can bring many benefits, as long as it is incorporated wisely, smartly, participatory and holistically, by first and foremost driven by users' needs.

As it has been discussed by previous authors [14], [16], [29] »users play an important role in sustainable spatial development« and it is highly important to

know how they experience open space and how their »environmental perception reflects their priorities, and consequently, their use of open space« [29]. In the same way, it is clearly as much important to understand also the use of digital tools in public spaces, which is still a relatively new phenomenon, and by human brain considered as a multitasking activity, which our brain still has difficulties accepting [21].

Among possible reasons, that can prevent full adoption of digital tools there were many discussed [1], [4], [6]. Considering the complexity and the abundance of challenges also in usage and adoption of digital tools, it is obvious that a thoughtful consideration will need to be undertaken in order to fully understand the use of digital tools in the city, specifically among disabled people, how these tools can support community engagement and finally the process of planning, design and governance of the city as a whole, and specifically public spaces.

In this context a Smart City concept has been promoted as a city for the future, »an urban development vision to integrate ICTs and IoT« in order »to improve the efficiency of services«, »allow officials to interact directly with the community and the city infrastructure and to monitor what is happening in the city, how the city is evolving, and how to enable a better quality of life« [30]. Nevertheless, as seen already, technology is not the only component of a Smart City, although often perceived by scholars and practitioners as the key component [17]. The main three pillars of components fitting into the Smart city concept usually are contextualized as a) Technology, b) People, and c) Institutions/Governments [26].

As emphasized by Hanson »urbanisation has become the fundamental human condition« and »cities are the engine of economic development, employment and opportunity« [16]. The concept of a Smart City is thus highly welcome, when adopted as thoughtfully and holistically as possible. One of the main Smart City definitions emphasizes exactly that: »The EU has developed a shared European vision of sustainable urban and territorial development. European cities should be places of advanced social progress and environmental regeneration, as well as places of attraction and engines of economic growth based on a holistic integrated approach in which all aspects of sustainability are taken into account.« [29]

Smart City could in fact be more ready to respond to a set of urban challenges than a traditionally governed city [30]. It certainly seems a promising but also a highly challenging paradigm for the modern cities to adopt. Cavada shares his doubts as follows: »Yet, the term itself remains unclear to its specifics and therefore is open to many interpretations.« [8]. Not only that, the concept has many conceptual relatives e.g. Digital city, Intelligent city, Wired city, Information city,

⁶ <https://www.pps.org/blog/technology-brings-people-together-in-public-spaces-after-all/> (5th May 2017)

Knowledge city, Smart community [26 – Table 3] and lacks “shared understanding”, thus there is “a need for a universal definition” of a Smart city [8]. “The discussion of smart city has been made without solid conceptualization” [26] thus many researchers have asked themselves questions such as: What is a smart city? What are its characteristics? Which components are crucial to be addressed within the smart city? What are the indicators that can be applied globally to different city contexts? How can we approach the concept in a most holistic way? How can we apply the concept in practice? [3], [8], [26]. Here we go even deeper, asking ourselves: How can we ensure a fully inclusive city design by incorporating basic inclusive principles, respecting the various needs of each group of disabled citizens, into each of the city components and processes?

Nevertheless, it is important to emphasize that scholars and practitioners have mostly come to a general agreement that a Smart City is “a system of (sub)systems” or a structure of “components” that need to work together on a relational level as a whole [9], [20], [24], [26] and only then can make a city truly smarter. Holistic approach is thus a crux of the Smart City’s smart functioning.

Last but not least, the human value should be perceived as a city priority and it should always come before the profit [26]. As well put by the Focus Group on Smart Sustainable Cities the “needs of present and future generations with respect to economic, social and environmental aspects”⁷ should be ensured. British Standards Institution defines Smart cities as cities that should “deliver a sustainable, prosperous and inclusive future for its citizens.” [26]

Our vision builds exactly on what has been introduced so far; on human value and citizen-driven approach on the one hand, and the need for a holistic and integrated approach to connect all the components, the stakeholders and the processes, on the other hand, integrating also the digital dimension to support the city interactions and automation of processes. Meaning, not only a holistic approach towards a city’s smartness as perceived by most scholars, but a true smartness incorporating also the needs of disabled people into each and every city subsystem, its component, element and pore, in order to design a truly inclusive city.

4. How can we holistically address the needs of disabled citizens in inclusive city design? Challenges and opportunities.

Herein we wish to bring forth some insights into the complexity of societal challenges that cities face

⁷ <http://www.itu.int/en/ITU-T/focusgroups/ssc/Pages/default.aspx> (June 2017)

when aiming at planning, designing and governing inclusive cities, specifically public spaces (services and information) that should respond to the needs of all their citizens. A *four-dimensional model* of considering societal challenges is proposed. Within this model we explain, which questions we are addressing within our research in order to be able to understand the complexity of the studied phenomena and propose a truly holistic approach to smart and inclusive cities. Following the presentation of this four-dimensional model, a Vision of a Smart and Inclusive City is drafted, as a holistic model that could represent an opportunity for further inclusive city design initiatives. Finally, a concept of a Social Cooperative Monitoring Tool is proposed as an integral part of our vision and as a part of the proposed holistic approach.

4.1. Societal challenges & a four-dimensional model

As a platform on which our vision is built, we use the modern concept of a Smart City, in order to pave the way to better understanding of the city’s complexity, its functional components and the relations between these components, and finally address the specific societal challenges of our research. As said, the Smart City concepts are usually introduced by emphasizing three main components, namely a) technology, b) people and c) institutions [26]. Following this logic, we propose a *four-dimensional model* towards addressing the identified societal challenges within inclusive city design. As introduced in the Figure 1, within this model, the holistic approach incorporates four levels: a) individual or user level, b) environmental and governmental level, c) technology level, and finally d) relational level. The relations between the first three components are of a paramount importance, if the city wants to address the citizens’ needs, and work as a system in a whole, thus we consider the relational level as the main set of challenges to be addressed when striving for a holistic approach.

At the individual level, the challenges that we need to tackle are related to (disabled) citizens, their needs, their individuality and their role as public space users within context of a growing urban, ageing and differently abled population in Europe. A citizen-driven approach needs to be incorporated into each further discussion.

At the environmental and governance level the challenges relate to the environment, specifically open public spaces, how they are built, planned, designed and governed. One of the main challenges here is also how the planning, design and governing processes can be improved, and approached through a holistic participatory and integrative approach, involving users and stakeholders throughout the whole process. From a governance perspective, a

Smart City concept, a Placemaking paradigm, Open-government and other related conceptualizations undoubtedly represent important success stories to be considered.

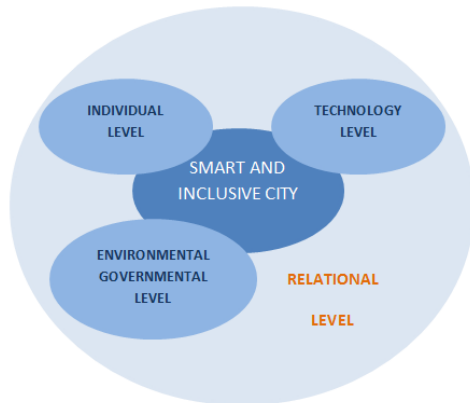


Figure 1: A four-dimensional model of addressing societal challenges

Several cities across the globe have already implemented concepts following the Smart City principles, for example Barcelona, Madrid, Amsterdam, Toronto, London or Berlin [32]. Many have also holistically raised a question of accessibility and inclusiveness to fit the needs of disabled people, thus designing extensive accessibility projects. European Union supports these projects and promotes good practice examples through an Access City Awards⁸ initiative, which each year awards several prizes. Certainly we can learn much from all these cities, however in majority cities still struggle with incorporating all the aspects of fully inclusive design strategies, and incorporating inclusiveness into all the components, processes and pores of a (smart) city.

At the technology level, it is evident that the modern society faces an increasing penetration of digital technologies and devices (e.g. smart phones etc.), as well as rapid development and increasing application possibilities. These application possibilities are not yet fully investigated, and have a highly untapped potential to being applied and used widely in the real life environments addressing specific sets of users' behaviours and needs. To develop technologies that will be acceptable to the end-users, it is essential to involve the later in the development and testing process. It is important to know why, when and how people use digital tools or don't use them. We need to be aware of possibilities and limitations of existing digital solutions. At this level, our specific research challenge relates to investigating the array of digital solutions designed

for the purpose of inclusive city design and governance, such as different Smart City platforms and apps, including or standalone citizens' apps, community engaging tools, urban planning, design and governance tools, evaluation and monitoring tools, (behavioural) analysis tools, (ethnographic) research tools etc.

Finally, there is the relational level, which puts the understanding of the other three levels to another dimension. Here we are challenged with the (co)relations between at least; a) public space users and public spaces, b) public space users and public-space agents (co-creation), and the nature of Human-Computer Interaction (HCI) between c) public space users and digital tools, and finally between d) public space agents and digital tools.

4.2. Holistic approach & A Vision of a Smart and Inclusive City

As introduced, our holistic approach builds on a *four-dimensional model* of a complex set of societal challenges through which our specific study problem needs to be addressed. It also builds on a *needs-driven approach* that considers participatory practices between public space agents and public space users, and in addition integrates digital tools aiming at supporting co-creation processes between the two groups. This *needs-driven approach* is introduced in Figure 2.



Figure 2: Needs-driven approach to inclusive public spaces design

Further on, in Figure 3 our holistic model itself is introduced. This incorporates a complex set of diverse needs and corresponding solutions into each step and each component of the city design. By saying that, we refer to respecting (dis)ability of different groups of disabled people e.g. physically disabled, blind and visually impaired, deaf and hard of hearing, intellectually and mentally disabled, but also a diverse range of other disabilities arising from long-term conditions and/or illnesses. Awareness among relevant stakeholders through strong participatory and open-governance approach is then strongly promoted, meaning not only about the diversity between these groups but also the diversity within a specific group of disabled people. Further on, there is a set of standardized, legislative

⁸ <http://ec.europa.eu/social/main.jsp?catId=1141&langId=en> (4th May 2017)

procedures and solutions incorporated, however a strong emphasis on individuality is also given, as the needs of individuals with similar disabilities can significantly differ from one another. This is supported through a strong user-centred participatory approach and open-government principles with a constant exchange of knowledge, ideas and practices between all the relevant stakeholders. Since it is not realistic not reasonable to always implement a direct user involvement, as seen in Figure 3, a three-level-user model is proposed when it comes to citizen-driven and open-government participatory approach: a) end users (disabled people themselves), b) association level (disability associations), c) representation/advocacy level (associations' representatives in governmental and political frameworks).

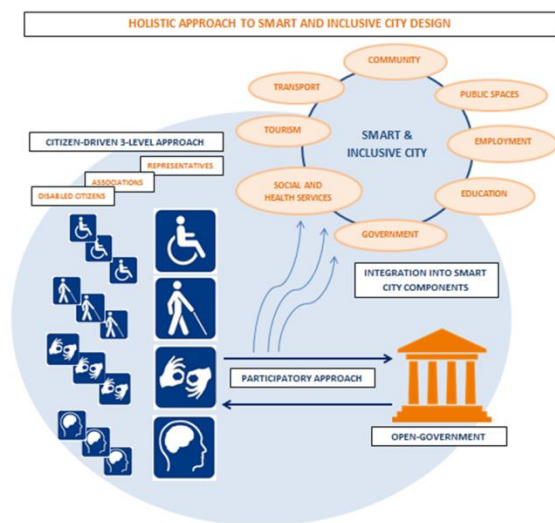


Figure 3: Holistic approach to Smart and Inclusive City design.

Participatory actions are further on proposed to be organized into the following levels: a) community level (focus groups, public disclosures, public opinions, direct collaborative practices etc.), b) operational level (meetings, working groups, workshops, automated on-going collaboration within city offices), c) management level (city management meetings, governance openness to disability initiatives, disability representatives involvement in decision making), d) political and strategic level (parliament and council sessions, disability representatives involvement in planning and strategic processes, groups etc.).

Finally, a holistic view over the city as a system of subsystems (components and processes) is proposed. Taking into account the Smart City concept, first all the city components, to which the inclusiveness should apply, are identified. The Figure 3 tries to give an overview of such relevant components, namely a) Public spaces, b) Transportation, c) Public services, d) Social and

Health services, e) Education, f) Employment, g) Tourism, h) Community etc. Within each of the components, a specific set of stakeholders, processes, steps, actions, measures, standards, models, tools etc. should then be identified, and adapted to the needs of each group of disabled people. Within each of the processes participatory and open-governance principles as explained above should be applied, in order to ensure that the needs of disabled people are truly recognized.

Within such a holistic approach, the city is governed through a *bottom-up* (needs-driven, citizens-driven), but also *top-down approach* (governmental, policy and strategic initiatives). These two approaches can be a winning combination, as long as they are primarily focused on a human dimension, well intertwined and iterative.

4.3. A Social Cooperative Monitoring Tool

The vision introduced, is a part of our broader research, namely “A Social Cooperative Monitoring Tool for the Production of Inclusive Public Spaces”. For this reason it incorporates also a proposal of such a digital tool as conceptualized herein and drafted in Figure 4. However, this tool first needs to be contextualized within our vision of a Smart and Inclusive city. As said, digital dimension is one of the key elements of a Smart City concept, but there are still some doubts to be considered. As noticed by several authors, “a greater attention is paid to the ICTs while ignoring the social aspects” [1], [13]. And in the flood of many digital tools, that do not live their full acceptance and adoption, perhaps Smart Cities could in fact play a significant role, but only when emphasizing the importance of all the dimensions needed to be considered in a holistic framework in inclusive public spaces design, always having disabled people in mind.

As shown through related work section, digital tools can in fact, to a certain level, increase the attractiveness of public spaces by supporting users in enjoying public spaces, providing them with location based and context based services, and at the same time giving them the opportunity to express their opinions, provide suggestions, complaints, and get engaged with the environment, other community members and stakeholders [1], [2], [32], [33]. They have been incorporated in many Smart City initiatives and are being thoroughly studied all the way through the last decades of the digital era. However, in order for them to be of a true value, the research show, that they need to respect and address the users’ needs, be designed with and for the users according to user-experience design principles, and finally be implemented holistically, thoughtfully and patiently as to gain the maturity and general acceptance.

Saying that, as a part of our vision to Smart and Inclusive Cities, we envision also a proposal of a holistic modular digital tool, carefully incorporated into all the identified city components and processes. We do not envision a completely new digital tool. In a flood of many this may not have a promising future. However, based on the state of the art, undertaking a conceptual approach, we propose a modular tool (Figure 4) that combines, intertwines and updates the already existing digital solutions, only to incorporate a holistic and inclusive dimension.

A great number of digital tools have already been identified through literature review and a participatory ethnographic field research. Some of the digital tools that are of interest to us for the proposal of a Social Cooperative Monitoring Tool, could be categorized into: a) location-based participatory digital tools, such as Wheelmap for wheelchair users⁹ [32], Arianna for the blind¹⁰, Fix my Street, Ushahidi, [32], EthnoAlly¹¹, b) monitoring, evaluation and analytical tools, such as SpaceSyntax¹² and Flux Space [32], unobtrusive tool for behavioural analysis [2]; Hadrian as an “design for all” evaluation tool [25], 311 app as an cooperative-analytical tool [4], but also c) context-based social and networking tools such as FourSquare¹³ [12], Fabric¹⁴; and finally, d) holistically designed Smart city digital solutions that can work globally or can be applied and adapted to the needs of a specific city context, such as Comarch Smart city platform¹⁵, holistic transportation Smart city tool Moovit¹⁶, Butterfly Smart city app for the citizens of Amsterdam¹⁷ etc. Of course, the categories introduced are only sketching the differentiation since technology nowadays is becoming more and more multimodal, multifunctional and thus has many overlapping functionalities.

For example, many of these tools use geo-positioning, geo-tracking, contextualized information etc. but combined with other functionalities in a different way for a most likely different purpose. Most of the participatory tools nowadays for example use a principle of *crowdsourcing* which in a context of urban planning »involves an interactive online environment, where community members help decision makers, financial bodies and project developers to tackle urban issues by locating them on

a map, by expressing opinions, wishes and expectations« [32]. This should allow cities to become more community engaging, open and responsive. However, adoption of such tools is a far more complex process. In the flood of new ideas and digital solutions it is difficult to; first, achieve successful integration into governmental systems, and second ensure a satisfactory level of interest among community members to use the proposed digital solutions. Also the community needs to be properly trained [32]. Further on, again there is often a lack of holistic approach. The digital solutions are often also dispersed for different purposes, although they are in most cases logically very integral solutions when considering a holistic functioning of a Smart City.

In fact, by combining these tools we envision that such a holistic modular digital tool could be conceptualized and designed, that a) can be used widely by all relevant city stakeholders, also respecting specific needs of disabled people, b) is integrated into all relevant city components with corresponding processes, c) creates solid channels of two-way communication and enables a participatory approach to governance, d) enables evaluation, monitoring, data collection and analysis, e) provides social networking opportunities, and safe, attractive, useful and usable exchange of information, and finally f) provides contextual information and navigation possibilities.

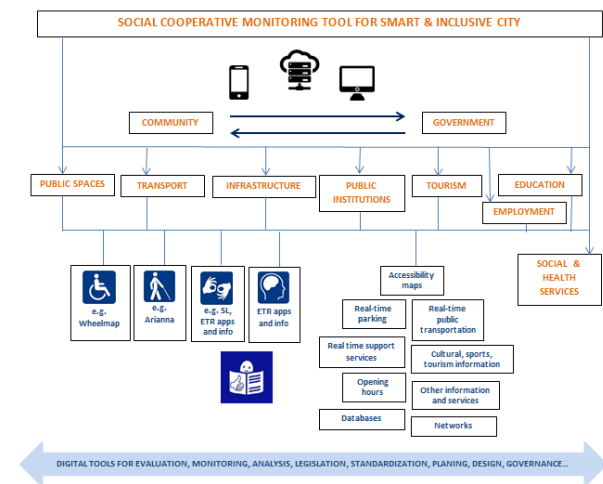


Figure 4: Social Cooperative Monitoring Tool

Specifically referring to inclusive public spaces design, this tool, as envisioned and conceptualized herein, would enable a two-way communication between public space agents and public space users, aiming at, on one hand communicating barriers, complaints, suggestions initiated by public space users, and on the other hand providing citizens with quality and useful contents by the public space agents (e.g. public services info, opening hours, events information, tourist information, accessibility

⁹ <https://wheelmap.org> (4th May 2017)

¹⁰ <http://in-sight.srl/arianna> (June 2017)

¹¹ <http://cloud.mobility.deustotech.eu/ethnoally/> (October 2016)

¹² <http://www.spacesyntax.net/> (January 2017)

¹³ <https://foursquare.com/about> (November 2016)

¹⁴ <https://techcrunch.com/2016/08/10/former-facebook-engineers-launch-fabric-an-automated-personal-journal-of-your-life/> (November 2016)

¹⁵ <https://smartcity.comarch.com> (June 2017)

¹⁶ <https://www.moovitapp.com/> (June 2018)

¹⁷ https://en.wikipedia.org/wiki/Smart_city (May 2016)

maps of locations, destinations and routes; sign language interpreters, audio information and navigation etc.). It would enable direct involvement of the citizens into all the aspects of *plan-design-govern-maintain public spaces chain*, but would also offer them useful contextual information to motivate them even more for using the tool. The tool could work on a municipality level, national level, union or global levels. The tool itself would follow WCAG 2.0 principles for accessible websites and apps, and would as such in its very essence respond to the basic needs of citizens with disabilities, be it the needs of physically disabled for getting information about accessible locations; be it providing visually impaired with easy-to-access audio information, contrast colours, big fonts; offering easy-to-read versions of all relevant information to support those with hearing, intellectual or mental impairment; and in addition provide sign language interpreters to support those with hearing impairment in social contacts.

5. Conclusion & Future work

It is anticipated that our vision, presented in this paper, will have an impact on the future work in the area of research. We conceptualize a smart and inclusive city as a city, that primarily responds to the needs of one of the most vulnerable citizens, namely disabled people who face a different array of barriers while using public spaces, services and information. In order to achieve full accessibility of the public sphere, the city must incorporate a biosocial model into its functioning. However, without deep understanding of the complexity behind disability, inclusion, citizenship and the Smart City itself, we are far from truly inclusive cities. We believe that current holistic approaches to smart city governance need to be upgraded with a detailed understanding of disability as a part of the citizenship. Thus, a holistic approach towards planning, design and the governance of public spaces needs to be undertaken. Inclusive dimension should be incorporated, thus making the city system work smarter for all the citizens. A digital, participatory and open-governance dimension should be incorporated into such system in order for the city to be able to build firm communication channels between all the relevant stakeholders, and simplify, optimize and automate the city processes. We believe the main challenges for the future will be, first to enhance the understanding of the diversity and the complexity of disability, secondly, to enhance the understanding that Smart city initiatives are worthless if they fail to meet the needs of disabled people, and last but not least, answering the challenge of how to incorporate the inclusive dimension into all the pores of the city. This research will further on focus on understanding of the relations between and/or among disabled

citizens, relevant stakeholders, public spaces, digital technology and the smart city governance approaches. We will continue to explore the complexity of the presented phenomena, considering the Smart City good practice examples as well as the most recent and most used Smart City digital solutions that could be incorporated into a holistic inclusive city design. Additionally, an exploratory field work will be conducted in a setting of at least one small-size European city, namely Maribor in Slovenia, possibly also in Ljubljana, Bilbao and/or Antwerp. As a contribution to the scientific, professional and political community, a practical step-by-step model to a holistic public spaces planning, design and governance will be proposed, incorporating the principles of inclusive, participatory and digital-based design. Following our conceptualization and ideology of a »Social Cooperative Monitoring Tool for the Production of Inclusive Public Spaces« a design specification is anticipated to be outlined.

6. Acknowledgements

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“Good designers design what they would design before they start designing it.”

Mustak Cobanli

4. Understanding the Complexity of Inclusive Public Space Design – Reflections on the Case study of Slovenia

Paper 3 is entitled *Understanding the complexity of inclusive public space design – Reflections on the case study of Slovenia*. It was published as a book chapter in *Neighbourhood and city - Between digital and analogue perspectives. CyberParks Project. Series Culture and Territory (3)*.

This paper positions the current research at the intersection between social sciences, engineering and urban studies. Although it does not specifically address any of the research questions, it contributes to all of them by outlining the overall structure, approach and methodology of the research, and by introducing a set of exploratory questions for ethnographic fieldwork, thus bringing together the three dimensions of people, places and digital tools (Paper 3, Fig. 2). Finally, it presents a preliminary report on four case studies conducted in Slovenia with the aim of exploring the research questions from an ethnographic perspective. This allows for preliminary conclusions with insights in regard to (a) the use, planning, design and governance of public spaces (cities); (b) the role of digital tools in inclusive city design; and (c) a methodological approach towards holistic, inclusive city design.

One of the core contributions of this publication is an overview of the main gaps and directions related to this research. It emphasises the complexity, diversity and individuality of the needs of public space users (citizens), which need to be explored and incorporated into inclusive city design in a holistic and participatory way. It also highlights the importance of community engagement, the potential of ethnography, and the role of digital tools in these processes. As a response to the identified need for innovative and diverse methodological approaches, techniques and tools, this paper also lays the groundwork for the novel CMA introduced in the next publication (Paper 4).

Among others, the results of the Short-term Scientific Mission (STM) conducted within the framework of the CyberParks project (COST Action TU 1306) at the Urban Planning Institute of the Republic of Slovenia (Ljubljana, Slovenia) are introduced.

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Understanding the complexity of inclusive public space design – Reflections on the case study of Slovenia

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Abstract - This chapter focuses on providing an overview of the pilot experimentation conducted in two case study cities in Slovenia (Maribor & Ljubljana), part of a project titled “Social Cooperative Monitoring Tool for the Production of Inclusive Public Spaces”. The experimentation aimed at investigating the challenges modern cities face in regard to understanding public space users with disabilities, their needs and perceptions of the use of public spaces. Additionally, with the penetration of digital tools into everyday lives, we assume that these can play an important role in enhancing interactions, mediations and support. Thus, they can contribute to understanding urban challenges and citizens’ needs, as well as help stakeholders respond adequately. Building on this assumption, our experimentation involves an investigation of the role of digital tools in enhancing inclusive urban planning and design to fit the needs of disabled citizens. Ethnography as a strongly user-centred methodological approach enriched with the use of digital tools was primarily used. A great amount of deep qualitative data was collected during the fieldwork and will be subject for further post-fieldwork analysis and interpretation. However, some preliminary conclusions have been drafted to guide future research and related discussions. This chapter sheds light on the gaps identified, proposes further research and practice-oriented directions, and contributes to the discussion on inclusive public space design.

Keywords - Open space, Urban planning and design, Inclusion, Ethnography, Digital tools

INTRODUCTION

With rapid technological and economic developments, modern societies nowadays face in parallel both endless opportunities and challenges. With the trend of a growth, aging and diversification of the world population, social divide could represent one of the main challenges to be addressed. As a society and individuals, we are becoming increasingly demanding in seeking justice, equality and inclusion. In all the diversity, we seek individuality therefore providing a true equality without

emphasizing the individual's special needs remains a true challenge. According to New Urban Agenda "by 2050 the world urban population is expected to nearly double" (UN Habitat, 2016: 1). With such growth of urban population on the one hand, and globalization, innovation and smart supply on the other, cities are becoming complex systems. How to plan, design and govern such systems to ensure justice, equality, inclusion and sustainable growth? Many scholars, practitioners and governments have tackled this question, and many efforts have been made within the last decades. Principles of Placemaking (PPS, 2018) and a concept of Smart Cities (Nam et al., 2011) are only a few to name. However, cities still face challenges in addressing the needs of all their citizens, including those with disabilities. The New Urban Agenda is a response to these challenges. This chapter explores questions of inclusive planning and design, specifically related to the needs that disabled citizens have as users of urban spaces. Particularly we try to understand how cities can enhance collaboration between public space users and public space agents through the use of participatory digital tools, and establish a holistic approach to planning, design and governance in order to enhance the production of inclusive public spaces? We assume that for addressing the needs of disabled people we need to address them holistically by first and foremost, establishing firm, fluent and long-lasting channels of two-way communication, and bringing the reality of disabled people closer to those in power to take actions. Both, the growing complexity of cities, and of the studied phenomena itself, call for a holistic approach and an in-depth exploration. This shows the need for applied research and fieldwork to truly understand how inclusive planning and design can be studied and enhanced through new approaches that fit into modern visions of smart and inclusive cities (Rebernik et al., 2017; UN Habitat, 2016).

This chapter contributes to such challenges by outlining results and preliminary conclusions drafted from the experimental work, conducted within four case studies in two largest Slovenian cities, Maribor (MB-I, II, III) and Ljubljana (LJ-I). Firstly, the disabled citizens, their needs and attitudes towards their (dis)ability and life are addressed. Secondly, the question how public spaces are currently planned, designed and governed is explored. Thirdly, the questions as to what kind of digital tools already exist in planning, design and governance practice, what features they include, how usable and useful they are, and how these can be improved, are investigated. Further, the relations between people, places and technology are examined by addressing the questions of how disabled people use and perceive public spaces on the one hand, and how they use and perceive digital tools on the other. Finally, we explore how places and digital tools can be interrelated and can support planning, design and governance practice (Rebernik et al., 2017).

Through experimentation we especially observed the following questions on the relational level:

- What makes a Space a Place?

- How citizens perceive public spaces, how they interact with them and within, what motivates and what prevents them from using public spaces they live in?
- How citizens' use digital tools, what is their relationship with them, and what are their attitudes, motivations and constraints towards using the tools?
- How people with disabilities use the public space in comparison with those without any impairment and how understanding of differences and similarities between their behaviours should affect the urban planning and design practice?

Based on the experimentation we outline some insights into the issues raised, and draft a set of preliminary conclusions, interesting enough for driving, prospecting and directing further discussions and research.

THEORETICAL FRAMEWORK

We ground our work on two conceptual ideas: a) *Vision of a Smart and Inclusive City*, and b) *a four-dimensional model* (Rebernik et al., 2017). The latter is considered to help relevant stakeholders tackle the societal challenges that they face in regard to fully inclusive city design. This model builds on three main pillars; the users, the space, and the technology (Fig. 1). It proposes to approach societal challenges through four dimensions: a) individual, b) environmental, c) technological, and d) relational level. Both, the vision and the four-dimensional model are a response to the growing complexity and diversity within urban environments, and the need to approach this complex phenomenon from a holistic perspective. Figure 1 shows the three dimensions as core pillars and their interrelations in a context of collaboration between public space users and public space agents for enhanced inclusive design.

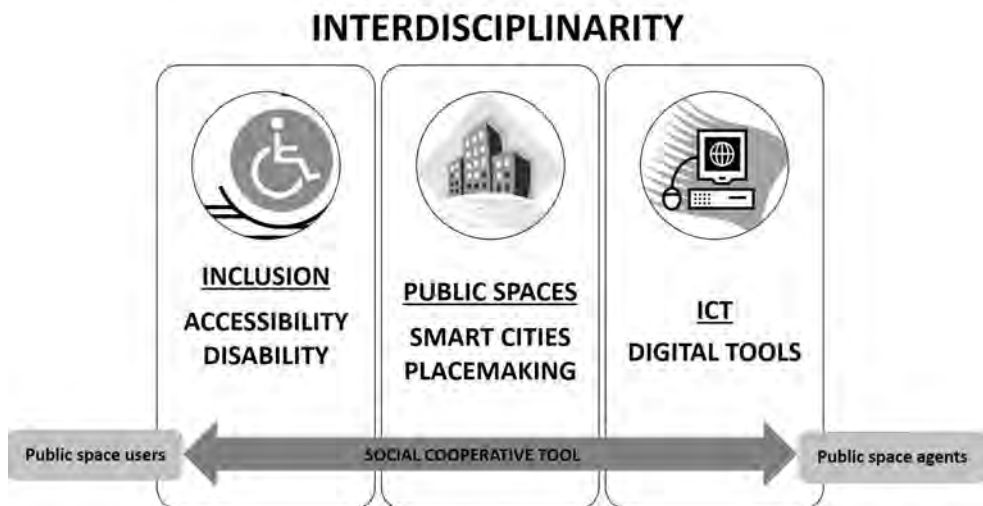


Fig. 1: The three research perspectives (Inclusion of users – Individual level, Public spaces – Environmental level, Digital tools – Technological level). Source: Authors

Although primarily focused on human dimension (individual level), it is obvious that this complex phenomenon needs to be observed also through the digital dimension (technological level), dimension of space (environmental dimension), and through relations between them (Rebernik et al., 2017). Only in this way we can understand the complexity and respond accordingly.

All these levels have raised challenges and have been exposed to previous discussions. Placemaking paradigm (PPS, 2009) suggests the four qualities of successful public spaces (accessible, occupied with people, comfortable, sociable). To fit the needs of all the citizens, the spaces primarily need to be accessible. Inclusive and universal design have been promoted as barrier-free concepts and have recently been discussed also in urban design (e.g. Hanson, 2004; Imrie 2012; Oliver et al., 2010). The scholars show that these concepts are clearly paving the way to urban planning and design but among disabled citizens there still seems to be a struggle for inclusion (Hanson, 2004). Therefore, there is a growing need for active citizens' involvement in the governance processes. Castelnovo et al. (2015, 2016) emphasise the importance of a holistic approach to Smart city governance grounding on principles of co-creation, co-design and co-production. Gooch et al. (2015) and Wolf et al. (2015) highlight the shift from "citizens as active participators" to "citizens as innovators" and drivers of city's development. Furthermore, the role of digital tools has been discussed in the context of technological advancements, smart city processes and the need for citizens' engagement. As said by Abdel-Aziz et al. (2016), ICTs can allow to better analyse, use and sometimes predict the use of public spaces. According to Stadler (2013), new ICTs bring new opportunities and can significantly enhance public spaces, their governance and maintenance as well as encourage interaction among people and dialogue between citizens and administrations. Within the use of ICTs the behaviours, motivations and constraints that users face while using them have been discussed (Klichowski & Patricio, 2017; Verkasalo et al., 2010). Although digital tools have proven to offer endless opportunities for enhanced inclusive urban practice (Klichowski & Patricio, 2017; PPS, 2014), neuroscience suggests that human brain may not yet be ready to fully accept the logic of technology at least not using it while moving and/or spending time outdoors (Klichowski & Patricio, 2017).

METHODOLOGY

The experimental work was conducted in Slovenia within two cities, Maribor and Ljubljana. It fits into a broader research which had been conceptually and methodologically divided into three phases as seen in Fig. 2. Following this, four study cases have been implemented (MB-I, MB-II, MB-III and LJ-I). The experimentation aimed at addressing the challenges in respect to understanding public space users, their use of public spaces, and at reflecting on the actual role of digital tools in enhancing the use of public spaces. Responding to the need of understanding the

complexity of citizens' needs for fully inclusive public spaces design, both disabled and non-disabled citizens were involved. Building on the assumption that new media technologies can enhance user engagement, communication between stakeholders and improve understanding of citizens' needs for more inclusive city design, a digital dimension was explored. An array of research and practice oriented digital tools was identified. Those selected were then analysed and tested through ethnographic techniques of digital tools elicitation. The main aim of such an approach was to observe the use of digital tools among the participants and gain some insights into how different digital tools can actually support the public space users, public space agents and the researcher in communication on the one hand, and on the other hand in identification of limitations of space in regard to inclusion.

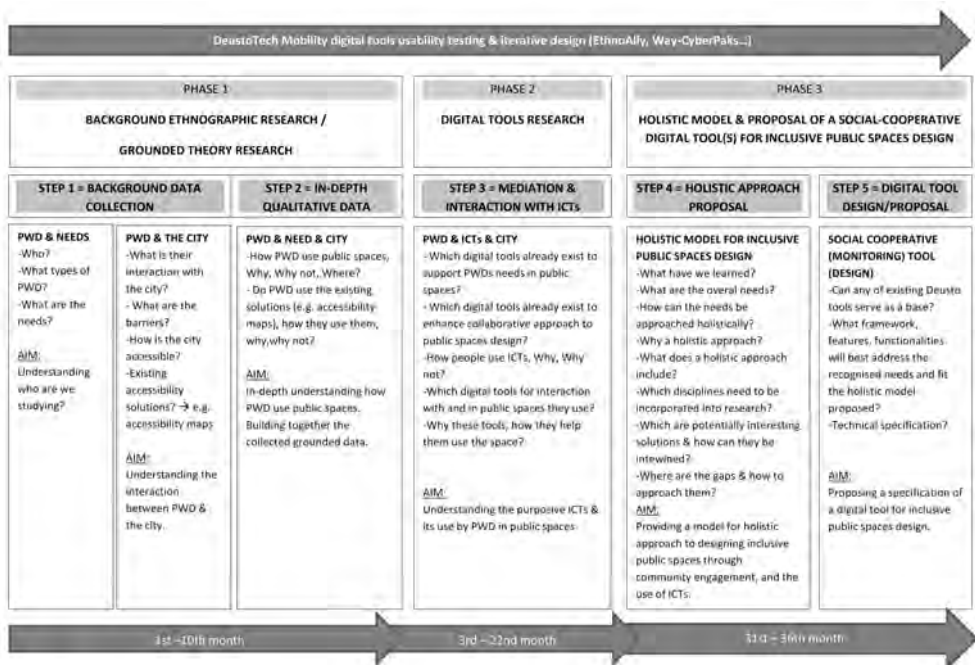


Fig. 2: Conceptual and methodological structure and flow of the research. Source: Authors

The exploration covered four dimensions (individual, environmental, technological, relational level) (Rebernik et al., 2017). For implementation of such approach participatory and user-centred techniques were used in order to get the in-depth perspective of the phenomenon. Methodologically we ground our work on ethnography as a core user-centred and deep, slow and small-data oriented research that can enhance deeper understanding of the users, their needs, their use of public spaces, and of diverse digital tools. Specifically, ethnography participant observation, friendly interviews, diary writing, and digital tools elicitation techniques were used to collect data. Complementary methodologies were also incorporated, depending on the research question being explored, such as background ethnographic research

(Phase I – Step 1), post-occupancy evaluation (POE), behaviour mapping and the like (Phase I – Step 2). To address digital dimension (Phase 2) a literature review with on-line research of the existing digital tools was implemented, followed by digital ethnography techniques, such as digital tools elicitation, mediation, interaction, geotracking and geomapping. Iteratively, a comparative analysis of identified tools was used in order to gain an understanding of the features, functionalities and usability of diverse identified tools. In the process some of the tools were tested with public space users, public space agents and by the researchers themselves.

CASE STUDY OF SLOVENIA

The four case studies were implemented within a specific urban setting of the two largest Slovenian cities, Maribor (MB-I, II, III) and Ljubljana (LJ-I), with no more than 400.000 inhabitants in total. As such they fit into the category of small (Maribor) and middle-sized (Ljubljana) European cities. The experiments took place in three different periods, between end of 2016 and 2017, covering winter, spring and summer months. All three periods lasted of approximately 1 or 1,5 months in order to have enough time to adapt to the participants' availability, weather conditions and fieldwork plan itself.

Target group definition

Two groups of users were considered as research participants:

- Physically and/or sensory impaired, while they more than others may rely on such tools as assistive-devices, and
- Non-impaired public space users, urban planning practitioners and governmental officials.

However, the main participants in this research represented physically and/or sensory impaired persons. They represent the most vulnerable users, as they regularly face barriers in accessing and enjoying public spaces. The decision to involve them as the main group was driven by our belief, that only when the spaces are inclusive for the most vulnerable members of the society, they are truly inclusive. Engaging both, disabled and non-disabled public space users finally enabled us to get some insights into similarities and differences in the use of public spaces and the digital tools comparing both groups of users. Recruitment of the participants was mainly a result of previous ethnographic work and a result of researcher's professional and personal networks.

Experimentation process

The experimentation followed a step-by-step process as presented in Fig. 2. Within Phase I an intensive ethnographic fieldwork was conducted within case studies MB-I and MB-II, aiming at understanding the culture of public space users, their needs, and their interactions with public spaces. This phase based on conducted

ethnographic and elements of grounded theory research resulted in gaining participants trust for further exploration, and in-depth knowledge about disabled citizens as public space users and co-creators. Through this work we were able to get to know the participants, their attitudes towards the use of public spaces, some basic insights into their familiarization with digital tools, and their openness towards participation in governmental efforts in building more inclusive cities.

The conclusions of case studies MB-I and MB-II were used in order to explore questions of how the public spaces are used, planned, designed and governed with the use of digital tools as a media towards more inclusive urban design practice (Phase 2). Within case studies MB-III and LJ-I we started focusing on mediation and interaction with potentially interesting digital tools such as EthnoAlly¹, Way-CyberParks², WheelMap³. The aim was to understand the role that new media technology can play in inclusive public spaces design. Finally, still a part of the Phase 2, but connecting the Phase 3 of a holistic approach to inclusive city design, we tried to observe how the tested methodologies can be of use in the urban planning and design practice. Specifically, we explored how can public spaces and their use be observed, and better understood through the use of digital tools, addressing three perspectives:

- User (easiness and usefulness of the tool (app));
- Ethnographer (usefulness for in-depth research);
- Urban planner/designer (applicable value for urban planning or design practice).

Discussion and results

Herein we outline preliminary conclusions of the experimental work. There is a need to explore public space users and their needs through all the diversity and individuality. Moreover, diversity (and the individuality within) needs to be respected by public space stakeholders and incorporated into inclusive city design by following the logic of minimum standards to fit the principles of inclusiveness for all. Due to the complexity and diversity of these needs and difficulty to truly understand them, one could argue that inclusive design, universal design and design for all, lack applicability to real life scenarios. However, we see such a visionary approach as the only way to reflect on this complexity and enhance efforts to cover the widest possible array of needs. A strong participatory approach should be undertaken and combined with constant efforts of the relevant stakeholders to reach out to disabled citizens for advice and consultation on inclusive city design. However, that may not be one of the easiest tasks.

While recruiting participants for the research that was planned to be conducted in the most possible participatory and user-centred way, we faced difficulties in

¹ <http://cloud.mobility.deustotech.eu/ethnoally/>

² <http://cloud.mobility.deustotech.eu/cyberparks>

³ <https://wheelmap.org/en/map>

ensuring a satisfactory level of interest and dedication by the target group of disabled people. This was of a great surprise, specifically due to the fact that a high level of trust and collaboration had already been established with disability associations, their members and disabled individuals. The case study showed that engagement is a process that is not so easy to be ensured, at least not in a fully dedicated manner. Reasons for this should be further explored, and special attention should be given by relevant stakeholders to implement behavioural change strategies for enhanced community engagement. The experimentation has also shown that current urban design practices seem not to be sensitive enough to functional design. In this way a wide array of public space users is being excluded. As a result of this pilot case we propose that strong participatory approaches are employed within the existing urban planning, design and governance practices. For this purpose, the stakeholders need to be encouraged to incorporate deep, slow and small-data oriented qualitative research in order to gain deeper and holistic understanding of citizens as drivers of the city, their needs and their use of public spaces.

There was a great deal of misunderstandings and miscommunications between public space users and public space stakeholders identified. Whereas the first claimed to have provided stakeholders with a clear overview of their needs but not have been heard, the stakeholders on the other hand expressed great interest in addressing the disabled people's needs but claimed that they do not know exactly what that array of needs and solutions is. Such lack of communication, education and misinformation calls for urgent application of participatory approaches and firm channels of two-way communication between users and governments, which could also be implemented using digital tools.

A great number of ethnographic and related research digital tools that could support inclusive urban design practices have been identified. A few (e.g. EtnoAlly, Way-CyberParks, WheelMap) were also tested. In spite of many challenges, the results imply that digital tools could in fact play an important role in enhancing collaboration between public space users, researchers and urban planning and design practitioners. Further on, they could support the exchange of information, enhance communication and support deep qualitative research of the complex research questions. The tools are to be explored in more depth; specifically, their features, functionalities, usability and usefulness, and a list of priority features for inclusive design should be proposed. Nevertheless, several issues appear when thinking of employment of digital tools into participatory actions. Based on our exploration, the disabled participants faced constraints in using ICTs due to both internal and external reasons. These reasons should be explored in the field in more details, and HCI and UXD research perspectives should be incorporated.

Finally, research-wise, one of the important comments addresses the methodological perspective. The complexity of inclusive city design and diversity of research questions addressed within, seek new, innovative and diverse methodological

approaches, techniques and tools. Nature of research questions calls for a combinatory methodological approach. Within the case studies we built the research methodology mainly on ethnography-based techniques, but we experimented also with grounded theory principles, POE and behavioural mapping. We assess an added value of combining these techniques when addressing inclusive place, but however, as tested merely in a pilot case study, it should be further addressed.

CONCLUSIONS

The experimentation introduced with this chapter, although timely limited, brought interesting insights in regard to a.) the use, planning, designing and governance of public spaces, b.) the role of digital tools in inclusive public spaces design, as well as c.) methodological approach towards holistic inclusive city design. By outlining core findings that have come to light through deep qualitative experimentation we contribute to the discussion on interaction between people, places and digital tools for enhanced inclusive city design. Specifically, we reflect on the national perspective of Slovenia as a small European country.

The conclusions are of a preliminary nature, mostly due to time constraints for further analysis and interpretation of the collected materials, as well as the complexity that they address. Thus, our main contribution here is to provide an overview of main gaps and main directions for further research towards enhanced inclusive public spaces design. As with all qualitative research the amount of deep-qualitative data that we collected seeks in-depth analysis and extensive post-fieldwork in order to address the complexity of the phenomena in a holistic way and provide more specific and applicable conclusions for further planning and design practice. The materials are currently being further elaborated and are planned to be comparatively reflected also from the perspective of other national environments, specifically Belgium and Spain.

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“If you cannot measure it, you cannot improve it.”

Lord Kelvin

7. Measuring Disability Inclusion Performance in Cities Using Disability Inclusion Evaluation Tool (DIETool)

Paper 6 is titled *Measuring disability inclusion performance in cities using Disability Inclusion Evaluation Tool (DIETool)*. It was published in *Sustainability* (JCR-Q1) in February 2020.

This paper represents a response to the initially crafted vision of a disability-inclusive city within the framework of smart and sustainable cities, and attempts to fill the gap relating to missing disability inclusion metrics and evaluation systems for cities. It completes this research work as the last in the series of publications arising from this research, and responds to the following two research questions:

Research question 2: How can we translate the complex legislative, political and standardisation frameworks into simplified, comprehensive models that can help city officials better understand the complexity and diversity of disability inclusion and reflect their numerous positive aspects also in practice?

Research question 6: What kinds of tools could be used to translate a complex set of accessibility and disability inclusion requirements into a simplified understanding of disability inclusion and a practical set of indicators at the city level, which could help city officials identify their strengths and weaknesses, motivate them to design appropriate corrective measures and bringing disability-inclusive city closer to reality?

This paper contributes to the field by proposing a unique DIETool with a DIPI component. In a compact and holistic way, these tools can translate accessibility and disability inclusion requirements from global political, legislative and standardisation frameworks into a practical set of indicators at the city level. In this way, they offer a novel solution that can help in guiding cities towards improving disability inclusion performance.

The paper also discusses the results of implementing and testing DIETool and DIPI in two cities in Slovenia and Poland. These results prove the value of the initial vision and demonstrate that

there is a way to incorporate holistic and integrative approaches to the understanding of disability inclusion, not only on paper but also in policy and practice.

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Article

Measuring Disability Inclusion Performance in Cities Using Disability Inclusion Evaluation Tool (DIETool)

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Abstract: Cities are exposed to a growing complexity, diversity and rapid socio-technical developments. One of the greatest challenges is as of how to become fully inclusive to fit the needs of all their citizens, including those with disabilities. Inclusive city, both in theory and practice, still lacks attention. Even in the context of ambitious contemporary concepts, such as smart and sustainable city, the question remains: Do smart and sustainable cities consider inclusiveness of all their inhabitants? Among numerous evaluation systems that measure city's smartness, sustainability or quality of life, those tackling inclusion are very rare. Specifically, disability inclusion is hardly covered. This may be one of the reasons why cities struggle with applying disability inclusion to practice in a holistic and integrative way. This paper proposes a Disability Inclusion Evaluation Tool (DIETool) and Disability Inclusion Performance Index (DIPI), designed to guide cities through a maze of accessibility and disability inclusion related requirements set within the political, legislative and standardization frameworks. The testing in two European cities shows that the tool is beneficial for providing diagnosis as to how disability friendly a city is, and as such offers an opportunity for designing informed corrective measures towards disability inclusive city design.

Keywords: inclusive city; disability inclusion; urban studies; social sustainability; smart and sustainable city; city performance metrics; Disability Inclusion Evaluation Tool (DIETool); Disability Inclusion Performance Index (DIPI)

1. Introduction

By UN HABITAT, an inclusive city "is a place where everyone, regardless of their economic means, gender, race, ethnicity or religion, is enabled and empowered to fully participate in the social, economic and political opportunities that cities have to offer" [1]. Modern city concepts, such as smart and sustainable city, nowadays all claim to be human-centered and inclusive. However, does this really mean that they address principles of inclusiveness for all? If so, do they incorporate evaluation, management and monitoring systems for assessing how inclusive cities are? Which of them, if any, addresses the question of disability inclusion through a set of respective indicators? Through an extensive literature review, document analysis, exchange of knowledge with scholars, practitioners and decision makers, our previous research brought a set of findings:

- (1) Cities' governments still struggle with understanding the diversity of citizens' needs.

- (2) Consequently, cities are not able to fully understand what disability inclusion means, how complex and important it is and how it can contribute to the quality of lives of a wider population of citizens, not only those with impairments.
- (3) Cities lack a holistic and systemic approach, and disability inclusive measures are still greatly of an ad-hoc nature.
- (4) Cities lack awareness and knowledge about disability inclusion, which is evidently reflected among relevant stakeholders, such as politicians, local authorities, architects, designers, planners etc.
- (5) Consequently, cities still tend to be designed in a non-inclusive manner, considering a fully abled 40-year old male as a norm for city design [2]. Hence, vulnerable groups with a set of needs that differ from such norm get excluded.

There are numerous political, legislative and standardization frameworks that may serve as guidelines. For instance, The New Urban Agenda [3], The 2030 Agenda for Sustainable Development with its goals and targets [4,5], the United Nations' paper on the right to the cities for all [6], as well as other initiatives [7–9] attempt to bring inclusive city to practice as a requirement and a norm.

Nevertheless, no exhaustive disability inclusion metrics and/or a complete guiding system has been identified that would allow cities to assess where they are in terms of disability inclusion, where their performance is low and where corrective measures need to be taken.

With this paper, we contribute to the area by outlining a novel evaluation and monitoring system as a response to the identified gap in city evaluation metrics. The herein proposed Disability Inclusion Evaluation Tool (DIETool) and its corresponding Disability Inclusion Performance Index (DIPI), in a compact and holistic way, translate the accessibility and disability inclusion requirements from the global political, legislative and standardization frameworks into a practical set of indicators at a city level. As such, they help in guiding cities towards improving their disability inclusion performance. By demonstrating how DIETool works in practice, we attempt to stimulate theoretical and empirical work towards more disability inclusive societies. We argue that smart and sustainable city initiatives should strive to become inclusive for all, and that social sustainability should encapsulate questions, such as how to design socially sustainable cities concerning social inclusion also of those with diverse impairments.

The structure of this paper is as follows: Section 2 sheds light onto the related work in the context of the identified gaps. Section 3 presents the DIETool and the DIPI main objectives, design process, structure and methodology. Section 4 demonstrates results of the DIETool testing within two European cities, Maribor (Slovenia) and Pułtusk (Poland). Finally, Section 5 compares the results, discusses the challenges faced and concludes with some research limitations and future directions.

2. Background

2.1. Smart, Sustainable and Inclusive City

Within contemporary city discussions and current global urban agendas, an inclusive city has often been referred to in broad terms of economic or social inclusion emphasizing the need for equal opportunities for all [3–6,10–15]. However, in narrow terms, inclusion reaches a greater complexity. For instance, it can be perceived on a basis of gender, age, sexual orientation, disability, religion, ethnicity, socio-cultural background, economic status, etc. For the purpose of designing fully inclusive cities, stakeholders need to understand the needs of citizens within each of these groups and make them a part of their strategic planning and implementation agendas [12,16,17]. However, cities are difficult to design and as a result, vulnerable groups with a set of needs that differ from a “norm” get often excluded [2,16–19].

Furthermore, even in the context of ambitious contemporary concepts, such as smart and sustainable city, the question remains: Do smart and sustainable cities consider inclusiveness of all their inhabitants? An extensive body of existing literature [20–28] demonstrates a significant gap and shows

that currently neither smart nor sustainable city concepts are fully ready to meet the requirements for an inclusive city as envisioned by some authors [2,9,12,14,15,29,30].

A smart city is a complex but consciously organized, purposeful system of subsystems, components and processes [26–28,31]. As such, it should make (disability) inclusion as an organic element and non-negotiable fact. The smart city concept, however, still confuses scholars, practitioners and decision makers with many different conceptualizations, “contradicting definitions and unclear measures” Having in mind such lack of cohesion, it is not surprising that it has, in theory and practice, been struggling with understanding the real meaning, importance and complexity of inclusion of diverse groups of citizens.

Sustainable city has been subjected to diverse conceptualizations, too [22,23,32], causing the need for discussions around what sustainability really means Sustainability originates from environmental studies [32–34]. Initially being concerned with sustaining balance between human well-being and nature, it has gradually grown into a conceptualization of three main dimensions: social, economic and environmental However, environmental and economic sustainability discussions have outnumbered those related to social sustainability, as the latter were introduced to sustainable development debates relatively late [35,36].

Scholars have attempted to conceptualize social sustainability, for instance, as a blend of social equity, social justice, social interaction, participation, safety, accessibility, sense of place, etc. [36–42]. Hermani et al. [43] (p. 172) see social sustainability in terms of 4’S’: social capital, social cohesion, social inclusion and social equity.

According to Larimian and Sadeghi [36] (p. 5), a socially sustainable neighbourhood is “one that provides residents with equitable access to facilities, services, and affordable housing; creates a viable and safe environment for interaction and participation in community activities; and promotes sense of satisfaction and pride” among current and future generations. Despite diverse views on what social sustainability is, social equity and inclusion are part of it one way or the other. Social inclusion, viewing it holistically, entails access to environment, structures, services, processes, products and information [5–9,12,14,15,31,40], while social equity ensures that such access is fair, just and equitable to all the people (including people with disabilities). It recognizes and respects diversity and through equitable governance enables everyone to exercise their rights and duties as equal members of society [10,11,13,35,40].

This background sets the stage for further discussions around disability inclusion in the context of smart and sustainable cities for all [2,17,29,30], and questions the ways disability inclusion performance therein could be measured.

2.2. City Evaluation and Monitoring Systems

There is a growing presence of evaluation and monitoring systems that measure cities’ attributes such as smartness [21,24,44–46], sustainability [21,36,37,47–49], accessibility [50–52], quality of life [53], creativity [54] and universal design (UD) [55].

Sustainability evaluation systems are well elaborated from environmental and economic perspectives. Where they tackle social sustainability, disability inclusion gets lost in the overall inclusion approach [36,37]. Studies have elaborated diverse metrics, for instance, in terms of economic, racial and overall inclusion [13] or social, spatial and economic inclusion However, rarely any evaluation system considers disability inclusion, such as DOTCOM tool [56], Assessment tool for inclusive cities by UNESCO [57], SDGs Advocacy toolkit [58] or at least integrates disability and accessibility related indicators as the integral part of the tool Surprisingly, even within the recent international standard ISO 37120:2018 Sustainable cities and communities—Indicators for city services and quality of life [59] within the extensive list of indicators across 19 areas, not one of the core or supplementary indicators refers to disability inclusion.

Nevertheless, disability rights are a part of the global agenda. The Standard Rules [60], United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) [61], United Nations Disability

Inclusion Strategy [62], European Disability Strategy 2010–2020 [63], The European Accessibility Act [64], Americans with Disabilities Act–ADA [65] and its renewed ADA Amendments Act–ADAAA [66], and standards, such as ISO 21542:2011 for accessibility of built environment [67] provide a solid framework for ensuring that cities are also taking the path towards disability inclusive communities.

For instance, in line with these efforts, Academic Network of European Disability Experts (ANED) in collaboration with the European Commission (EC) designed an online disability evaluation tool (DOTCOM) with the aim to aggregate data for the EU member states on a country level. Although the tool presents an exhaustive database for disability related policy, governance and legislation in EU member states, its approach is not suitable for measuring cities' performance in disability inclusiveness. Firstly, the tool targets countries, not cities. This unavoidably brings differences in the approach, although city governments follow national political, legislative and standardization frameworks, too. Secondly, the DOTCOM tool serves as a collection of information about countries, hence the indicators are of a generic, qualitative and broadly descriptive nature. They are not designed as performance indicators. Neither do they include a scoring methodology; thus, they do not enable cities to measure their disability inclusion performance.

Relevant disability indicators have been recently proposed within the SDGs Advocacy toolkit. 27 new indicators within 19 SDGs targets have been designed and are still paving the way into the national statistical offices. Again, the indicators are directly intended for countries, not cities.

On the city level, an interesting attempt is the UNESCO's assessment tool for inclusive cities. Within 11 areas of city life, it proposes between 3 and 12 simple, qualitative indicators per area. Once ready for implementation, its simplicity may in fact provide a fast performance score and help encourage cities towards considering disability inclusion. Nonetheless, its simplicity is also a drawback. It makes it incomplete, specifically in terms of diversity of disability types and heterogeneity of city's structures, services, processes, products and information that need to be covered. Finally, the tool consists of a series of closed-ended questions with no complementary indicators that would allow to understand the performance in more detail. A strong point is, however, that it envisions the collection of information on the side of city governments, as well as citizens in order to balance the obtained score.

Further on, the Access City Award [50,51] has been a joint initiative between the EC and the European Disability Forum, as an attempt to encourage cities towards accessibility. However, its aim is not a detailed evaluation of city's performance, neither in terms of benchmarking, nor in terms of a self-assessment and guidelines on how to perform better. It was designed more as an incentive for raising awareness among European cities for promoting disability inclusive practices. It is designed as a voluntary self-application process with a set of open-ended qualitative questions that may easily be answered with the main purpose of convincing the jury, rather than attempting to look in the mirror and see the real picture. As Steffan and Denninghaus [51] (p. 7) explain, one of the great challenges of such awards is, indeed, how to overcome their benchmarking nature, and among the winning cities, avoid the "window dressing" with "excuses to stop improving further".

2.3. City-Specific Context

With this paper, we focus on a small-scale European city context, specifically two case study cities, Maribor (Slovenia) and Pułtusk (Poland), where the pilot testing was manageable and traceable. Here, the environment is well known to the first two authors and the city administration is not too big, so that the collaboration was doable. In addition, a certain degree of commitment to the disability rights area had been proven by both cities in the past.

Both in Slovenia and Poland, strong efforts can be recognized towards establishing firm disability rights frameworks, following global and European disability rights agendas [60–64]. Beyond national and local strategies and action plans in both the countries [68–76], there was an interesting initiative developed in Slovenia to encourage cities to become disability friendly. The project of the national work-related disability association, which could be translated to "Municipality friendly to persons with disabilities" [77] assesses a candidate city based on how committed they are to ensure that inclusivity

becomes one of the main principles within their organizational structures. In fact, Maribor as our pilot case study, has been awarded with this title in 2010 after establishing a Council for Disabled People, designing an Analysis on the Rights of Persons with Disabilities [71] and drafting, at that time, the first 4-year Action Plan for Improving Equal Opportunities for Persons with Disabilities [72,73]. This was one of the first attempts to systematically and holistically approach disability inclusion in the city. Since then, the climate has positively changed among others, demonstrated also by the latest Action plan for the period 2015–2021. In the case of Maribor, the mentioned national project [77] proved to be an excellent stimulator. However, it is not very suitable as a self-assessment tool for monitoring as of how the city is performing and improving in the disability domain. The project is dependent on financial and staff capacity and it consists of an external evaluation body that evaluates the city based on an extensive descriptive application form and occasional monitoring visits.

In Poland, dedication to disability inclusion is reflected through national strategy and action plans [69,70]. An interesting Local Data Bank (LDB) [74] can also be mentioned, which is a large national statistical database that includes disability-related features. However, the data is collected at the poviats level and thus, cannot be directly applicable to a city context. Therefore, with this work, we also bridge the gap in data collection on social inclusion of persons with disabilities, giving cities an opportunity to self-assess their performance with an easy-to-use tool. Furthermore, following the global and national frameworks, also Pułtusk Poviats has shown dedication to disability inclusion by adopting a Strategy for Solving Social Problems in Pułtusk Poviats 2015–2022 [75] and Action Program for Persons with Disabilities in the Pułtusk Poviats 2015–2022 [76]. The two documents attempt to follow the progress in Pułtusk (as a poviats and the city), discuss factors influencing the inclusion of people with disabilities and help local administrations in designing future responsive measures.

3. Methodology and Methods

This chapter presents a novel tool (DIETool) and its associated component DIPI for self-assessment of city inclusiveness. It outlines their objectives, the design processes to achieve them, as well as the methodology of their construction and operation in a local governance context.

3.1. DIETool and DIPI Objectives and Design Process

The DIETool is a self-evaluation system allowing cities to measure their disability inclusion performance. It consists of 20 areas of city life (Table 1), each with a combination of carefully selected qualitative and quantitative indicators translated into a score (DIPI) that shows the city's performance against the optimum situation. The DIETool's main objectives are to offer guidance and support to local city governments. It helps identify strengths and weaknesses and provides diagnosis of disability inclusiveness in the city. As such, it can be incorporated into a holistic disability inclusive city design approach, ideally consisted of the following steps:

- (1) Assessing the situation and identifying the gaps.
- (2) Assessing the technical and organizational capabilities demonstrated in the area of disability inclusion performance.
- (3) Discussing, designing and planning appropriate corrective measures according to the analysis.
- (4) Strategic planning and action plans design.
- (5) Undertaking action/Implementation of corrective measures.
- (6) Creating public-private partnerships and an ongoing dialogue with citizens.
- (7) Ongoing evaluation, iteration and improvement.

Table 1. DIETool outline with 20 areas, goals and characteristics for indicators design.

Inclusive City Areas of Assessment		
Area	Goal	Characteristics/Requirements/Examples for Indicators' Design
1	Public Spaces and Built Environment	Accessibility to public spaces and built environment.
2	Public Services and Community Supply	Accessibility to public services.
3	Transportation and Urban Mobility	Availability, accessibility and affordability of inclusive transportation infrastructure, products and services.
4	Policy and Governance	Availability, accessibility and participation in policy, governance and decision-making processes.
5	Legislation and Standardization	Availability and enforcement of inclusive legislation and standardization.
6	Media, Information and Communication	Accessible, democratic, inclusive and non-discriminating media, information and means of information-communication.
7	Education, Training and Childcare	Availability of, accessibility to and affordability of inclusive education, training and childcare for all.
8	Work, Career and Employment	Availability of and accessibility to work, career and employment opportunities, including employment rehabilitation programmes.
9	Housing	Availability, accessibility and affordability of housing.
10	Health Care and Social Security	Availability, accessibility and affordability of inclusive health care, medical services, rehabilitation and social security programmes and schemes.
11	Assistive Technology and Independent Living	Availability, accessibility and affordability of assistive technology and ICTs.
12	Family Life	Awareness, climate and accessibility to information, educational programmes and support towards creating family life.
13	Economy, Business and Industry	Accessibility to products, services and information, business opportunities and inclusive business climate.

Table 1. Cont.

Inclusive City Areas of Assessment		
Area	Goal	Characteristics/Requirements/Examples for Indicators' Design
14	Finance and Financial Security	Financial safety, availability and accessibility of financial services, infrastructures and information.
15	Community Life and Civil Initiative	Accepting non-discriminating, equality-based community climate.
16	Recreation, Sports and Leisure	Availability, accessibility and affordability of recreational activities, sports and leisure.
17	Culture, Arts, Cultural Heritage and Tourism	Availability, accessibility and affordability of culture, arts, cultural heritage and tourism infrastructure, items/products/works/artefacts, services, contents, information and events.
18	Religion	Availability and accessibility of inclusive religious facilities and rituals.
19	Technology and Innovation	Availability, accessibility and the use of inclusive technology and support to innovation
20	Safety, Quality of Life and Independent Living	Ensuring safety and quality of life of persons with disabilities.

A city is a system of subsystems that need to work together. In this sense, the areas within the DIETool serve as subsystems to be explored for designing an inclusive city. They complement one another and, in a whole, represent an organic blend within urban life. Under each of the areas, the DIETool identifies main goals to be pursued. Aligned with the goals, the tool then outlines a list of more detailed characteristics and/or requirements towards reaching disability inclusion. Taking an example of area 3, the goal is to achieve “accessible transportation”, which can be done through an extensive list of actions for ensuring accessible means of transportation, accessible facilities (e.g., stations, platforms, information offices, ticketing machines), accessible transportation related information and services, all in forms suitable for physically, sensory and intellectually impaired people. For the purpose of evaluating disability inclusion performance of a city, we also shed light onto strategic approach, staff training, funding availability, safety, etc., in the respective area. These characteristics (as seen in Table 1) act as specific goals and serve as guidelines for further indicators for design.

The DIETool has been developed through several phases as follows:

In phase 1, we identified the 20 areas for assessment and to each of them assigned main goals.

In phase 2, a list of characteristics/requirements (as more specific goals) has been prepared for each of the respective areas. Whereas the main goals define an overall availability, accessibility and affordability of the areas, characteristics and specific goals go deeper into exploring services, products, facilities, programmes, training, contents, information and events, including the main requirements for their accessibility. With the list of characteristics, we tried to address diversity and complexity of citizens’ needs, having in mind the challenges that diverse groups of disabled people face while living in a city.

Phase 3 brought a list of indicators, each consisting of:

- (1) Indicator’s definition (based on the identified disability rights documents with their policy guidelines, legal requirements and accessibility standards).
- (2) Methodology definition (the unit, the calculation method and scoring scale definition).
- (3) Data sources identification (e.g., open sources, specific city departments, other potential sources).

Phase 4 focuses on definition of overall indexing methodology and a scoring system for the DIPI.

Phase 5, finally envisions a complementary repository of relevant disability rights documents, guidelines, standards, data collection techniques (questionnaires, indirect data search, repository search, software design to support data collection, etc.) and protocol design to help stakeholders in implementing the DIETool analysis and improving their disability inclusion performance.

The selection process of the 20 areas (Table 1) builds on a careful consideration of disability inclusion and disability rights literature, such as UNCRPD [61], European Disability Strategy 2010–2020 [62], Standard Rules on the Equalization of Opportunities for Persons with Disabilities of the United Nations [60], and the European Accessibility [64]. Act These documents emphasize a vast list of areas, where the rights of persons with disabilities need to be protected. For instance, the right to life, freedom of speech, equal recognition before law, liberty and security, freedom from violence and abuse, participation in life, equal opportunities, the right to living independently, the right to accessibility (e.g., built environment, information, services and products), personal mobility, home and family, accessible education, work and employment, financial security, adequate housing, social protection, participation in political life, leisure and sports, access to culture and tourism, religion and more. Based on this extensive list, the mentioned smart and sustainable city resources gave additional tips on how to compact this vast array of disability rights’ areas into a list of 20 DIETool areas, in which full enjoyment of city life should be ensured also for persons with disabilities.

The DIETool indicators were then designed, which required: (a) a detailed analysis of accessibility and inclusion principles and characteristics within each of the areas based on the disability rights legal requirements and accessibility standards; (b) exploration of what could potentially be available data resources and feasible ways of data collection in the city; (c) methodology definition and scoring scales design for each indicator; (d) rethinking the weighting system and an overall DIPI methodology

design. Before deciding on whether the indicator should be a part of the DIETool or not, we created a list of desired criteria. Ideally, in the following criteria each indicator should fulfil:

- (1) Data refers to the city level (not e.g., individual, corporate, region or country level).
- (2) Data collection is feasible (data exists, is available, can be retrieved, collected or gathered from existing databases, running activities or proposed DIETool data collection techniques).
- (3) Data can be objectively measured and compared, can be estimated based on available information, or explored through participatory user-centered techniques.
- (4) Data as the main observed attribute reflects either input (e.g., disability inclusive strategy, available funding schemes, % of annual funding available for accessible transportation) or output of city's inclusiveness (e.g., % of accessible buses, % of passengers with disabilities, % employed persons with disabilities, satisfaction levels).

It should be noted that even though it may be difficult to obtain some data, the DIETool points out its importance, thus a city is encouraged to find a way and do so. The DIETool can also guide the city in this process by proposing alternative data collection techniques and as an ongoingly upgrading repository of main political, legislative and standardization documents.

3.2. DIETool and DIPI Methodology

The DIETool uses a scoring methodology. As seen from the tables of the selected areas, available in the supplementary material (Tables S1–S9), each indicator is given a number, an indicator name, description, methodology description, a unit and a scoring scale. Several different scoring scales have been built, depending on the nature of the indicator, the unit used for calculation (e.g., %, no.), known reference scoring scales, etc. In all cases, the scoring scales range from 0 to 5, where 0 corresponds with extremely poor performance and value 5 for excellent performance. The overall performance score for each area is given by the normalized average score of all the indicators calculated within the respective area. The total DIPI score for the city is then calculated by the normalized average score of all the areas.

The DIETool is designed holistically and thus aiming at obtaining the overall performance index DIPI across all the areas. However, it can also be used to measure each area separately (e.g., by separate city departments). As such, it serves as a monitoring tool in order to identify the gaps and discrepancies from the optimum state in that specific working area. As a tool, it is organized in an easy way by providing ready Excel templates with indicators as seen in Supplementary Materials, Tables S1–S9. In a separate spreadsheet, it automatically calculates the scoring and provides the graphic presentation of the results as seen in Figures 1–4. With some initial guidance, it can be used independently by city officials for evaluation and analysis, future planning and monitoring.

It must be said, however, that the tool, at this point, does not include an elaborated weighting system or a benchmarking approach. When trying to correspond with this requirement, we decided to get the experience from practice first. A weighting methodology design is a complex process, that may be greatly context dependent (e.g., city-size, city's economic status, etc.). Currently, the DIETool offers a framework for the preliminary DIPI score in order to demonstrate that a city's disability inclusion performance can be measured according to the proposed legal requirements. As such, the DIETool with its methodology, is ready to be used by any city, considering possible local, regional and national specifics, but not yet ready for comparison between different cities. A thorough consideration of weighting methodology, as well as possible diversity of contexts for applying the tool is a matter of its future methodological upgrade.

3.3. Case Studies Definition and Approach

The DIETool was tested in real urban environments of two European cities with the aim to demonstrate how it can be used in practice and how lessons learned can feed its future development. The criteria for selection were three: Firstly, we needed an easy access to the city government. The selected two cities (Maribor, a medium-sized Slovenian city with app. 95,000 inhabitants, and Pułtusk,

a small Polish town with app. 19,500 inhabitants) are hometowns of the first two authors of this paper, who in the past already worked closely with the respective city councils. This greatly helped in accomplishing the criteria. Secondly, we needed the city mayors to say “yes”, which they did without hesitation. And thirdly, we needed them to ensure enough resources in terms of time and staff capacity. They did, by assigning to the project a responsible coordinating department.

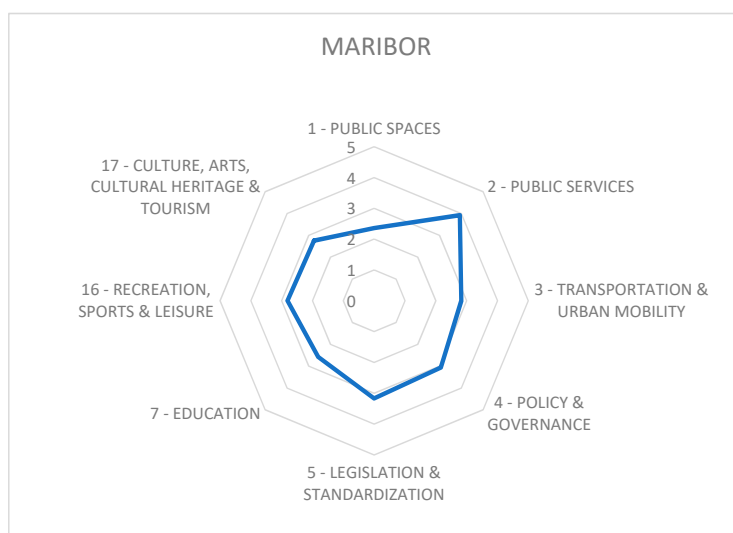


Figure 1. DIPI score for Maribor case study (selected areas).

In both cities, the testing was centrally managed, following the same protocol. Firstly, it was approved by the Mayor’s office and a responsible department was assigned for the data collection, who then (in close collaboration with the researchers) took the leading role in coordinating data collection across city departments and external public offices. In this way, the Council for disabled people of Maribor, and the General Secretary of Pułtusk, respectively, greatly contributed to feeding the DIETool with the required data and obtaining the respective performance index DIPI.

The DIETool spreadsheet (in some cases, an area specific exert of the spreadsheet) had been sent for them to get acquainted with the nature of the required data. Usually, at least one on-site and/or one on-line meeting was organized. It took several interventions to guide the collaborators through the indicators and to obtain the respective data in a desired form. Although the initial plan was to test only about 5 areas per city, the research developed beyond our expectations. Both the cities demonstrated a high level of dedication and attempted to complete as many areas and indicators as possible. After 4 full months of data collection (June–September 2019), the team decided to complete the experiment in order to draw some preliminary conclusions. This pilot study brought interesting insights into the strengths and weaknesses, as well as challenges and opportunities to be addressed in the future regarding reliability and validity of the tool, the implementation process and the data collected.

3.3.1. Maribor Case Study

Maribor is the 2nd largest city of Slovenia, situated in the northeast of the country. In 2019, it had a population of 95,767 as a city settlement (not municipality), of which 47,144 are males and 48,623 are females. The number of persons with disabilities is not known. We estimated the number based on the results of the Eurostat household questionnaire (every 7th person or around 14.29% of population has some level of activity limitation [78], which accounts 13,685 of people with disabilities).

The Municipality of Maribor includes 10 departments and 27 organizational units. It has a city council with 45 councillors, of which 1 is with disabilities. The Council for disabled people was constituted in 2009 and represents the Mayor’s consultancy body, as well as the network of all the

disability associations acting on the local level. It represents an important mediator and advocacy body for the rights of persons with disabilities in the city.

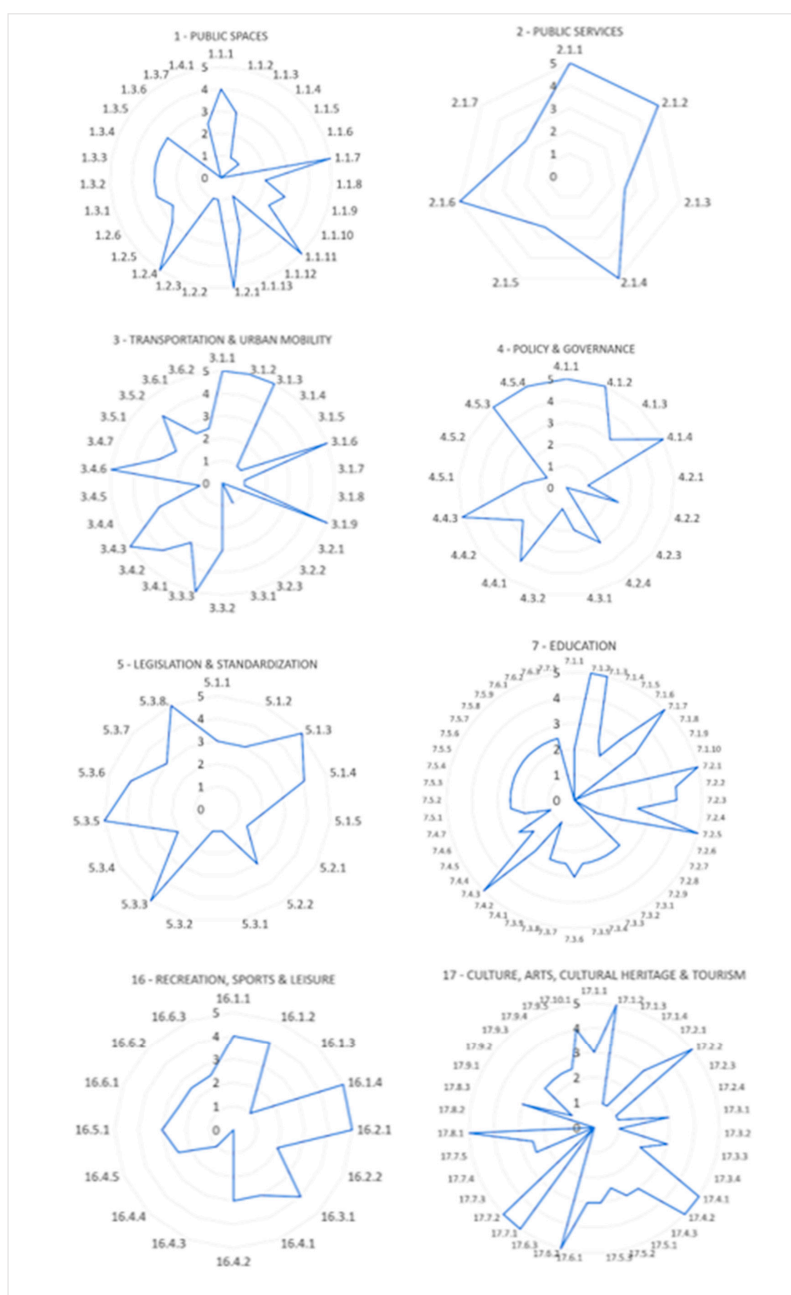


Figure 2. DIPI scores for Maribor for individual areas 1, 2, 3, 4, 5, 7, 16 and 17.

In the DIETool testing, the Council for disabled people of Maribor took the role of the internal coordinator. In total, 9 internal offices (Council for Disabled People, Mayor’s Cabinet, City Council’s office, HR office, Department for Communal Services, Transportation and Public Spaces, Department for Culture and Youth, Department for Sports, Department for Economic Activities, Department for Education, Schooling, Health, Social Services and Research Activities), and 13 external institutions were involved (local office of the Employment Service of the Republic of Slovenia, Regional Housing Fund, Social Work Center Maribor, Tourism Board Pohorje-Maribor, University of Maribor, University of Maribor Library, Maribor Public Library, Maribor Adult Education Center, local Police Administration,

local Chamber of Commerce, regional Association for Deaf and Hard of Hearing, local office of the Association for Students with Disabilities and Zavod PIP–Legal and Information Center Maribor).

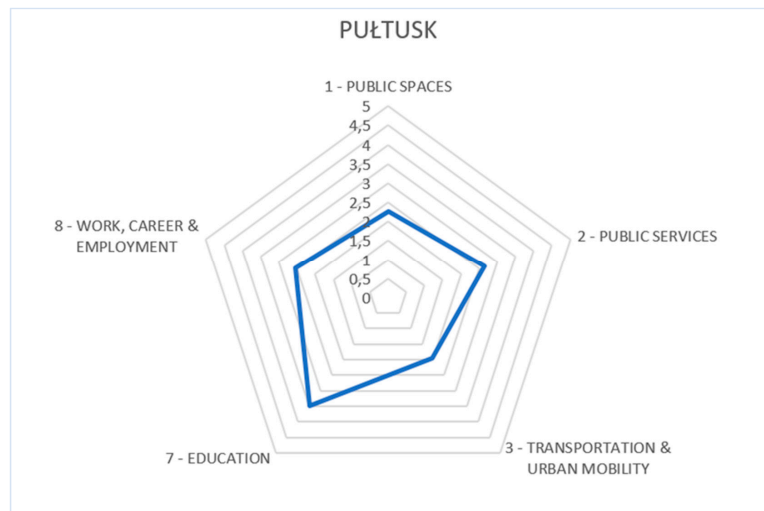


Figure 3. DIPI score for Pułtusk case study (selected areas).

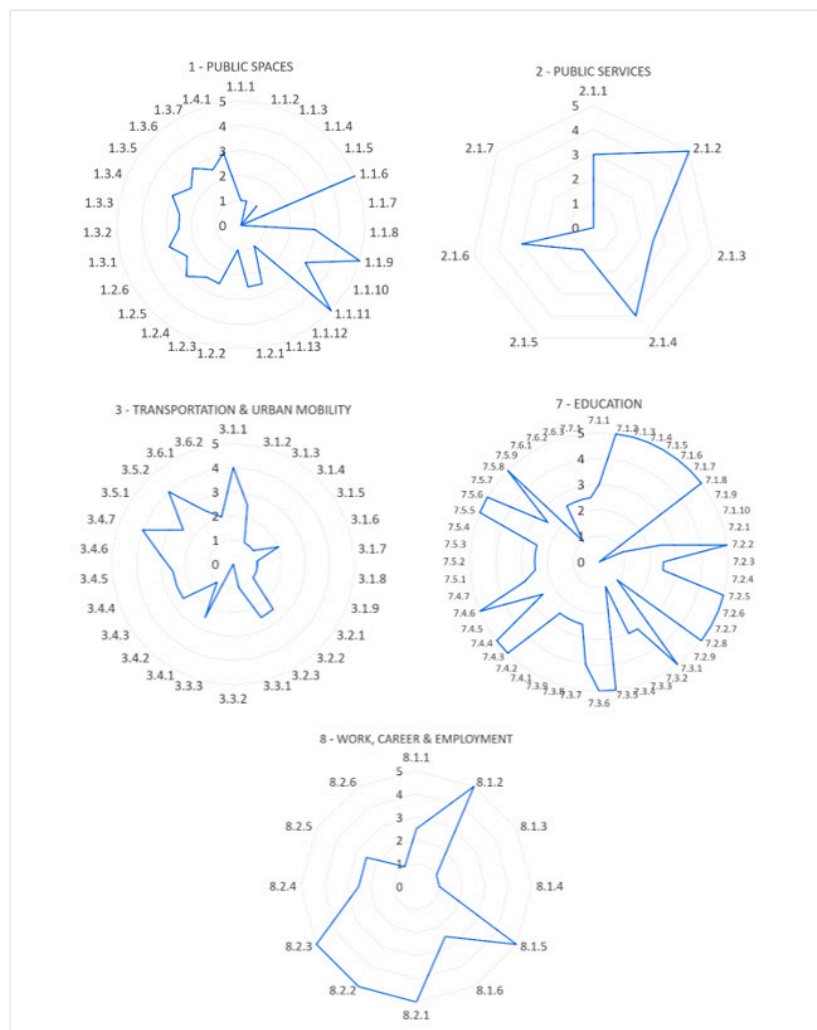


Figure 4. DIPI scores for Pułtusk for individual areas 1, 2, 3, 7 and 8.

3.3.2. Pułtusk Case Study

Pułtusk is a town in Poland lying by the river Narew, 70 kilometers north of Warsaw. It is the capital and the only town in the Pułtusk Poviát (district), in the northeast of the Masovian Voivodship. In 2018, it had a population of 19,431 in 2018, of which 9,298 are males and 10,133 are females. The number of persons with disabilities is not known exactly. However, based on statistics available for the Pułtusk District, we estimated the number of people with disabilities to 2,466 which amounts to 12.60% of the total population of the town. The structure of the Town hall consists of 7 departments, 6 offices, 5 independent workplaces and 10 organizational units. There is no organizational unit in the town dedicated specifically for people with disabilities. According to the Polish law, ensuring disability rights is a public task of district administrations, not towns. Only the towns with more than 50,000 inhabitants have a status of a “city county”. As such, city counties cover the tasks on the commune and district (county) level. In the DIETool testing, the General Secretary took the role of the internal coordinator. In total, 6 internal departments/offices were involved: Department of Education and Promotion; Department of Organization and Supervision; Department of Civil Affairs, Department of Investment, Agriculture and Non-Budget Funds; Department of Land Management and Architecture; and Social Welfare Municipal Center. Moreover, 3 external institutions were involved in testing: District Labor Office, District Department of Education, and District Center of Family Support.

4. Results

This section addresses actual implementation of the tool in the two European cities, Maribor (Slovenia) and Pułtusk (Poland). It reflects some practicalities as well as challenges and benefits the studied cities may gain by tool implementation. Firstly, we elucidate the case studies in order to understand the context of the testing. Secondly, we represent the results obtained by each city. Finally, the relevant selected results are introduced and commented.

4.1. Maribor Case Study

4.1.1. Maribor Case Study Results

Maribor took a very dedicated holistic approach trying to provide information and gain insights into the performance in all the 20 areas. For this paper, we have chosen the 8 most representative and demonstrative areas (no. 1, 2, 3, 4, 5, 7, 16 and 17), where data has been provided for at least 50% of the indicators. The reasons why none of the areas reached 100% of completion are complex. Firstly, the city does not have a joint statistical office, a well-defined monitoring system or a profound e-governance approach. The data needed to be collected across a large array of resources and a wide network of stakeholders. Due to the limited staff capacity as well as limited amount of time, some of the indicators were therefore answered with “no data”. The lack of city competences for obtaining the data (e.g., about the private sector) also contributed to such results. Nevertheless, enough data has been collected to be able to demonstrate the usefulness of the DIETool in the city of Maribor.

The Figure 1 shows the city’s performance in the following 8 selected areas: 1-Public spaces, 2-Public services, 3-Transportation and urban mobility, 4-Policy and governance, 5-Legislation and standardization, 7-Education, 16-Recreation, sports and leisure, 17-Culture, arts, cultural heritage and tourism (a detailed list of indicators for each of the areas is available in Tables S1–S6, Table S8 and Table S9). According to Figure 1, Maribor performed average or above average in all the 8 areas with slightly better performance in the area 2-Public services. There are no areas with really poor performance.

However, the DIETool has been designed to explore deeper as of how the city performs in individual areas and individual indicators. The Figure 2 therefore, shows performance visualizations for each of the 8 areas (including all the indicators), where strengths and weaknesses can be identified in more details. They provide a quick diagnosis for Maribor and are to be further used to complement the DIETool spreadsheet for a thorough evaluation of each indicator that will indicate, where the

city needs to activate, as they wish, to improve disability inclusion performance and the DIPI index. For instance, when we look into the area 1-Public spaces (Figure 2–Inset 1 “Public spaces”; Table S1), we can see that Maribor performs very well (score 5) in indicators 1.1.7., 1.1.11., 1.2.1., 1.2.4. It performs well (score 4) in indicator 1.1.1., around average (score 3) in indicators 1.1.2., 1.1.9., 1.2.5., 1.3.1.–1.3.5. and poorly or very poorly (scores 0–2) in indicators 1.1.3.–1.1.6., 1.1.8., 1.1.12, 1.2.2.–1.2.3., 1.3.6.–1.3.7. Using the Excel spreadsheet for this specific area (Table S1) and using responses provided by the city officials, we can further analyze this result as follows.

In Maribor, the *Proportion (%) of wheelchair accessible parking payment machines (1.1.7.)* is 100% (scored 5), considering not only physical accessibility, but also the fact that public parking for persons with disabilities in the city is free of charge and alternative payment methods are provided (on-line and text message payment). The *Proportion (%) of accessible green spaces and parks (1.1.11.)* is also 100% and as such scored as very high (5), explaining that wheelchair accessibility is ensured to and within green areas, as well as a ground tactile guiding system is provided to the main city park, where some benches are also equipped with braille. Further on, very high score (5) has been assigned to the city in indicator 1.2.1. since the city provides a *participatory mobile app*, through which citizens (including persons with disabilities) can report accessibility issues in public spaces. The same score goes to indicator 1.2.4. because the city provides *tactile maps for visually impaired people*. Finally, the city reports that the *Proportion (%) of wheelchair accessible crossroads (1.1.1.)* is about 80%, which is considered as good (score 4).

Similar interpretation can be given for indicators given a score of 3, but with more consideration to the fact that these indicators need certain improvements in the future. For instance, *Proportion (%) of sidewalks accessible to wheelchair users (1.1.2.)* is only around 40%, which will undoubtedly need more dedication due to the lack of ramps, presence of barriers or damaged surfaces. *Proportion (%) of public toilet facilities accessible for persons with disabilities (1.1.9.)* still seems to be low and additional toilets will need to be planned, too. Only 42% or 3 out of 7 public toilets are accessible. These may be some of the reasons why the *Presence of people with disabilities in public spaces (1.2.5.)* may be rather around average (score 3). The reason may also lie in the average performance of indicators related to *Spatial planning (1.3.1.)*, *Accessibility planning, management and evaluation (1.3.2.)*, *Accessibility expertise among designers and architects (1.3.3.)*, *Inclusion of accessibility requirements into public procurements (1.3.4.)* and/or *Inclusion of accessibility requirements into construction projects (1.3.5.)*. For such performance, the city will need to rethink their planning, management and evaluation policy in the area of public spaces, spatial and environmental planning, and work towards a more elaborate, integrated and consistent system allowing for inclusion and accessibility principles to be incorporated throughout all the structures, services and processes.

The most intriguing part of the evaluation for the city comes where the performance is recognized as low or very low (0–2). An important set of questions appears, such as why the city is performing so low, which elements of accessibility and inclusion are missing and how they should be improved. Such examples are indicators 1.1.3.–1.1.5., which all refer to *accessibility of public spaces for visually impaired people*. 1.1.3. and 1.1.4. demonstrate that *crossroads and sidewalks are equipped with a tactile guiding system* in only about 10%, whereas 1.1.5. shows that only 9% of *traffic light crossroads are equipped with audio signals for visually impaired people*. These indicators clearly show a joint nominator, pointing out that the city might have a poor policy for ensuring accessibility in public spaces in terms of the needs of visually impaired people. A few other indicators with low or very low performance may be mentioned. The indicator 1.1.6. shows a low *number of wheelchair accessible parking spaces*, which speaks about the initial number of designed dedicated parking spaces as well as their actual accessibility (without barriers, with manoeuvring space, access to a sidewalk, etc.). The indicator 1.1.12. points out that the city might not have enough *wheelchair accessible playgrounds for children* and may need to consider not only arranging an access to the playing surfaces, but also providing wheelchair-dedicated swings and other accessible facilities, etc. The indicator 1.3.6. refers to *accessibility requirements for events organized in public spaces*, which may or may not be included in the general conditions while obtaining

permission. In Maribor, unfortunately, there are no such requirements and actual accessibility provision is a result of how knowledgeable, aware and willing organizers of the events are. The DIETool clearly shows absence of disability inclusion policy in the area of organization of events, and, as such, aims at encouraging the city towards future measures.

4.1.2. Maribor Case Study Observations

Maribor, as a city, is one of the smaller among middle-sized cities in Europe. It has low investment rates and relatively low innovation in the public sphere. Open and digital governance is still under construction without any real implementation yet. These factors may clearly outbalance the generally solid DIPI performance. As seen from the graphs, numerous indicators have been assigned values above average (3–5) but have been outbalanced by others below average (0–2).

Nevertheless, with all its efforts, the city of Maribor demonstrates a firm tradition of disability inclusive city management. Firstly, they were immediately willing to participate, provide the data and explain specific indicators. Secondly, they have had the Council for Disabled people as a part of the city's organizational structure for around 10 years. Thirdly, they have tried to complete the whole DIETool and were thus in contact with the researcher on a weekly basis to find ways of providing the data. They accompanied the DIETool Excel spreadsheet with a word document, providing descriptive contextual information area by area, indicator by indicator, which will give them a greater insight into the current state and the needed improvements.

Some challenges in obtaining the data may be worth mentioning. In Maribor, it was difficult to get even an overall idea of the situation referring to the private sector (private employers, private educational institutions, private cultural, sports and tourism services, banks and financial services etc.), unless the respective city department had been involved with private stakeholders already in the past. Additional challenges appeared in some cases, when the working area is regulated on the national level (e.g., for secondary education) or is under the power of another public institution (e.g., University of Maribor for higher education). In such cases, in Maribor, they tried to find information through publicly available resources (e.g., websites, reports, articles) or they contacted external stakeholders (e.g., University of Maribor, Employment Service). These efforts showed that the data collection and disability inclusion monitoring is greatly dependent on many factors, including the level of collaboration and partnerships across different sectors and stakeholders, creating a cohesive society.

4.2. Pułtusk Case Study

4.2.1. Pułtusk Case Study Results

Pułtusk focused on the areas 1-8, but in the later stages tried to find more data also on further areas. For this paper, we have chosen the 5 most representative and demonstrative areas (no. 1, 2, 3, 7 and 8), where data has been provided for at least 50% of the indicators. In none of the areas, 100% of indicators were unfortunately collected. One of the reasons is the fact that disability inclusion by Polish law is coordinated by the city counties. As such, disability inclusion is thus mostly regulated on the regional level. Consequently, Pułtusk does not have any disability inclusion related office or a disability inclusion monitoring system. The lack of city competences in some of the areas (e.g., that are regulated on the regional level or are a matter of a private sector) greatly contributed to the lack of data too. Nevertheless, the DIETool can still demonstrate the city's performance in the selected areas. The Figure 3 shows how well Pułtusk is performing in the following 5 selected areas: 1-Public spaces, 2-Public services, 3-Transportation and urban mobility, 7-Education and 8-Work, career and employment (for detailed list of indicators for each of the areas see Supplementary Materials, Tables S1–S3, Table S6 and Table S7). According to the Figure 3, Pułtusk performed above average in the area 7-Education (app. score 3,5) and around average in areas 1-Public spaces, 2-Public services, 8-Work, career and employment (app. score 2,5). There is one area with poor performance, that is 3-Transportation and urban mobility (app. score 2).

Similarly to the previous example of the Maribor case study, we provide 5 area specific insets (Figure 4) also for Pułtusk. They give an opportunity to explore the results in more details and point out indicators' specific strengths and weaknesses. When combined with the DIETool spreadsheet, the initial diagnoses can thus be further analyzed through each indicator.

For instance, when we look into the area 8-Work, career and employment (Figure 4–Inset “8-Work, Career & Employment”; Table S7), we can notice that Pułtusk performs either very well (score 5) in indicators 8.1.2., 8.1.5., 8.2.1., 8.2.2., 8.2.3. or it performs very poorly (scores 1) in indicators 8.1.3., 8.1.4., 8.2.6. It is worth noting that such bipolarism also occurs in other areas in which the city achieves very good results for some indicators and weak for others.

Using the Excel spreadsheet for this specific area (Table S7) and using responses provided by the city officials, we can further analyze this result as follows. In Pułtusk, *Unemployment rate (%) of individuals with disabilities against unemployed individuals without disabilities* (8.1.2.) is 3.38%. It means that in the city, there are 42 registered unemployed persons with disabilities out of 1.242 registered unemployed persons without disability. Besides that, the *Proportion (%) of youth with disabilities (aged 15–24 years) not in employment nor in education and training against all young persons with disabilities* (8.1.5.) is 4.76 %. It means that only 4 youth with disabilities out of 42 of totally registered persons with disabilities are not in employment nor in education or training. The values obtained for the above indicators reflect that the professional integration of people with disabilities, carried out by the Poviats Labor Office, is quite effective. The second group of indicators in which Pułtusk also performs very well (score 5) are indicators: *Availability of programs for disability employment development* (8.2.1.), *Availability of funding for employers (for employment, for ergonomic solutions, rehabilitation and training, etc.)* (8.2.2.) and *Availability of funding opportunities for disabled people (for self-employment, individual training, etc.)* (8.2.3.). Here we see the interconnection between the previous two indicators (8.1.2. and 8.1.5.) with the last three (8.2.1.–8.2.3.). It is probably the availability of active programmes and funds for people with disabilities that contributes to such a good result and makes the number of registered persons with disabilities relatively low.

However, one must bear in mind, when addressing the whole picture, that there was a lack of data for some indicators, such as: *Proportion (%) of unemployed individuals with disabilities against all active persons with disabilities* (8.1.1); and *Proportion (%) of individuals with disabilities living below the national poverty line* (8.1.6.). The three indicators, for which the city performs poorly (score 1) are: *Proportion (%) of individuals with disabilities in long-term unemployment against the unemployed persons with disabilities* (8.1.3.); *Proportion (%) of temporarily employed individuals with disabilities against the total no. of employed persons with disabilities* (8.1.4.); and *Level of satisfaction among employees with disabilities (working climate, equity, available ergonomic solutions, staff training, support provision, etc.)* (8.2.6.). In the city, there are 27 persons with disabilities in long-term unemployment among 42 registered unemployed persons with disabilities (64%) and 36% temporarily employed. These results confirm that the issue of professional activation of the long-term unemployed, including people with disabilities is very complex. Among the reasons for this situation, we can find the lack or inappropriate qualifications, the lack of jobs in the place of residence as well as low mobility, possibly low personal motivation, and/or family problems. In many cases, these causes an overlap. The city may need to explore further how to overcome these numbers. Finally, the level of satisfaction among disabled employees is around 20%.

A further questionnaire could tell whether the non-satisfaction is a result of insufficient ergonomic solutions, attitudinal barriers, economic reasons, non-suitability of work or the lack of opportunities for career advancements. Summarizing the results for area 8, we can say that DIETool clearly indicates difficulties in monitoring the employment of people with disabilities. Although in the case of Pułtusk town, conducting labor market policy is the task of the poviats, this tool shows in what areas the city could undertake improvement actions related to work and employment of the persons with disabilities, in particular, those long-term unemployed and those already employed.

4.2.2. Pułtusk Case Study Observations

The DIETool testing in the city of Pułtusk has highlighted several challenges and limitations in collecting the data, too. The first and most important issue turned out to be that small cities in Poland, such as Pułtusk, constitute parts of poviats (county), and only these have the legally assigned competences regarding social inclusion, in particular, related to persons with disabilities. Additionally, other related competences such as health protection and hospital management, organization of upper secondary schools, or running labor market institutions belong to the poviat administration and not to the city administration. Therefore, using a tool such as DIETool, in the case of small cities, requires the inclusion of the poviat administration in the research process. The second most important limitation associated with the first one is the fact that statistical data on social inclusion are collected only at the poviat level. The general difficulty is, therefore, to disaggregate the data in such a way to obtain data for the city. On the territory of the Pułtusk Poviat, which includes six communes, there is only one city, Pułtusk; hence the starting point for many calculations as part of the research was the percentage share of the city's population among the poviat residents (app. 37 %). Thirdly, within the research, we detected a lack of data collected by the city on the DIETool indicators related to private and non-governmental sectors.

These were among other reasons why Pułtusk, as a small city without a department dedicated specifically to the area of disability inclusion, faced difficulties completing the DIETool within the timeframe of the pilot study.

5. Discussion and Conclusions

Recent studies [2,9,12,14,19] show that contemporary city concepts, such as the smart and sustainable city, are not fully ready to meet the requirements for an inclusive city for all. That is, a city inclusive of all their inhabitants, including those with disabilities and diverse impairments [1,2,30]. Within current conceptualizations, disability inclusion gets lost in overall inclusion dimensions, perceived either as inclusion for all, economic, social or racial inclusion [14,15]. Social equity and social inclusion dimensions within social sustainability debates [36–43], although are important paradigms, can neither respond to the complexity, diversity and specific nature of disability inclusion. This creates a need for further discussions as of what an inclusive city truly means, and specifically, how to address the inclusiveness of vulnerable groups of citizens, such as those with disabilities [2,17,29]. Modern urban [60–65] and disability rights agendas [3–5] with respective political, legislative and standardization frameworks provide a starting point for understanding what a disability inclusive city is. However, a lack of disability specific evaluation, monitoring and implementation tools may be one of the reasons why cities are still unable to follow these ambitious agendas and legislative frameworks to bring them to practice.

The DIETool presented herein attempts to translate political and legislative requirements into main inclusion and accessibility principles, and holistically integrates them into a single tool covering diverse a) disability types; b) city settings (areas); and c) services, products, environments and information. It responds to the absence of disability inclusion specific evaluation and monitoring systems within current smart, sustainable and inclusive city initiatives [21,24,36,37,44–55], and creates a vision of a disability inclusive city.

The results of the testing in Maribor and Pułtusk confirmed the lack of such tools in practice. Most of all, they proved that the evaluation process for cities is demanding, not only in terms of time and staff capacity, but also in terms of understanding disability inclusion and its complexity. Other issues are both the level and the scope of city competences regarding disability inclusion, as well as data collection possibilities. A good coordination across internal city departments, as well as partnerships with external stakeholders are needed, and still the data is difficult to obtain. Nevertheless, we noticed that a designated disability inclusion office may bring more success in getting informed about the actual level of inclusivity. Such was the case of Maribor, where the presence of the Council for Disabled People showed how a small organizational change and a tradition in ensuring disability rights within

the city organizational structures can make an important difference. In Maribor, the dedication to complete the DIETool was, therefore, very high, and the experimentation resulted in 8 areas completed with more than 50%, and an additional 8 areas with at least 25% completion rate.

For Pułtusk, on the other hand, firstly the collection of data was poorer. Only 5 areas were completed with at least 50% of indicators, and an additional 2 areas with at least 25%. This is hardly surprising, having in mind that it is a small city of only app. 19,500 inhabitants without any Disability Rights office. As such, it has limited staff capacity and disability rights related competences, thus the data collection was even more demanding.

Despite this brief comparison, the aim of the DIETool and DIPI, at this point, is not to make cities competitors but rather to help an individual city to see where their strong and weak points are. In fact, as we see in the case of Maribor and Pułtusk, the two cities are non-comparable, although they are both European cities under the powers of the same EU directives and frameworks. Nevertheless, they have their national and local specifics. They are of different size, with different economic development and different disability rights traditions, as well as different organizational, legislative and socio-cultural backgrounds to name only a few. Diverse internal and external factors may be affecting the city governance, which, in turn, affects the situation of people with disabilities in the city and impacts the DIPI score.

In both cities, however, we faced challenges with obtaining the data. The reasons were multifaceted. Firstly, one of the reasons may be the nature of the indicators, although our aim was to simplify the extensive set of legal accessibility and disability rights requirements and standards, not to make them more complicated. Secondly, absence of a statistical office and a monitoring system in the city may reflect the lack of detailed analytics needed to feed the DIETool. Thirdly, the city may have divided competences across specific working areas, thus may not be able to collect the data. For instance, many disability inclusion related aspects in Poland are managed on a regional level by counties (poviats), and in Slovenia, some areas are centrally managed by the national government. In addition, a wide network of stakeholders may be needed to collect the data from the private sectors. On the other hand, both the tested cities were recognized to have a very low level of digital governance. A digital upgrade may thus represent an interesting and needed vision for the future of the DIETool to help cities automatize parts of the data collection, analysis and management processes, while at the same time disaggregating data for monitoring disability inclusion. Furthermore, data reliability and validity may need to be discussed further, too. The pilot tests could not give answers to this challenging field.

The two pilot case studies, however, should not be considered as a proof of concept, but rather as the DIETool demonstration as of how to evaluate and monitor disability inclusion performance and stimulate cities to become more sensitive and holistically conscious of disability inclusion. We can consider it, as a proof, that such a demanding evaluation process can be done. Despite the challenges in data collection in Maribor and Pułtusk, we cannot claim that the data cannot be obtained more extensively in other cities with different organizational structures, management systems, different disability inclusion policies and advanced digital governance. For instance, it would be interesting to explore the DIETool in a context of a large, highly digitized and citizen inclusive smart city [46], such as Singapore (Singapore), Zurich (Switzerland), Copenhagen (Denmark), Vancouver (Canada), Amsterdam (Netherlands) or Vienna (Austria).

The DIETool, overall, demonstrates several strengths, benefits and opportunities. Firstly, it sums up and simplifies a complex set of disability inclusion rights and accessibility requirements across diverse areas of city life. As such, it supports the process of learning, raising awareness and gaining a profound understanding of what disability inclusion really means.

Secondly, as a disability specific evaluation and monitoring tool, it attempts to fill in the gap within the existing city metrics, which currently cover attributes, such as smartness, (social) sustainability, quality of life, creativity, etc., but not yet disability inclusion. When applied to practice, the DIETool points out to the strengths and weaknesses of a city's performance in a sensitive area of disability

inclusion and by doing so, it guides the city towards designing informed corrective measures for an accessible and disability friendly city.

Thirdly, the DIETool acts as a toolkit and guidelines. It not only sets the requirements but also envisions a set of alternative techniques (e.g., questionnaires, focus groups). These aim at a) supporting the demanding data collection processes, and b) obtaining the viewpoint of other stakeholders (citizens, non-governmental and private sector). This may increase reliability and validity of the tool in obtaining the data, as well as may help objectivize, validate and, as such, balance out the results that may be biased just because they were collected only from city administrations. By doing so, the tool provides a mechanism to control validity and reliability risks in terms of possible conflicts of interest and subjectivity. Unfortunately, our preliminary pilot study did not incorporate such validation tests with direct users yet, as it was conducted with two main aims: a) to see whether such a tool could be accepted by city administrative decision, and b) to see whether the data for the envisioned indicators could be obtained, to what extent and in what form, in order to further approach its reliability and validity issues. On the one hand, we proved that the tool can be accepted even though it demands commitment, effort and time. On the other hand, the data can be collected to a certain degree to feed the tool, even though many challenges have been faced.

Fourthly, the tool requires a proactive approach. The joint efforts across different city departments, institutions and diverse range of stakeholders to obtain the data will undoubtedly create stronger partnerships also for future actions, improve data collection processes and, in turn, improve data reliability and validity, too.

Fifthly, it may also help setting inclusiveness as a norm and one of the main principles within the work of all the city's departments. This could bring an important opportunity for reaching a long-term commitment and socially sustainable approach towards inclusive city design. As shown in the case study of Maribor, the DIETool can be used to conduct a preliminary (or periodical) analysis and can feed annual reports on the equal opportunities for persons with disabilities. It can support the design of a local disability inclusion strategy and provide the basis for an action plan towards a disability inclusion in the city. Nonetheless, the DIETool can be used both as a complete tool across all the 20 areas and as a tool to detect weaknesses in specific working areas, aiming at guiding specific city departments in improving their disability inclusion performance.

Finally, the DIETool demonstrates strengths, also speaking in terms of software quality design. For it to be accepted by the cities, we designed it in a way that it fulfils certain quality properties following the product quality model proposed by the standard ISO/IEC 25010:2011 The DIETool, therefore, fulfils quality in terms of 8 characteristics: Functional suitability, Reliability, Performance efficiency, Usability, Security, Compatibility, Maintainability and Portability [79] (p. 10). During the pilot testing, the tool achieved a good level of acceptance among city staff. It was conceptualized in a way that assumes a basic knowledge of disability inclusion, but it does not require advanced knowledge for its comprehension. In fact, the tool itself is a source of knowledge for the user and, as a result, provides learnability and promotion of disability inclusion. Using the tool should, thus, not be a barrier. Although the process of data collection for each of the indicators may be challenging, very time consuming and requires extensive work, once the data is collected, the tool enables a quick entry, immediate DIPI score calculation and the provision of corresponding graphical visualizations (both for the overall DIPI score, as well as area specific DIPI scores). This enables an immediate diagnosis and efficient analysis of results.

The DIETool itself guarantees high reliability for the city staff due to high probability to maintain its level of performance and high performance of failure-free operation in the environment of the public administration. DIETool, due to its design, can also continue operating properly in the event of inability to use one of its independent components (areas). In fact, it has been designed so to be able to follow the overall performance across all the areas, across a few selected areas and/or only within individual areas. However, over time it may be necessary to update the tool, e.g., by incorporating mechanisms

for validity risk control, developing a weighting system and ensuring subsequent up-to-date versions, all that taking into account the complexity and diversity within the fast-paced changing city life.

Summarizing the pilot case studies, although not conducted as classical big-scale verification tests, have helped us point out some of the limitations, drawbacks and challenges to be addressed in the future. These may refer to: (a) the implementation process (e.g., the need for coordination, commitment, effort, time, partnerships, risks of subjectivity, conflicts of interests, validation process, involving direct users, etc.), (b) the data collection process (e.g., data collection methods (primary/secondary data), data validity issues (lack of data, dispersed, incorrect, subjective, non-comparable, non-consistent data, for instance, in the scope; geographical coverage, time span, status-related etc.), and (c) the DIETool with its methodology (e.g., the need for a weighting system, mechanisms for reliability and validity risks control).

For instance, the weighting methodology will need to be explored considering various internal and external factors. Prioritization of indicators and areas, as well as compensation considering diverse distorting factors may need to represent one of the first steps towards improving the reliability and validity of the tool, its methodology and its results. One of the current limitations of the tool is its non-comparability across diverse city contexts. Thus, city-specific factors may need to be studied. These factors, among others, include the country of origin, the city's development stage, its size, overall maturity level, etc. For instance, the scoring scales for crime rates, employment rates etc., may need to be different for differently developed countries (non-comparability across countries). Optimal targeted performance for cities of different size may be different, too. We cannot compare a small town of Pułtusk and a middle-sized city of Maribor with a metropolitan city of a complex structure inhabited by several million people on the one hand, and with a greater financial and organizational capacity on the other hand. In the future, we may think of a tool with pre-set country specific and/or size specific profiles. Such profiles would include different scoring reference rates and possibly even different indicators, depending on the national and size specific requirements.

Pilot testing in the two cities did not bring answers in many aspects listed above. It is a new tool, process-related and therefore "a-live". Thus, the challenges will need to be addressed gradually. Over time, however, the number of inconsistencies will decrease as it matures. In the future, we may even envision it as an integral component of a complex smart city platform with interconnected subsystems/areas (e.g., 20 as in the DIETool) providing and exchanging information in real time on demand. Each of the areas would be fed with content relevant for the citizens, enabling them to get the right information at the right time, get engaged with city authorities, collaborate in city surveys or answer questions at points of interest. On the other hand, it would enable cities to have a direct and channelled citizens' feedback supported with an automated data collection and analytics system. The DIETool could serve as a monitoring tool within the platform, benefitting all the city departments with automatically fed information, as well as enabling the creation of additional surveys, reports and finally the DIPI performance score.

With the presented work, we hope to have provided a practical tool that will advance research and practice on how to design a socially sustainable city concerning questions of inclusiveness for all, and by that, stimulate current smart and sustainable city initiatives to consider disability inclusion as an important element of any contemporary city. Our vision is to bring accessibility and inclusion into everyday lives of people with disabilities, for which, each city subsystem, service, product, process or information needs to be designed, evaluated and monitored in line with best disability inclusion practices.

Supplementary Materials: Supplementary materials consist of Tables S1–S9. They are available online at <http://www.mdpi.com/2071-1050/12/4/1378/s1>.

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Abbreviations

ANED	Academic Network of European Disability Experts
DIETool	Disability Inclusion Evaluation Tool
DIPI	Disability Inclusion Performance Index
DOTCOM	Disability Online Tool of the Commission
EC	European Commission
EDF	European Disability Forum
EU	European Union
ICT	Information and Communication Technologies
PWD	person with disabilities
SDGs	Sustainable Development Goals
UD	Universal Design
UNCRPD	United Nations Conventions on the Rights of Persons with Disabilities

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8. Discussion and Conclusions

The societal challenges related to designing cities that are inclusive of people with disabilities have been extensively addressed through disability-rights frameworks on the one hand (e.g. the *United Nations Convention on the Rights of Persons with Disabilities* (UNCRPD) (UN General Assembly, 2007), the *United Nations Disability Strategy* (UN General Assembly, 2020), the *European Disability Strategy* (EC, 2010a), the *European Accessibility Act* (EC, 2015)) and modern urban agendas on the other (e.g. the *New Urban Agenda* (UN Habitat, 2016), the *2030 Agenda for Sustainable Development* (UN Habitat, 2015), and the United Nations' paper on the right to the cities for all (UN Habitat, 2017)). Extensive research has been conducted in the domain (Hanson, 2004; Gleeson, 2001; Imrie, 2012; Imrie, 2014; Imrie, 2015; Barrett, Horne & Fien, 2016; Rodrigues & Cardoso, 2019; Rebernik et al., 2020). However, despite significant improvements over recent decades, disability inclusion in cities is not yet reflected in real lives of people with disabilities.

In view of this, the present research has been led by the question of what a disability-inclusive city truly means, and how to make its complexity more comprehensible to the relevant stakeholders. It has explored ways, approaches and methodologies that could strengthen the understanding of the diversity of needs of people with disabilities, and consequently the importance and complexity of designing disability-inclusive cities with effects that can manifest in citizens' everyday lives. It aims to introduce new conceptual, methodological and practical insights and tools that can help simplify the overwhelming complexity of disability inclusion and its legal requirements. This involves models and tools that can enhance communication with citizens with disabilities, thus leading to more holistic, participatory and informed urban planning, design and governance systems for all. It represents an attempt to bridge the theoretical and practical understandings of a disability-inclusive city within the diverse disciplines of this multidisciplinary domain.

Using ethnography-based participatory research, this study has explored the unsurmountable array of societal challenges faced by city officials and citizens when considering disability inclusion. Decision makers are often overwhelmed by this complexity, and are therefore confused and ignorant of the needs of people with disabilities. This leads to dissatisfaction on both sides, clearly with a greater loss on the side of those with disabilities.

In line with the research hypotheses presented here, the results of this exploration have consistently shown that cities need more systemic, holistic and participatory approaches that consider disability inclusion as an imperative, in all its diversity, complexity and individuality, first and foremost by exploring citizens' needs and their use of city services, spaces, products and information. In this thesis, it is argued that qualitative, bottom-up, small, slow and deep-data-oriented approaches should be incorporated into urban practice in order to enhance communication, awareness and understanding of disability inclusion as a whole, and to create smarter disability-inclusive urban planning, design and governance in the long term. For this purpose, a holistic approach was applied to exploring a city as a system of subsystems (Boob, 2015; Cavada, Rogers & Hunt, 2014; Nam & Pardo, 2011; Rebernik et al., 2019), building upon the modern concept of a smart city and its components, which are usually clustered and contextualised in the form of three main pillars: (a) technology; (b) people; and (c) institutions/governments/spaces (Nam & Pardo, 2011).

Surprising as it may seem, despite firm legislative, standardisation and political frameworks and novel conceptualisations of smart and sustainable cities, which would in their very essence be inclusive of all their inhabitants, it is shown here that inclusion has not yet been achieved. Numerous ethnographic encounters that I have had with people with disabilities and city officials brought to light an array of interesting insights, showing that cities are still not disability friendly, a result which is in line with previous studies (Hanson, 2004; Phoram et al., 2015; Neto & Kofuji, 2016). Prior work has also shown that even smart cities, as a novel conceptualisation of a city, may not yet be fully ready to meet the requirements of a disability-inclusive city, since they are primarily designed with technology in mind, while the human dimension and social aspects are overlooked (Abdel-Aziz, Abdel-Salam, & El-Sayad, 2016; Gehl, 2010). Furthermore, inclusive cities and inclusion are mostly perceived in broad, vague terms relating to economic, spatial and social inclusion, while disability inclusion is neglected. Prior research also highlights the poor understanding among relevant stakeholders of the complexity, diversity and individuality of disability inclusion. A great deal of misunderstanding and miscommunication between citizens and city officials were also revealed: the former claimed to have provided officials with a clear overview of their needs but to have not been heard, while the officials themselves expressed great interest in addressing disabled people's needs but claimed that they did not know exactly what these needs were or how to address them. They often expressed disappointment over their insufficient communication with, and feedback from, people with disabilities. Despite many ongoing projects and programmes, and a range of funding schemes, awareness-raising campaigns, training sessions and other forms of

collaboration between diverse stakeholders, an ethnographic exploration showed that a lack of communication was contributing to poor results, which were also too often of a temporary nature. This left people with disabilities in disbelief, and under the impression that they were not considered as equal citizens.

As we can see, this phenomenon is truly complex, as are the reasons behind the currently insufficient attention being paid to disability inclusion. These reasons are multifaceted, and thus difficult to explore.

In response to the identified gaps, the vision of this research involved a holistically designed, smart, disability-inclusive city (Paper 2) that would take into account the needs of diverse groups of people with disabilities. This vision would take into account the complexity of a city as a purposeful system of subsystems, apply a strong, bottom-up, participatory approach towards exploring the variety of citizens' needs, and investigate the potential of the increasingly pervasive digital tools for the design of inclusive cities. Later, with the aim of addressing the complex nature of cities and disability inclusion with its legal requirements, an attempt was made to provide a simplified view of a disability-inclusive city that adopted an overarching understanding of disability inclusion (a) across diverse types of disabilities; (b) across all the subsystems of a city; and (c) throughout all the services, spaces, products, processes and information of the city (Paper 1). This approach is perhaps one of the core contributions to the growing complexity of cities and is as such further reflected through all the main research results. It is most evidently reflected in the final paper of this dissertation, in which a practical tool, DIETool, is proposed for measuring disability inclusion performance in cities (Paper 6).

An attempt to provide an overview of the research structure and its challenging multidisciplinary nature across social sciences, engineering and urban studies is made in Paper 3. In this paper, the flow of the research is illustrated using the three main pillars of humans, space and technology, and is complemented with a short list of societal challenges and research questions. In Paper 4, these were complemented with a four-dimensional model designed to give a more structured understanding of the challenges in the domain of disability-inclusive cities. This model shows in more detail the complexity of the societal challenges that can and should be addressed when designing cities for people rather than cars (Gehl, 2010), technology (Rebernik et al., 2019) or merely profit (Lefebvre, 1996; Purcell, 2002; Cavada, Hunt, & Rogers, 2014; Barrett, Horne, & Fien, 2016). It explores these varied complexities based on the premise of *human-space-technology*, and focusing on the interactions between

these three dimensions on the fourth, *relational* level, where the real complexity appears within the city. In order to carry out an in-depth exploration of these interactions, a CMA was added to the model, comprising a combination of ethnography, digital tools and complementary techniques from urban studies, such as behavioural mapping (BM) and post-occupancy evaluation (POE). This combination of methodological techniques was proposed based on the argument that no single methodology or its technique can encompass the complexity of inclusive city design, as reflected in the four-dimensional model. The CMA was therefore proposed to allow this model to be used for urban practice and research.

Both the four-dimensional model and the CMA were tested in four case studies, conducted in Maribor and Ljubljana, Slovenia. These tests demonstrated the significant contributions of these approaches in terms of unfolding the complexity of the interactions between people, spaces and digital tools. They also showed the richness of the insights that can be obtained from observation and direct communication with citizens, not only about their accessibility needs and disability-related characteristics, but also their motivations, constraints, opinions, aspirations, attitudes and behaviours towards themselves and others, the space in which they interact and the technology they use. This part of the study serves as an example of holistically organised, participatory, user-centred research for improved urban design. It is also applicable to other phenomena, and specifically those associated with the design of cities that respond to the needs of all their citizens.

For the CMA, I have selected ethnography as the backbone methodology, as it can offer a relatively deep understanding of citizens as the main drivers of the city. This is undoubtedly its main advantage. However, it also has limitations. As a highly time-consuming approach, it has often been neglected in urban design and may be superseded in the future. However, this study has a high value in terms of providing a deep understanding of how a city is used, in order to be able to design its structures and functions accordingly. In combination with POE techniques (designed to explore how existing outdoor spaces are used, how they function, and what lessons we can learn from their design) and behavioural mapping (designed to explore patterns and discrepancies in the use of space, the characteristics and behaviours of users who occupy the space and the reasons behind these patterns), the CMA enriches ethnographic approaches and brings ethnography closer to the urban arena. Digital tools were incorporated to support the research process and to study the impact of technological advances on the creation of disability-inclusive urban environments.

Pervasive digital technologies have marked the era of the 21st century, and offer unimaginable opportunities for smart disability-inclusive city design. Hence, using the four-dimensional model and the CMA approach, an exploration of smart technologies and existing digital tools was carried out in the context of disability-inclusive cities, with the aim of answering the questions of what kind of tools are available today, what are their actual contributions towards the design of truly disability-inclusive cities, and how novel technologies impact the lives of people with disabilities (Paper 5). For this purpose, I conducted a review of the existing digital tools. Again, an overwhelming complexity emerged due to the ongoing penetration of digital technology and smart technologies into our everyday lives. These tools were therefore classified into three groups, according to whether they can be used by (a) people with disabilities; (b) city authorities; and (c) researchers. They were then explored using the ethnographic techniques of participant observation, wheel-walking ethnography, friendly interviews, digital tools elicitation, diary writing and other similar approaches. A rich ethnographic account was constructed that focused on the advantages and drawbacks of digital tools when used in the context of disability inclusion in cities. Based on ethnographic encounters with several informants from Slovenia, of whom Joe, Ann and Vanessa from Maribor, Slovenia were selected for a more in-depth report, two conclusions could be drawn. The first was that the study confirmed the findings of previous research: that digital tools can aid people with disabilities in accessing city services, spaces and information, thus supporting them in overcoming barriers and leading more fulfilling and better-quality lives (Neto & Kofuji, 2016; Rodrigues & Cardoso, 2019; Pankau, 2019; Gleeson, 1999), and that these tools can also enable more systemic and collaborative planning and design (Stadler, 2013), helping establish firm communication channels and closer connections with citizens (Bagni et al., 2017; Stadler, 2013; Gehl, 2010; Hampton et al., 2010) and finally in gaining an overall deeper understanding of their needs. They can also greatly benefit researchers, specifically in terms of conducting slow, small and deep-data research (Favero & Bahillo, 2016; Collins et al., 2017) in semiotically dense environments (Favero & Theunissen, 2018) such as cities.

The second conclusion was that this ethnographic exploration reflected the numerous challenges posed by digital tools to people with disabilities, city officials and researchers. In fact, the research disproved several myths about the use of technology as an ultimate solution for people with disabilities in the city, demonstrating that digital tools are both enablers and disablers of being in space. It is difficult to design good digital technology that is true to its original use and purpose, and this is particularly the case in the domain of disability. The deep ethnographic research carried out here has highlighted a number of drawbacks, which may not

necessarily reflect the design itself but a number of contextual factors, which may ‘construct new forms of disabling barriers’ for people in relation to disability-space-technology (MacDonald & Clayton, 2013, 702). For instance, while observing Joe and Vanessa using their smartphones while moving in space with their wheelchairs, I came to an understanding of how a great diversity of contextual factors influenced their ability to connect with the tool and hence to use it efficiently. Weather conditions, the intricacies of urban design, the personal preferences of the user and the specifics of the impairment itself may impact the ways in which people with disabilities use novel technologies and how these technologies are of use to them. The research also showed that the immaterial world of technology, in a way, reaches the material world by scanning it, adding layers of information about it, in such a way as to affect the presence of people in space, but it cannot change the space itself for the better or magically remove barriers to inclusion. As such, ethnography has again been proven to significantly enhance our understanding of the interactions between cities, citizens and novel technology, which should be explored further in the future. This type of deep, slow, small-data-oriented research is time-consuming and slow, but can enrich not only urban practice but also the design of smart technology. Its orientation towards understanding the *how* and the *why* behind any phenomenon, rather than asking only *what* should be designed, complements the technical nature of engineering and design. It can also balance out the current predominantly structural and aesthetic focus of design, which often leads to non-functional solutions when designing spaces and digital tools. Taking this into account, the CMA helps fill in the gaps of mainstream quantitative approaches and offers in-depth qualitative insights into phenomena. It is therefore one of the outcomes of this work that represents the original viewpoint of this study.

Finally, as a practical solution to the challenges explored throughout the study, DIETool was designed, with its DIPI component. DIETool wraps up the research circle and provides a response to the identified gaps and the main research questions. It is aligned with the main vision of this research of a holistic, disability-inclusive city design, and the initial simplified conceptualisation of a disability-inclusive city design. Its aim is to translate political and legislative requirements into their main inclusion and accessibility principles, and to holistically integrate them into a single tool covering a range of diverse (a) disability types; (b) city settings (areas); and (c) services, products, environments and information. It responds to the absence of evaluation and monitoring systems that are specific to disability inclusion within current smart, sustainable and inclusive initiatives that would allow cities to assess where they are in terms of disability inclusion, where their performance is low and where corrective measures

need to be taken. It supports the processes of learning, raising awareness and gaining a profound understanding of what disability inclusion really means. Although it uses a holistic approach, it is based on the logic of simplicity rather than complexity, and this is one of its main advantages. It offers a selected number of indicators for each of the 20 areas of city life, taking into consideration the needs of diverse groups of people with disabilities, and offers city officials simplified guidelines that can help them to easily understand where they are in terms of disability inclusion performance, and can serve as a roadmap for designing future corrective measures and responsive strategies for each of these areas and indicators of poor performance. Using and respecting the existing political, legislative and standardisation requirements are then natural consequences, since the city has a simplified framework and a clearer understanding of the complexity within those guidelines.

DIETool was tested in two European cities, the city of Maribor in Slovenia, and the city of Pułtusk in Poland. The testing carried out as part of this research confirmed the lack of such tools in practice, and proved that the evaluation process for cities is demanding and time-consuming and that data are difficult to obtain. In line with our hypotheses and previous studies, it confirmed that creating an understanding of the complexity of disability inclusion among stakeholders is still a significant challenge, and that such a tool would have a beneficial effect. Although the two pilot case studies were not used as a proof of concept, but rather as a demonstration of DIETool, they can be considered as proof that a demanding evaluation process can be applied and can stimulate cities to become more sensitive and holistically conscious of disability inclusion.

Due to the complete absence of disability inclusion evaluation systems, it could be expected that the invited cities would be interested in using the proposed tool. Maribor and Pułtusk had both shown interest from the very start and had a dedicated approach to data collection and analysis. A coordinating person or department was assigned to the project, and within a period of less than four months, both cities completed data collection beyond expectations. However, the testing also faced a significant number of challenges. Firstly, these were associated with implementation process, since strong coordination, commitment, effort, time and partnerships were needed to collect the data. There is a risk of subjectivity and conflict of interest, and the DIETool therefore proposes a two-fold evaluation, using questionnaires, interviews and control check directly from citizens with disabilities. This may help in objectivising, validating and balancing out potentially biased results. Secondly, challenges were associated with the data collection process itself. The databases in the two cities were dispersed across several departments, and the competences for data collection were found to be on multiple levels,

including local, regional and national levels. Data from the private sector were also very difficult or almost impossible to obtain. DIETool therefore encourages cities to build strong partnerships across diverse stakeholders in the long term, not only for the purposes of obtaining data, but mainly to create collaborative, disability-inclusive policies. Data revision is also needed during the collection process, as the data may be incorrect, subjective, noncomparable or inconsistent, for instance in terms of geographical coverage, time span, units etc. Finally, the DIETool methodology currently does not have a weighting system; for instance, it does not prioritise indicators and areas, and does not consider distorting factors. It also does not allow for a comparison between cities in differing contexts (e.g. the country, size or stage of development of the city). This may be a matter for future research. A tool could be developed with pre-set country-specific and/or size-specific city profiles with different scoring rates, and if necessary, even different country- or size-specific indicators.

It is important to note, however, that the aim of developing DIETool and DIPI was not to turn cities into competitors or to create a ranking system; they were designed to help an individual city to identify where their strong and weak points are. One of the advantages of DIETool is that it can be used both as a complete tool across all 20 areas of interest and also as a tool to detect weaknesses in specific working areas or even a single specific indicator. This is of particular importance as cities do not all have the same access to data; data collection is also in general a highly demanding process, and not all data will always be collected. Furthermore, once the data have been collected (even if they are incomplete), the tool allows for quick entry, immediate DIPI score calculation and corresponding graphical visualisations. This enables an immediate diagnosis and efficient analysis of the results. It may also serve as a tool allowing city officials to conduct preliminary and/or intermediate analyses for feeding into annual reports and designing disability inclusion strategies and action plans. In fact, this was the case in Maribor, which has a dedicated disability inclusion office and took on the project as “its own”. The dedication of the officials was very high, and the results were used to feed into its annual report on equal opportunities for people with disabilities.

DIETool has been tested only in two cities, a sample that is too small to allow for any generalisability. Although the cities involved were very dedicated to completing the tool with the relevant data, a lack of long-term commitment and overall dedication across city departments may represent one of the most important drawbacks for implementation in other cities. Nevertheless, the tool was intriguing to all of the city staff involved in testing, and it would be interesting to see if it was accepted in larger city contexts as well as other national and cultural environments. In the future, DIETool may form an integral component of a

complex smart city platform, with interconnected subsystems/areas providing an exchange of information between citizens and city authorities, in real time and on demand. It could offer relevant content in each of the areas of interest, enable participation and serve as an automated data collection and analytics system for monitoring purposes.

In summary, in these challenging times when the urban population is growing, ageing and becoming increasingly diverse, and societal challenges are becoming overwhelmingly complex, when technology is leading the way towards the future and often leaves the human dimension aside, and when new threatening crises unexpectedly unfold, this research may help in rethinking existing city models and urban practices that have until now not been able to fulfil the requirements for a city that is inclusive of all its citizens, including those with disabilities. The main contributions of this study are its attempt to bridge diverse disciplines within such a highly multidisciplinary domain; its holistic view on the complex phenomenon of disability-inclusive city design; its visionary approach, offering a way in which the ideal of holistically disability-inclusive city can and must be pursued; its help in unravelling the overwhelming complexity of existing legal, political and standardisation requirements for disability-inclusive design, and the provision of a simplified view and a more comprehensive understanding of how disability inclusion should be perceived in a city; and its contribution in terms of a carefully thought-out combination of methods, combined into a CMA approach, that offers a novel methodological contribution to urban research and practice and builds on the four-dimensional model with thoughtfully organised societal challenges and research questions associated with the dimensions of people, spaces, technology and the interactions between them. As such, it offers a simple, comprehensible framework for tackling the overwhelming challenges that cities currently face in terms of these dimensions. A further contribution of this research is that it demonstrates that ethnography can serve as a valuable methodology within computer engineering and urban design, rather than solely within qualitatively oriented social sciences research. It shows how ethnography can aid in developing a better understanding of how to design digital tools and spaces that take into account the needs of people with disabilities. Finally, it contributes via the holistically designed DIETool, which responds not only to the identified absence of monitoring tools for disability inclusion but also wraps up the research aims, objectives and research questions into a single final result, and is shown to be a useful solution for cities and their governance. Using a combination of qualitative and quantitative indicators across 20 areas of city life, it helps in evaluating where cities are in terms of disability inclusion for diverse groups of people with disabilities, in order to be able to design more informed and responsive disability-inclusive policies. The tool translates

legislative, political and standardisation frameworks into a simplified but still holistic and in-depth evaluation tool that requires cities to apply a dedicated, proactive approach. This is one of its main advantages.

My quest for inclusivity in terms of the needs of people with disabilities started over a decade ago, and has been growing ever since. However, the present research was limited by several factors such as time, geographical coverage, and the multidisciplinary team needed for such a complex area of research, to name only a few. Thus, this research offers a vision complemented with some novel methodological techniques for the design of disability-inclusive cities. It presents preliminary results and practical examples of how the proposed methods and tools can be used in the future. Its ultimate goal is to stimulate officials involved in current smart and sustainable city initiatives and contemporary urban practices to consider disability inclusion as an important element of any contemporary city and hence to bring accessibility and inclusion into the everyday lives of people with disabilities. In particular, the present research follows my personal vision of a holistic approach to any issue related to disability-inclusivity, rather than solely within the urban domain. It aims to encourage future academic research and practice towards rethinking disability inclusion as an essential component and a core principle to be considered in any multidisciplinary field when planning, designing and managing services, spaces, products, processes or information. I also hope that through the multiple international presentations of this research, this message has reached non-disability experts and policy makers and has made a mark among my computer engineer colleagues in terms of encouraging them to rethink how they perceive users and their interactions with the technology that they design.

9. References

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