

DIGITAL SOCIAL INNOVATION IN SUPPORT OF SPATIAL PLANNING. AN INVESTIGATION THROUGH NINE INITIATIVES IN THREE SMART CITY PROGRAMMES.

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This paper examines how technologically-enabled social innovation can support spatial planning. Social innovation is a long-standing practice; however, in recent years its popularity, importance and applications have increased due to both the financial and social challenges that cities face, and due to important technological advances. Digital Social Innovation (DSI), more specifically, is increasingly penetrating smart city programmes and strategies throughout the world. Through research into nine DSI initiatives in the context of three smart city programmes (Amsterdam, Barcelona, New York), we point out the functions and benefits of incorporating DSI in spatial planning and trace its different levels and characteristics. The conclusions suggest that: online and offline means are equally important in DSI for spatial planning; the mix and degree of involvement of different sectors varies significantly across DSI initiatives; spatial planning and place making experts and professionals have a distinctive role within these initiatives; and particular attention should be paid to scaling and uptake issues.

Key words: urban planning, collaborative planning, citizen empowerment, civic innovation, online platforms and tools.

INTRODUCTION

In recent years, cities have been increasingly pressured to become more attractive, innovative and competitive, as globalization has opened up competition for human capital and financial resources to a wholly new scale. As if this was not enough, they are expected to do more with less; recent economic downturns have decreased city budgets, compelling governments to downsize their investment in social, environmental and economic welfare. Innovative cities compensate for this widening gap by promoting social and human capital development and mobilizing citizens as agents of change, hoping to achieve faster and more inclusive growth through alternative routes.

In parallel, citizens are becoming more informed and participatory by their own initiative. They claim democratic representation in policy making and governance; they come up with resourceful ideas, open pathways to innovation and often become innovators themselves. Urban citizens have the capability to summon and incite citizen and

community movements from the bottom-up. They come up with solutions that government could never think of, let alone implement. Ongoing scientific discussions have introduced new concepts and theories that represent the new dynamic participation of citizens in policy making, product development and service provision. Such concepts include grassroots innovation, co-creation, crowdsourcing, bottom-up engagement, open innovation and so forth. Among them lies social innovation, broadly referring to new ideas, concepts and business models that are focused on promoting public welfare.

The above deeply transformative developments in society could not have left spatial planning unaffected. Online, real-time, ubiquitous technology, grassroots movements, the pressure to do more with less, and the desire of people to shape their own future, have led to the rise of social and participatory innovation platforms for collectively transforming urban environments.

Altogether, we are undergoing a situation in which the government's ability to react to urban challenges and proactively plan for the future is extremely limited, while citizens and their communities increasingly assume action

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to fill this gap by means of innovating. The role of digital platforms and tools is critical in this transformative process, allowing for large-scale, real time monitoring and informed decision-making next to saving significant financial and human resources. However, as explained in the literature review of section 2, digitally enabled social innovation is a critically under-studied and documented concept in the social field, including spatial planning. Also, despite the fact that smart cities –among others – address issues of spatial planning, and urban regeneration and development, with the digital sphere influencing the physical one, spatial planners are often not included in their design.

This paper aspires to stimulate the related discussion in the academic community and serve as inspiration for the pursuit of new research paths. It also aspires to present urban policy makers with a comprehensive view of the emerging opportunities and methods to promote urban innovation and effective spatial planning. More particularly, the purpose of this paper is to examine how and in what ways Digital Social Innovation (DSI) can support spatial planning and development. This is achieved by analyzing the dimensions and functions of DSI initiatives related to spatial planning in the context of broadly known and accredited smart city programmes that favor and welcome such kinds of initiatives (analytical justification in section 3). Several different levels of spatial planning are addressed, focusing on the city scale: urban design, urban planning and strategic planning for urban development.

In terms of structure, the following section (Section 2) presents the notion of social innovation and offers a thorough literature review about the relationship between DSI and spatial planning and development, focusing on the tools and methods that may be used to this end. The next section (Section 3) is dedicated to the case study research that took place for the purpose of this paper. It includes the research methodology and the research findings from nine DSI cases in the context of three smart city strategies, and it closes with a synthesis of the research findings. The last section (Section 4) presents the Conclusions from the research. It offers a critical discussion and policy recommendations for leveraging DSI for more effective spatial planning.

LITERATURE REVIEW

Social Innovation in the contemporary context

Social innovation is a broad quasi-concept (Davies *et al.*, 2014) which generally refers to the development of new and innovative ideas, services and business models to address social issues. Its foremost purpose is to address challenges for which the public or the private sector cannot provide solutions alone, due to financial or operational constraints. Such challenges include social exclusion, environmental degradation, public services provision, public health and others (Murray *et al.*, 2010). To this end, social innovation invites input from the public sector, the private sector and civil society, which are called to unite their forces in order to achieve complementarities and thus maximize results. Although social innovation may produce economic benefit, its primary concern rests with social benefit. An operational definition of social innovation is provided by the OECD (2011), whereby *'Social Innovation refers to new strategies,*

concepts, ideas and organizations that meet social needs of all kinds - from working conditions and education to community development and health - and that extend and strengthen civil society'.

During recent years, social innovation has attracted increased interest from academics, entrepreneurs and policy makers due to the economic challenges that some of the world's most developed countries have come to face. Indeed, urban citizens have been increasingly exposed to poor public services, high unemployment, financial austerity, social disparities and international migration. In most cases, public authorities lack the necessary funds to address such large scale and complex issues, whereas the business sector is only marginally concerned with solving problems that do not generate quick profit. Social innovation not only seeks to provide new and innovative solutions, but also to restrain the overconsumption of resources and provide locally customized answers, hence opening the way to more efficient solutions (European Commission - DG Regional and Urban Policy, 2013).

Science and Technology have a very important role to play when it comes to social innovation; they allow for large-scale response not only to economic, but social problems, as well (OECD, 2011). Online platforms and digital tools enable people to exchange and share knowledge that generates significant social, economic and environmental benefits (Angelidou and Psaltoglou, 2017; Ivanović-Vojvodić and Stupar, 2015). They contribute to the advancement of knowledgeable, participatory and creative citizens, communities and social actors, and they enhance the knowledge base, innovation capability, and creativity of populations (Aurigi, 2006; Haque, 2012). Furthermore, large-scale engagement favors the equal representation of stakeholders and highlights social needs more effectively (ARUP *et al.*, 2011; Bays and Callanan, 2012). Online platforms also yield very significant economic benefits; through user input, cities save resources, streamline processes and generate solutions that have not yet been addressed by the market (ARUP, 2011; Bakici, 2012). In environmental terms, online platforms eliminate the necessity for physical travel and the existence of physical workplaces. Urban resilience, greenhouse gas reduction and health benefits are achieved through the development of applications for a cleaner environment, transport and waste management (ARUP *et al.*, 2011). Citizens become more energy-wise, as they become aware of their own resource consumption. Thus, the term "Digital Social Innovation" has been coined, referring to *'a type of social and collaborative innovation in which innovators, users and communities collaborate using digital technologies to co-create knowledge and solutions for a wide range of social needs and at a scale and speed that was unimaginable before the rise of the Internet'* (Bria *et al.*, 2015).

Digital Social Innovation for intelligent urban development

Social Innovation has been used in public planning for over fifty years now (Angelidou, 2015; Maeng and Nedovic-Budic, 2008). The famous Dutch woonerfs, for example, which are streets that accommodate pedestrians, bicyclists, and people along with cars – were first introduced by Dutch

residents who took it upon themselves to reclaim public space in residential communities, meeting the social need for safety, livability and social interaction in urbanized spaces. The movement grew so massive, that woonerfs were formally incorporated in the spatial planning standards of the Dutch state in 1976 (Lydon and Garcia, 2015).

Thanks to recent technological advancements, however, social innovation has acquired a new characteristic: given that ubiquitous connectivity of smart city systems allows real-time interaction, innovators can be engaged 'on the go', especially through social media. This instant and direct interaction elevates the effectiveness of bottom-up approaches to an entirely new level. Although it is an idea still under exploration, open and social innovation is put forth by many urban development scientists as a basic ingredient of the successfulness of smart, intelligent and eco city strategies (for example Almirall, 2012; Angelidou, 2017; 2016a; 2015; 2014; 2012; Bakici, 2012; Komninos, 2011; 2015; Paskaleva, 2011; Schaffers *et al.*, 2012). DSI approaches capitalize on the skills and knowledge of the city's people and advance intelligence, innovation and problem-solving capacity in cities. Web 2.0 platforms, underpinned by smart devices and networks, provide an unprecedented opportunity for broad-scale user engagement and codification of input and information, enabling advanced city functionality and improved operations. Constituent involvement, facilitated through web-based collaboration, leads to the development of locally customized solutions that efficiently address both existing and emerging urban problems, and elevates the collective intelligence of the population to a whole new level of innovation, knowledge and skills (Bria, 2012). In this process, people are the essential source of innovation, as the collective intelligence that stems from the populace holds unprecedented potential for tackling city-wide problems. This form of intelligence is usually ignored in exclusive top-down approaches for the development of smart cities. However, empowering people to find and build their own solutions may allow the full potential of smart cities to be realized. In this context, any adequate model for a smart city must focus on the intelligence of its citizens and prioritize participatory processes (Haque, 2012, Angelidou, 2016a, Angelidou, 2015). As A. Greenfield stated, *'the city is already smart. The intelligence is just bound up in the actions and behaviors of its users. If we harness that intelligence, we win'* (Young, 2011).

In recent years, DSI has been variably exploited in the policy context, while the majority of public policies favor social and open innovation (Bakici, 2012). Innovative governments see Web 2.0 platforms as a way to engage quadruple helix stakeholders (citizens and civic organizations, public sector, private sector, academia) in providing their ideas, solve problems collectively, and develop and test new products. Bottom-up approaches, facilitated through digital networking, can become part of the strategy for spatial planning and development, namely the creation of smart cities in several different ways (Almirall, 2012; Bakici, 2012; González and Rossi, 2012), including:

- **User engagement**, referring to the involvement of the people of the city, interest groups and organizations (i.e. 'stakeholders') in all or some stages of smart city

development (Almirall, 2012; Bélissent, 2012; Nam and Pardo, 2011; Schaffers *et al.*, 2012). User engagement can extend across the design and execution of policies (Paskaleva, 2011) and cover the full value chain of service planning, designing, commissioning, managing, delivering, monitoring, expanding and evaluation activities (Bovaird, 2007). Digital tools that may be used to stimulate engagement include collaboration platforms, citizen reporting platforms, social media (such as Facebook, Twitter, LinkedIn), and also more traditional means, such as surveys, interviews, focus groups and meetings (Bélissent, 2012; Hodgkinson, 2011; Seltzer and Mahmoudi, 2013).

- **Crowdsourcing**, which is the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an 'open call'², is considered another one of the basic mechanisms for the bottom-up engagement of urban stakeholders (Almirall, 2012; Bakici, 2012; Evans-Cowley, 2011; Schuurman *et al.*, 2012). In general, motives to participate in crowdsourcing procedures include monetary compensation, altruistic reasons (the 'opportunity to contribute'), fun/pleasure, recognition, self-development, passion for problem solving, and reputation (Bakici, 2012; Evans-Cowley, 2011). Cities release 'open calls' to attract interested participants in submitting creative proposals/ideas for solving the city's problems. In recent years, Web 2.0 technologies have facilitated crowdsourcing techniques tremendously.
- **Prizes, Challenges and Competitions**. One part (the 'seeker') challenges a third party or parties (the 'solvers') to identify a solution for a particular problem and rewards winning contestants. Rewards can be of all kinds: money, objects or services. Many players in the market are using open challenges or open calls in order to get the users to participate in building a 'smart' solution or a service, often in conjunction with crowdsourcing and citizen engagement (Evans-Cowley, 2011; González and Rossi, 2012; Schuurman *et al.*, 2012).
- **Living labs** are open innovation platforms that engage stakeholders in real life contexts to test breakthrough concepts and assess their potential value for society as a whole (Bakici, 2012; European Network of Living Labs, 2013; González and Rossi, 2012; Paskaleva, 2011). Methodology-wise, a living lab engages in four main activities: co-creation, exploration, experimentation and evaluation (European Network of Living Labs, 2013). Currently there are about 400 living labs only in Europe. Recent research has focused on the connections and synergies between living labs and smart cities; it has found that living labs are ideal test-beds for gaining useful knowledge and experience with regard to smart city solutions (Paskaleva, 2011; Vicini *et al.*, 2012).
- **'Big Data'** refers to the vast amounts of data that are produced and collected daily in our cities. It comes from different sources (government, sensors, social media)

² As defined for the first time on J. Howe's blog in 2006, URL:< <http://crowdsourcing.typepad.com/>>.

and can be used in creative ways towards helping a city become 'smart'. Recent technological advancements have played a decisive role in the utilization of data for the common good; on the one hand, powerful analytics, data-mining³ techniques and mashups⁴ have allowed for the analysis of large quantities of data and their correlation in resourceful ways to identify trends and reach conclusions about the urban environment and the incidents that happen (or are prone to happen) therein. On the other hand, technology-savvy citizens and developers have used this data to develop innovative smart city applications that improve the daily life of the city's users. The idea of big data (including open data) is especially popular in terms of how it can enhance the smartness of cities and their citizens (Almirall, 2012; Bakici, 2012; Bays and Callanan, 2012; Bélissent, 2012; Haque, 2012; Kalampokis *et al.*, 2012). However, despite the growing interest, the idea is still largely under exploration.

- **Open sensor networks**, as means of ubiquitous connectivity that allow the city's users to be connected and engaged at all times. In essence, ubiquitous connectivity enables the seamless and constant provision of cloud computing and Future Internet services, and this is the reason why it can be considered another tool for bottom-up engagement (Bakici, 2012; Carter, 2012; Hodgkinson, 2011; Schaffers *et al.*, 2012).

Spatial Planning in Smart Cities

Smart cities represent a conceptual urban development model based on the utilization of human, collective, and technological capital for the enhancement of development and prosperity in urban agglomerations. The working definition of a 'smart city' is the following: '*smart cities are all urban settlements that make a conscious effort to capitalize on the new Information and Communications Technology (ICT) landscape in a strategic way, seeking to achieve prosperity, effectiveness and competitiveness on multiple socio-economic levels*' (Angelidou, 2014).

An important factor to account for is that in using ICT tools for spatial planning and development, all initiatives are inherently place-specific. They cannot exist without spatial reference, and each urban challenge is unique and constantly affected by its societal, political and economic context. Thus, many DSI initiatives are not only supported by means of online tools and platforms, but also by means of offline methods, such as focus groups, discussion groups and task forces that work with actual plans, models and physical interventions. These allow the better framing of those initiatives in their contexts of application.

Given the spatial implications of the smart city movement, one could also argue that the development of technologically augmented cities requires the involvement of spatial planners, computer scientists and engineers. Physical and digital projects in the context of the smart city strategy

³ Data mining is the computational process of discovering patterns in large data sets with methods of artificial intelligence, machine learning and statistics, in order to extract meaning from a raw dataset.

⁴ A mash-up is a Web application that combines data from multiple sources to create powerful analyses that can identify patterns that were not previously visible' (Bays and Callanan, 2012).

should not be interpreted as unrelated dimensions, but should complement each other (Aurigi, 2006), and spatial planning can hold an enabling role to this end (Nam and Pardo, 2011). However, despite the fact that smart cities address issues of spatial planning, regeneration and development, with the digital sphere influencing the physical one, spatial planners are often not included in their design. This approach results in incomplete approaches to urban problems and leads to strategic deficits. The case of IBM's 'Smarter Cities' programme is a very characteristic and broadly mentioned one: The global technology vendor, counting 435,000 employees worldwide, and with the 'Smarter Cities' programme running since 2008, until recently did not employ a single urban planner to work on the programme (Doig, 2012).

CASE STUDIES

Methodology

The literature review of Section 2 revealed that although DSI is already on the rise from the bottom-up, and despite its potential for application in spatial planning practices, its benefits and the different ways it can be applied are unknown. Consequently, the opportunities emerging from DSI are underutilized by spatial policy makers. Accounting for this knowledge gap, this paper aims to examine how and in what ways DSI can support spatial planning and development. More particularly, it seeks to provide answers to the following research questions:

- Which particular aspects of spatial planning can be facilitated by means of DSI?
- What are the benefits of incorporating DSI practices in spatial planning?
- Who are the major stakeholders involved in this process?
- Which methodologies, tools and technologies can be used to incorporate DSI in spatial planning?

Case study research (Eisenhardt, 1989; Yin, 2003) presents a fitting research method for answering the above research questions, because it allows for the induction of in-depth insights about the questions to be answered. More particularly, case study research methods allow researchers to arrange and analyze qualitative data in a way that allows for the detection of underlying patterns and similarities, thus facilitating the emergence of overarching conclusions and results and allowing for the development of new theoretical constructs about the research in focus.

Moreover, smart cities, due to their inherent implementation with the use of digital applications and tools, are ideal frameworks where advanced cases of DSI initiatives in support of spatial planning and development can be found. DSI has actually been a priority in many successful smart city initiatives undertaken by cities such as New York, Washington, San Francisco, Berlin, Barcelona, Amsterdam, Helsinki, Manchester, Stockholm and others (Angelidou, 2014; 2016b; 2017). For the purposes of this paper, three smart city initiatives were selected, based on the following criteria:

- The existence of an integrated strategy: they have integrated, standalone smart city strategies, with an explicit framework of actions and included projects.
- The degree of data availability: they offer insights on the specific objective of this research, which is to identify DSI initiatives specifically related to place making, spatial planning and urban development.
- A citizen-oriented approach: they adopt citizen driven design methods, and seek to empower citizens as agents of change.

It is especially important to note here that in the smart city strategies researched, information sharing and citizen request platforms are made openly available in full to quadruple helix stakeholders, and these stakeholders are provided with training opportunities on how to use these data in constructive ways related to spatial planning. This is a necessary precondition for the substantial enrichment of the spatial planning processes through DSI.

Accounting for the previous considerations, the research methodology is built on research into nine different instances of DSI initiatives related to spatial planning that have been developed in the context of the above smart city strategies. These nine initiatives are initially analyzed independently and then synthetically with regards to the research questions mentioned above. In the following section we elaborate on the findings of each case with respect to DSI in the context of spatial planning and development.

Findings

The Case of Amsterdam

Amsterdam Smart City is an innovation platform whereby actors from the government, the private sector, academia and civil society collaborate in developing and testing new solutions by means of specifically designed and dedicated projects. The ultimate goal of the platform is to increase the livelihood and sustainability of the city of Amsterdam. The smart city projects are arranged across six themes: i. Infrastructure and Technology, ii. Energy, Water and Waste, iii. Mobility, iv. Circular City, v. Governance and Education, vi. Citizens and Living. Anyone can start their own project on the platform and seek collaborators. The result is new technologies, new solutions and new business models in these areas (Amsterdam Smart City official website, 2016; Angelidou, 2016a; 2016b).

Within the smart city platform, there is a host of DSI initiatives directly related to spatial planning and development. Three noteworthy initiatives include:

- **The Hackable City** (<http://thehackablecity.nl>): an initiative that explores the potential of new modes of collaborative city-making, using digital technologies and new media. Citizens, design professionals and knowledge institutions come together to collaborate in spatial planning and city management with the ultimate purpose of increasing democracy, livability and resilience. They are empowered towards acting on complex and common urban problems in modern, networked societies. The smart city strategic methods used in this initiative include user/citizen engagement, co-design, challenges and crowdsourcing.

- **Games for Cities** (www.gamesforcities.com): an initiative that explores how serious gaming can improve city-making and provide solutions for urban issues. Such issues can be related to urban regeneration, migration and the inclusion of minority groups, urban violence and resilience. Through games, coalitions are formed among contributing parties, while a common understanding of urban issues is promoted and citizens gain hands on insights about the potential action routes in terms of city making. The platform is facilitated by online and offline means. The smart city strategic methods used in this initiative include challenges, user/citizen engagement, co-design and crowdsourcing.
- **TransformCity (ZO!City pilot)** (www.zocity.nl): an online urban transformation dashboard for participatory place making and spatial planning. By means of storytelling, data-sharing, co-creation, crowdsourcing and crowdfunding, stakeholders co-design urban neighborhoods that are more inclusive, resilient and sustainable. The smart city strategic methods used in this initiative include user/citizen engagement, co-design and crowdsourcing.



Figure 1. "Games for Cities" in action. Various stakeholders assume distinct roles and co-create urban districts accounting for diverge needs and viewpoints
(Source: www.gamesforcities.com)

The Case of Barcelona

The Smart City of Barcelona is an initiative commissioned to improve the quality of life for the citizens of Barcelona in an inclusive outlook. Quality of life is achieved by more efficiently meeting citizens' needs; such needs span the areas of the environment, mobility, businesses, communications, energy and housing. Technology and innovation are substantial pillars of the strategy, enhancing sustainability and self-sufficiency. The smart city platform of Barcelona comprises projects in the following areas: i. Public and Social Services, ii. The environment, iii. Mobility, iv. Companies and business, iv. Research and innovation, v. Communications, vi. Infrastructures, vii. Tourism, viii. Citizen cooperation and ix. International Projects. Stakeholder engagement is a fundamental dimension of the city's strategy, realized through ubiquitous connectivity, open data and urban labs, which encourage citizens to be more active and participative (Barcelona Smart City official website, 2016; Angelidou, 2016b; 2016b; Bakici *et al.*, 2016).

DSI initiatives related to spatial planning and development in the context of Barcelona's smart city platform include:

Representative DSI initiatives and projects related to spatial planning and development within New York’s smart and equitable city strategy include:

- **Neighborhoods.nyc** (www.neighborhoods.nyc) is essentially an integrated public authorities’ information and citizen reporting online platform. It provides information about public transport services, social and schooling services, public health, construction works, quality of life, etc. Local community groups can use it to develop web-based hubs for collaborative spatial planning, civic engagement, online organizing and information sharing. The smart city strategic methods used in this initiative include user/citizen engagement, crowdsourcing and co-design.
- **MyNYCHA** (<http://www1.nyc.gov/site/nycha/mynycha/mynycha-landing.page>) is an online tool that allows users of real estate developments to access and contribute information about the services available therein. More particularly, it allows quadruple helix stakeholders (citizens, public, private, and non-profit sectors) to build innovative partnerships for better access to the city’s housing stock. Themes addressed span the demographic data of the population residing in the developments, the availability of family services, engagement opportunities and emergency preparedness plans. The smart city strategic methods used in this initiative include living labs, big data, user/citizen engagement, crowdsourcing and co-design.
- **IdeaScale for quality of life issues** (<https://ideascale.com/resource/new-york-city-police-department/>) is a real time street intelligence platform whereby citizens recommend to the New York Police Department (NYPD) neighborhood-based quality of life improvements in areas such as reducing noise pollution, safety/crime and illegal parking. Local police officers respond in their area of authority. The smart city strategic methods used in this initiative include user/citizen engagement, crowdsourcing, co-design and challenges.

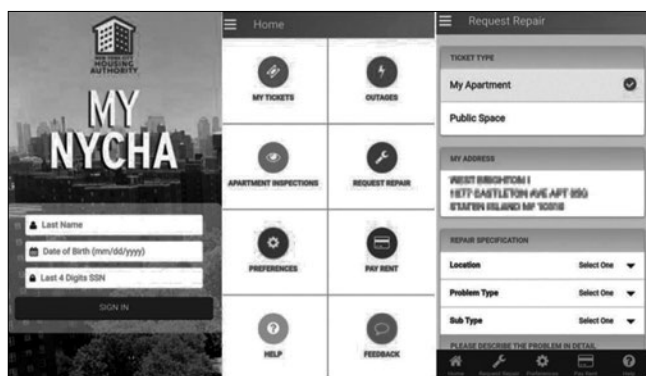


Figure 5. Screenshots from the mobile application of MyNYCHA, featuring the different areas of interest with regards to real estate developments

(Source: <http://www1.nyc.gov/site/nycha/mynycha/mynycha-landing.page>)

Synthesis of Results

In examining the previous nine DSI cases, we can first point out the **particular aspects of spatial planning that can be facilitated by means of DSI**. These include:

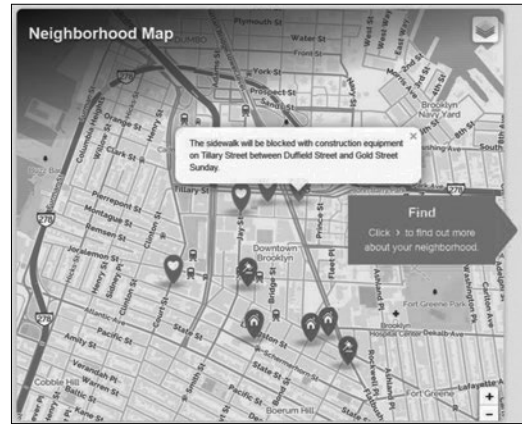


Figure 6. Snapshot from Neighborhoods.nyc depicting citizen reported issues on a neighborhood map

(Source: <http://www.neighborhoods.nyc/welcome.html>)

- **Collaborative planning**, in the sense of actually co-designing and co-creating spatial forms and structures for the city.
- **Better informed spatial planning**, facilitated by the insights coming from sourcing large amounts of data and opinions from the city’s stakeholders. In turn, spatial planners can use these insights to develop better and more targeted plans and urban stakeholders can participate in the spatial planning dialogue and public consultation in a more informed way.
- **Collaborative place making and branding**, for instance in reconciling stakeholder interests and building a common vision as to what kind of place they want to live in.
- **Solutions to specific challenges with a spatial element**, for example with respect to underprivileged and underdeveloped areas. Using these data, urban stakeholders and particularly citizens and their communities can develop their own digital applications related to spatial planning for addressing specific challenges.

In sequence, the benefits of incorporating DSI in spatial planning and development include:

- **Spatial Resilience**, in the sense of retaining functionality and effectiveness in the face of unexpected events, times of crisis and beyond.
- **Quality of life**, referring to the well-being of individuals and specific population and community groups, reflected by factors such as public health, access to services and resources.
- **Awareness raising**, namely making citizens more aware of the long and short term implications of human activity upon the inhabited environment and making them aware of the requirements of the different stakeholder groups that co-exist in the city environment.
- **Environmental Sustainability**, in the sense of saving energy and resources and reducing the environmental impact of human activity within cities.
- **Claiming affordable housing and public amenities**, by making information available and facilitating the co-design of public spaces, public services, citizen rights, events, points of interest and so forth.

- **Social inclusion**, in the sense of providing minority or socially marginalized population groups opportunities to confer and develop stronger bonds with their city and its inhabitants

The research also showed that **the stakeholders involved in DSI-driven spatial planning** typically include the city’s major users, i.e. citizens and their associations, community groups and non-governmental organizations, public authorities (municipal and metropolitan), civic enterprises, knowledge institutions (universities, research organizations, scholars) and design professionals.

From the above research we can also infer that are different levels and characteristics of exploiting DSI in the context of spatial planning and development. These include:

- **The used Methodologies.** They typically include i. Games – storytelling, ii. Living labs and pilot testing of new ideas, services and products, iii. Crowdsourcing and crowdfunding for new ideas and solutions, iv. Citizen engagement, co-design and co-creation by means of workshops, focus groups etc.
- **The available Tools and Technologies.** These include i. Open digital hardware that users can utilize to capture and transmit information into platforms for social good, ii. Open Networks, used to transmit information and share resources (for ex. sensor networks) iii. Open Data, used in creative ways to provide insights about unexplored issues and develop applications for social good and iv. Open Knowledge, used to inform and engage users in submitting their own piece of knowledge or other resources and ultimately create new knowledge and solutions to address social challenges (Bria *et al.*, 2015).

Accounting for the above analysis, we can design the following model towards inclusive DSI in the context of spatial planning and development (Figure 7). In the center of the model are the spatial planning aspects

that are facilitated by means of DSI; at the edges are the benefits arising from incorporating DSI practices in spatial planning, the stakeholders involved in this process and the methodologies, tools and technologies can be used to this end.

CONCLUSIONS

In this paper with analyzed nine instances of DSI, as they have been incorporated in three smart city strategies. We found that DSI serves different spatial planning and development functions, such as collaborative planning, better informed spatial planning, collaborative place making, and solutions to specific challenges with a spatial element. The stakeholders involved come from all the constituents of the quadruple helix: public sector, private sector, academia, and – most importantly – from citizens and civic organizations. The role of the latter group is essential in generating a wealth of ideas, achieving consensus and increasing uptake. The most common methods include serious games, living labs, crowdsourcing and co-design. The available tools and technologies can be distinguished depending on the technology and purpose of the DSI initiative.

Speaking of the quadruple helix, it is noteworthy that the mix and degree of involvement of different sectors varies significantly across DSI initiatives. The involvement and empowerment of citizens is consistent, as it is the basic ingredient of DSI. However, there is always an orchestrator or facilitator of the initiative – this role may be variably assumed by representatives of the public sector, the private sector (predominantly civic entrepreneurs), community groups or non-governmental organizations. Especially in challenge-focused initiatives, there is also usually an ‘owner’ of the challenge, and this is where an orchestrator or facilitator becomes indispensable.

One step further, and building on the above spatial consequences of DSI for spatial development and planning, we see that planning and place making experts and



Figure 7. Integrated Model for the incorporation of Digital Social Innovation in spatial planning and development (Source: authors)

professionals have a distinctive role to play within these initiatives. In Von Hippel's (2005) words, they are the so-called 'lead-users'. These individuals are the ones who possess the experience and training to transform abstract ideas into spatial strategies and plans, granting potentiality and functionality to abstract ideas. They have a trained and informed view of what is achievable and what is not; they know the rules and guidelines; they seek to work out a compromise to include the needs of all parties involved.

In any case, it is challenging to tell exactly what the best solutions for cities are, as most challenges are multi-leveled and open-ended. Without doubt, however, the diffusion and scaling of DSI is critical in sourcing a large volume of input. Smart cities, their people, and data that stem from their activities may be today's hot topics, but the complex networking processes of cities and their theoretical background are still issues to be studied. In this sense, interesting topics for future research arising from the work presented in this paper include i. the assessment of the contribution of the different DSI tools and methods in spatial planning, based on the impact generated through the case studies and ii. The investigation of the prospects for applying the solutions analyzed here to cities with other characteristics or to usual spatial planning practice.

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