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

Conference Paper · September 2017

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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 Eurostat[1] there were 42 million disabled people aged 15–64 in the EU-27 in 2012, if considering the EHSIS[2] 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 Fund[3], 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 intrust, 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 outmost, through understanding the complexity and holicity 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 mundaning 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

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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 city[4], Placemaking[5]). 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

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 project[6] 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 outmost 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,

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[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 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.
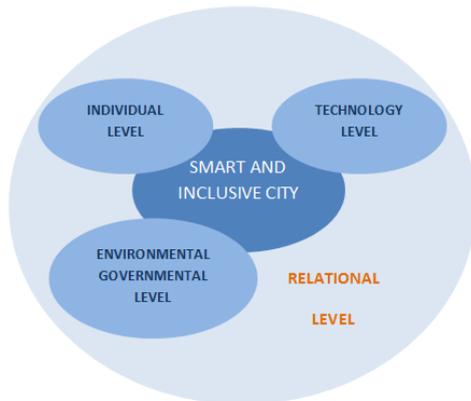
4.1. Societal challenges & *a four-dimensional model*

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 Awards[8] 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

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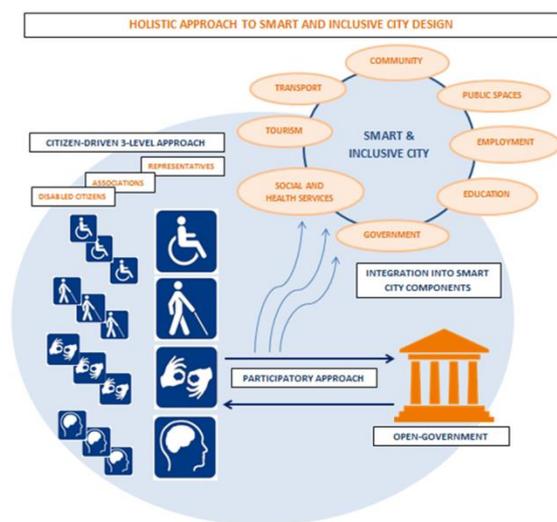
Figure 3: Holistic approach to Smart and Inclusive City design.

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 users[9] [32], Arianna for the blind[10], Fix my Street, Ushahidi, [32], EthnoAlly[11], b) monitoring, evaluation and analytical tools, such as SpaceSyntax[12] 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 FourSquare[13] [12], Fabric[14]; 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 platform[15], holistic transportation Smart city tool Moovit[16], Butterfly Smart city app for the citizens of Amsterdam[17] 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.
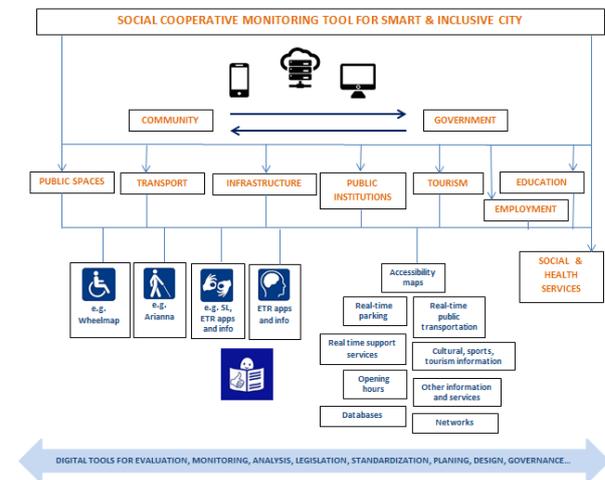

Figure 4: Social Cooperative Monitoring Tool

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

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[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

9. References

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