TOWARDS SOCIALLY SUSTAINABLE SMART CITIES: OBSERVATIONS AND POTENTIALS FROM DIGITIZING PARTICIPATORY PLANNING

Islam Bouzguenda

Universitat de Girona

جامعة السلطان قابوس
Sultan Qaboos University

DOCTORAL THESIS

TOWARDS SOCIALLY SUSTAINABLE SMART CITIES: OBSERVATIONS AND POTENTIALS FROM DIGITIZING PARTICIPATORY PLANNING

Islam Bouzguenda

2020

Universitat de Girona

جامعة السلطان قابوس
Sultan Qaboos University

DOCTORAL THESIS

TOWARDS SOCIALLY SUSTAINABLE SMART CITIES: OBSERVATIONS AND POTENTIALS FROM DIGITIZING PARTICIPATORY PLANNING

Islam Bouzguenda

2020

Doctoral Program in the Environment

Supervised by:

Nadia Fava

Chaham Alalouch

Tutor:

MARGARITA CASTAÑER

Presented to obtain the degree of PhD at the University of Girona

Dr. Nadia Fava of Department of Architecture and Engineering Construction, University of Girona, and Dr. Chaham Alalouch, of Department of Civil and Architectural Engineering, College of Engineering, Sultan Qaboos University

WE DECLARE:

That the thesis entitled — Towards Socially Sustainable Smart Cities: Observations and Potentials From Digitizing Participatory Planning, presented by Islam Bouzguenda to obtain a doctoral degree, has been completed under our joint-supervision.

For all intents and purposes, we hereby sign this document.

Dr. Nadia Fava

Dr. Chaham Alalouch

July 2020

Universitat de Girona

جامعة السلطان قابوس
Sultan Qaboos University

Dr. Nadia Fava and Dr. Chaham Alalouch, as co-authors of the following articles:

1. **Bouzguenda, I**., Alalouch, C., & Fava, N. (2019). "Towards Smart Sustainable Cities: A Review of the Role Digital Citizen Participation Could Play in Advancing Social Sustainability". *Sustainable Cities and Society, 50*, 101627.
2. **Bouzguenda, I**., Alalouch, C., & Fava, N. (2020). "Examining Digital Participatory Planning: a Maturity Assessment in a Small Dutch City". *Journal of Cleaner Production*, 264, 121706.
3. **Bouzguenda, I**., Fava, N., & Alalouch, C. (under review). "Would 3D Digital Participatory Planning Improve Social Sustainability in Smart Cities? An Empirical Evaluation Study in Less-advantaged Areas". *Journal of Urban Technology.*

Accepts that Mrs. Islam Bouzguenda presents the cited articles as the principal author and as part of her doctoral thesis and that said articles cannot, therefore, form part of any other doctoral thesis.

And for all intents and purposes, hereby signs this document.

Dr. Nadia Fava

Dr. Chaham Alalouch

July 2020

The majority of productivity growth in society derived not as much from technology as from human knowledge and creativity, which are the two essential components of innovation

(Solow 1950)

List of Publications

This jointly supervised PhD thesis is presented as a compendium of two published papers in peer-reviewed JCR journals and a third paper, which is under review. Complete references of the published papers included in this thesis and the corresponding impact factor of each journal, according to the 2019 Journal Citation Reports (JCR), are as follows:

1. **Bouzguenda, I**., Alalouch, C., & Fava, N. (2019). "Towards Smart Sustainable Cities: A Review of the Role Digital Citizen Participation Could Play in Advancing Social Sustainability". *Sustainable Cities and Society, 50*, 101627,
   DOI: 10.1016/J.SCS.2019.101627
   (Impact factor: 5.268; position 10/35: Category: green & sustainable science and technology; 1st quartile). Number of citations in Google Scholar: 29

2. **Bouzguenda, I**., Alalouch, C., & Fava, N. (2020). "Examining Digital Participatory Planning: a Maturity Assessment in a Small Dutch City". *Journal of Cleaner Production*, 264, 121706,
   DOI: 10.1016/j.jclepro.2020.121706
   (Impact factor: 7.100; position 6/35; Category: Environmental Science; 1st quartile; Listed as the top publication in Google Scholar's Sustainable Development category). Number of citations in Google Scholar: 1

3. **Bouzguenda, I**., Fava, N., & Alalouch, C. (under review)[1]. "Would 3D Digital Participatory Planning Improve Social Sustainability in Smart Cities? An Empirical Evaluation Study in Less-advantaged Areas". *Journal of Urban Technology.* (Impact factor: 2.590; Category: Urban Studies; 1st quartile).

Additional publications and conference participations related to this PhD thesis are as follows:

1. **Bouzguenda, I.** (2018). "Perspectives on Citizen Participation for the Digital Age; Urban Development Based Research & Case Study". Edited by Hanzl Małgorzata. Smart Sustainable City White Paper of the International Society of City and Regional Planners. *54th ISOCARP Congress*. Bodo: International Society of City and Regional Planners.

2. **Bouzguenda, I**, Nuss, S., & Alalouch, C. (2018). "Designing in Co-creation: Lessons from Van't Hoff Square, Netherlands, for the Omani Context". *First National Conference on Civil and Architectural Engineering*. Muscat

3. **Bouzguenda, I**. (2018). "Digitizing Community Engagement for Social Sustainability; Observations and Potentials from a Web-based Approach". *The II Conference of Pre-doctoral Researcher of the UDG.* Girona

[1] The authors have submitted a revised version of the manuscript to the Journal of Urban Technology since the second of September 2020.

Dedication

To my daughters, Hoor & Noor

Acknowledgment

In the name of Allah, the Most Beneficent, the Most Merciful.

{Recite, and your Lord is the most Generous - Who taught by the pen - Taught man that which he knew not} Verses 3, 4, and 5 Surah Al-Alaq

Praise be to Allah, the most merciful and compassionate, for giving me the strength and the opportunity to complete this PhD study. It would have been impossible without Him to sustain my mental health, and to move forward and cope with the inevitable stress that comes with doing research.

At the end of my journey through the ups and downs of research, I would like to acknowledge several individuals who have made this work possible.

First of all, I would like to thank my supervisors, Nadia Fava and Chaham Alalouch for their guidance and support throughout my research studies. Their knowledge and advice have influenced me a lot, in the way I perceive the philosophy of research and its meaning in practice. It would have been impossible for me to reach this point without their continuous help and support. I would also like to thank Sergi Nuss, MARGARITA CASTAÑER, and Anna Ribas from the Geography department for their support.

I am grateful for Schiedam municipality for funding this research. It is incredibly delightful to know and to experience the municipality's understanding of the importance of this research. I would like to thank all members of Schiedam municipality, especially Mareike Wijsman, Iris Vuyk-Verzijden, Stefanie Jacobs, Leonie E.T. Hulshof, Olga Bessova, Alexandra de Veth,

Ursula Rutten, Kees Brandwijk, and Christian Missing. I would also like to thank all individuals and Schiedam citizens who have contributed to this research project.

No journey is pleasant without friends alongside you. Thus, I would like to thank my friends in Girona, Vanessa and Ahlam for their help and support, and the incredible times we shared together.

Last but not least, everything that I have done would be impossible and would be in vain without the unconditional support and love from my family. Nothing in this world can repay the sacrifices made by my parents. I thank them and hope I can keep the smiles on their faces for a long time. I would also like to thank my brothers and sister, who have shown extreme support and comfort throughout my entire journey. I am thankful for my mother-in-law for supporting me to continue my educational achievements and for praying for me. I would like to thank my daughters as well for being patient during my busy times and separation periods. My final thank you is for my dear husband, who is my main source of support. I would like to thank him for understanding and accommodating my ambitions. Without him, this work and my life would be chaotic.

List of Abbreviations

ICT : Information Communication Technology

DCP : Digital Citizen Participation

DPP: Digital Participatory Planning

3DDPP: Three Dimensional Digital Participatory Planning

AI: Artificial Intelligence

QUAL: Qualitative Mixed-method

List of Figures

List of Tables

Table of Contents

Abstract

This thesis contributes to the current debate on the relationship between the participation of digital citizens in urban planning and social sustainability within the framework of the smart city concept. Recent studies have reported that smart city initiatives are failing to live up to sustainability expectations. This, in turn, opens up questions about social sustainability expectations, which require more research. This thesis is written to cast light on the importance of considering the social dimension in smart cities by emphasizing the potential role of citizen participation in urban planning. Specifically, the focus of this study was on small cities in Europe that claim to play an important role in the economic and political development of the European union and hence, should be given more attention in research. This is crucial in social sustainability research since some small cities and their disadvantaged areas are struggling to compete with cities that are able to attract wealth and development, thus reinforcing the inequality gap. This thesis aims to answer three main questions: i) Can digital citizen participation play a role in advancing social sustainability in smart cities?; ii) How can small cities prepare to introduce digital participatory planning under the umbrella of smart cities and how to assess a city's readiness for digital participatory planning?; and iii) What are the implications of utilizing three-dimensional digital participatory planning on the participatory planning process in less-advantaged area? This study was conducted in three stages based on a collaboration with a government organization and the local citizens. Qualitative and quantitative methods were utilized. The first stage of the research was based on a systematic review of the literature. The second stage utilized qualitative semi-structured interviews and quantitative questionnaires to collect data that were then analyzed using SPSS and NVivo software. The third stage of the research was based on the implementation of a digital participation tool in a real development project in Schiedam, the Netherlands. The

implementation process was evaluated using a newly developed assessment criteria via free-listing and pile sorting method. Data were collected qualitatively using semi-structured interviews, meetings, and participatory research, and then analyzed using the qualitatively-driven (QUAL) mixed-method design. The results of this study suggested that digital citizen participation plays a promising role in advancing the social sustainability of the community in the Digital Era. Upon developing a maturity assessment framework, it was suggested that digitizing participatory planning practices could potentially improve the social sustainability of the smart city, if certain maturity factors were fulfilled by the government organization and the society prior to the implementation. These factors may include relatively high levels of trust in community engagement processes and sufficiently high digital technology literacy among the residents. Additionally, technology appropriation, and respect for the local context and livelihood conditions are equally crucial. Positive impacts on the social sustainability of less-advantaged communities in Europe could be reinforced by prioritizing the needs of the concerned community. It can be concluded that despite the obsession with technology in this digital era, smartness should not be considered as the sole cure to every illness.

Resum

Aquesta tesi contribueix al debat actual sobre la relació entre la participació ciutadana digital en la planificació urbana i la sostenibilitat social en el marc del concepte de ciutat intel·ligent. Les recerques recents sobre aquest tema indiquen que les iniciatives de les ciutats intel·ligents no estan a l'altura de les expectatives de la sostenibilitat. Aquesta qüestió obre nous interrogants sobre les preocupacions específiques de sostenibilitat social, que mereixen una recerca més aprofundida. Aquesta tesi posa el focus sobre la importància de considerar la dimensió social de les ciutats intel·ligents destacant el paper potencial de la participació ciutadana en la planificació urbana. En particular, se centra en les ciutats petites d'Europa, que exerceixen un paper important en el desenvolupament econòmic i polític de la Unió Europea i que, per tant, haurien de rebre més atenció per part de la comunitat científica. Això és crucial en la recerca sobre la sostenibilitat social, ja que algunes ciutats petites i les seves zones desfavorides lluiten per competir amb ciutats que són capaces d'atreure la riquesa i el desenvolupament, fet que reforça la bretxa de la desigualtat. La present tesi té per objecte respondre a tres preguntes principals: Podria la participació ciutadana digital exercir un paper en el foment de la sostenibilitat social a les ciutats intel·ligents?; Com podrien preparar-se les ciutats petites per introduir la planificació participativa digital en el marc de les ciutats intel·ligents?, i Com podria avaluar-se la preparació de la ciutat per a la planificació participativa digital? L'estudi, que es va dur a terme en tres etapes, es va basar en una col·laboració amb una organització governamental i amb ciutadans. Es van utilitzar mètodes qualitatius i quantitatius. La primera etapa de la recerca es va basar en un examen sistemàtic de la bibliografia. En la segona etapa es van utilitzar entrevistes qualitatives semiestructurades i qüestionaris quantitatius per reunir les dades que després es van analitzar utilitzant el programari SPSS i NVivo. La tercera etapa de la recerca es va basar en la implementació d'una

eina de participació digital en un projecte de desenvolupament real a Schiedam , Països Baixos. El procés es va avaluar utilitzant un criteri d'avaluació desenvolupat mitjançant el mètode de llista lliure i classificació per pila. Les dades es van reunir qualitativament mitjançant entrevistes semiestructurades, trobades i recerca participativa i després es van analitzar les dades utilitzant el mètode mixt qualitatiu (QUAL). Els resultats d'aquest estudi van suggerir que la participació ciutadana digital exercia un paper prometedor en l'avenç de la sostenibilitat social de la comunitat. En elaborar un marc d'avaluació de la maduresa de les ciutats es va suggerir que la digitalització de les pràctiques de planificació participativa podria millorar la sostenibilitat social de la ciutat intel·ligent, si abans de l'aplicació es compleixen factors específics de maduresa per part de l'organització governamental i la societat, factors com ara una confiança relativament alta en els processos de participació de la comunitat o una alfabetització en la tecnologia digital prou alta entre els residents. S'han posat en relleu també altres factors crucials, com ara l'apropiació de la tecnologia, el context local i les condicions de benestar del lloc. Es considera que l'impacte positiu en la sostenibilitat social de les comunitats menys afavorides d'Europa podria reforçar-se donant prioritat a les necessitats de la comunitat interessada. En conclusió, malgrat l'obsessió per la tecnologia en la nostra era digital, aquesta no hauria de considerar-se com l'única cura per a totes les malalties.

Resumen

Esta tesis contribuye al debate actual sobre la relación entre la participación ciudadana digital en la planificación urbana y la sostenibilidad social en el marco del concepto de ciudad inteligente. Las investigaciones recientes sobre este tema indiquen que las iniciativas de las ciudades inteligentes no están a la altura de las expectativas de la sostenibilidad. Esta cuestión abre nuevos interrogantes sobre las preocupaciones en específico de sostenibilidad social, que merece una mayor investigación. Esta tesis abarca la importancia de considerar la dimensión social en las ciudades inteligentes destacando el papel potencial de la participación ciudadana en la planificación urbana. En particular, este estudio se centra en las pequeñas ciudades de Europa que desempeñan un papel importante en el desarrollo económico y político de la Unión Europea y que, por lo tanto, deberían recibir más atención por parte de la comunidad científica. Esto es crucial en la investigación sobre la sostenibilidad social, ya que algunas ciudades pequeñas y sus zonas desfavorecidas luchan por competir con ciudades que son capaces de atraer la riqueza y el desarrollo, reforzando así la brecha de la desigualdad. La presente tesis tiene por objeto responder a tres preguntas principales: ¿Podría la participación ciudadana digital desempeñar un papel en el fomento de la sostenibilidad social en las ciudades inteligentes?; ¿Cómo podrían prepararse las ciudades pequeñas para introducir la planificación participativa digital en el marco de las ciudades inteligentes y cómo podría evaluarse la preparación de la ciudad para la planificación participativa digital? El estudio, que se llevó a cabo en tres etapas, se basó en una colaboración con una organización gubernamental y los ciudadanos. Se utilizaron métodos cualitativos y cuantitativos. La primera etapa de la investigación se basó en un examen sistemático de la bibliografía. En la segunda etapa se utilizaron entrevistas cualitativas semiestructuradas y cuestionarios cuantitativos para reunir los datos que luego se analizaron utilizando el software SPSS y NVivo. La tercera etapa de la

investigación se basó en la implementación de una herramienta de participación digital en un proyecto de desarrollo real en Schiedam en Holanda. El proceso se evaluó utilizando un criterio de evaluación desarrollado mediante el método de lista libre y clasificación por pila. Los datos se reunieron cualitativamente mediante entrevistas semiestructuradas, encuentros e investigación participativa y luego se analizaron los datos utilizando el método mixto cualitativo (QUAL). Los resultados de este estudio sugirieron que la participación ciudadana digital desempeñaba un papel prometedor en el avance de la sostenibilidad social de la comunidad. Al elaborar un marco de evaluación de la madurez se sugirió que la digitalización de las prácticas de planificación participativa podría mejorar la sostenibilidad social de la ciudad inteligente, si antes de la aplicación se cumplen específicos factores de madurez por parte de la organización gubernamental y la sociedad. Factores como la confianza relativamente alta en los procesos de participación de la comunidad o la alfabetización en la tecnología digital suficientemente alta entre los residentes. Additionally, technology appropriation and the respect of the local context and the livelihood conditions is crucial. Se ha relevado también otros factores cruciales come la apropiación tecnología, el contexto local y las condiciones de bienestar del lugar. Se considera que el impacto positivo en la sostenibilidad social de las comunidades menos favorecidas de Europa podría reforzarse dando prioridad a las necesidades de la comunidad interesada. En conclusión, a pesar de la obsesión por la tecnología en nuestra era digital, esta no debería considerarse como la única cura para todas las enfermedades.

Chapter 1.

Introduction

1.1 Background

Citizen participation is the process of informing or collaborating with a variety of top-down and bottom-up stakeholders, with the objective of obtaining public feedback and suggestions on the governance of human settlements (Fredericks, Tomitsch, & Haeusler, 2020). In a world with more than half of its population living in cities (United Nations, 2014), this overwhelming governing role has been increasingly moving towards collaborative forms of governance. Hence, a greater dialogue is needed between governments and people to improve the effectiveness and inclusiveness of participatory decision-making processes (Fredericks, 2020). Participatory decision-making could include any realm of human activities, including economics, political, management, and cultural activities. One of the earliest attempts to define citizen participation and its relationship with social imperatives was Arnstein's ladder of participation (Arnstein, 1969). This ladder is a typology of eight levels of participation, starting with manipulation up to giving full control to the citizens. Arnstein's ladder of participation emphasizes that citizen participation is a categorical term for citizen power. Research situated within the built environment have explored collaborative and participatory planning. City planning is one of the collective needs that all modern societies are confronted with. For that reason, "*urban planning is part of the increasingly complex public administration framework that characterizes modern societies*" (Silva 2020, p. 1). A democratic urban planning requires the active participation of citizens to help shape cities. However, public administrations found that it is challenging to engage the citizens due to a matrix of tangible and intangible factors, such as busy lifestyles and competing priorities (Fredericks, Tomitsch, & Haeusler, 2020). Silva (2020), and Fredericks, Tomitsch, and Haeusler (2020) argued that citizens are reluctant to participate because participatory planning is seen as another face of top-down approaches employed predominately by governments and private enterprises. Others view it as the result of disillusionment, with formal political structures (Martini & Quaranta, 2020). However, the

focus on sustainable development and urban livability has influenced a shift towards stronger citizen engagement in urban planning (Yigitcanlar, Kamruzzaman, & Foth, 2019). This shift was further emphasized with the introduction of the smart city concept, in which citizen empowerment through technology was a major concern (Yigitcanlar, Kamruzzaman, & Foth, 2019). These focuses require new types of participatory planning, as well as non-ordinary forms of local knowledge collection and analysis to achieve a more citizen-responsive process (Silva, 2020).

The inter-linked relationship between sustainable development, participatory planning, and smart cities has evolved since the early nineteens of the XX century. Several attempts have been made to explore the role of participatory planning in advancing sustainable developments that might be further empowered by ICT. The relationship between smart cities and participatory decision-making has been extensively debated. (Hollands (2008, p. 316) suggested that in a real smart city, a shift has to exist "in the balance of power between the use of information technology by businesses, the government, communities, and ordinary people who live in cities, as well as seek to balance economic growth with sustainability". Deakin and Allwinkle (2007) have explored the development of digitally inclusive regeneration programs since 1990, where the first information sharing was provided via city websites until 2005. Then, the emergence of smart cities promoted the shift from government to citizen-led decision-making within the community (Lombardi et al., 2009). Promoting active citizen participation in the innovation and creativity process is smart(Deakin & Al Waer, 2011). Nonetheless, several authors have reflected upon the concerns currently surrounding smart city models (Yigitcanlar et al., 2018; Aurigi & Odendaal, 2020; Fredericks, Tomitsch, & Haeusler, 2020), which are described as being trending without having concrete content in policies (Lombardi et al., 2012). Deakin and Al Waer (2011) argued that several smart city initiatives have more to do with cities meeting the corporate branding needs of marketing campaigns than the social

intelligence required for them to be smart. Hence, the shift in the attention toward creating an empowered social capital is still a challenge.

1.2 Citizen participation in the planning of smart cities

With the ubiquitous presence of technological interventions and deployment of Information and Communication Technologies (ICT), as emphasized by smart city models, citizen engagement in city planning through ICT is increasingly gaining the attention of academia and industry (Falco, 2019). Currently, there is no commonly agreed definition of smart cities (Yigitcanlar et al., 2018). In the context of this study, the term 'smart city' is defined as a city that provides citizens with active engagement in the usage of smart solutions to improve living standards and urban sustainability (Goldsmith & Crawford, 2014). Digitizing participatory planning initiatives is viewed as an attempt to overcome the challenges faced by public administrations to engage the citizens (Martini & Quaranta, 2020). Digital participatory planning initiatives are taking different shapes and forms. With high Internet accessibility and the wide spread of social networks, citizens are granted the involvement in decision-making outside the institutional participation schemes led by government agents or public-private partnerships (Appio, Lima, & Paroutis, 2019). Social media (e.g., Twitter and Facebook) are utilized to deliver citizen's voices to decision makers. Although public administrations could be affected by these voices, non-institutional participation schemes might not be fully considered as part of trustworthy decision-making since they might lack the required diversity and quality (Tait, 2020).

In contrast, institutional participatory practices supported by ICT, such as city development through living labs (Mulder, 2015), participation in online surveys (Afzalan, 2015), and collaborative city planning applications (Zhang et al., 2019), have a better potential since the quality of participation could be monitored. The plethora of technological interventions has left

little space for reflective critique. Government organizations in developed countries are racing toward smartening their cities and citizens. Hence, participation practices are embracing smart tools and applications that have been applied often without careful consideration to their impacts (Yigitcanlar, Kamruzzaman, & Foth, 2019; Levenda et al., 2020). Ahvenniemi et al. (2017) suggested that the performance of digital participatory planning initiatives must be measured in terms of their environmental, economic, and social benefits according to the three pillars of sustainability. Additionally, such initiatives could be studied from a strategic perspective as they can spark the emergence of new value chains among stakeholders that are involved in designing and executing smart city projects (Appio, Lima, & Paroutis, 2019). Current literature associates smart city models with the usage of ICT (Yigitcanlar et al., 2018). While this observation might be true, the view of ICT usage as the core of a smart city has led to an ambiguous relationship between city governance and global problems, such as climate change, poverty, and citizen rights (Soegiono & Asmorowati, 2018). Ignoring the environmental and social aspects in favor of technology could negatively affect efforts toward a sustainable and smart transition, with reduced inequality (Anastasiu, 2019). Ahvenniemi et al. (2017) argued that smart cities tend to fail to keep their sustainability promises. This twist in the current practice has shifted the emphasis on the original concept of "smart sustainable cities" to "sustainable" becoming intertwined with "smart" to achieve the desired outcomes. A smart sustainable city is defined as "*a city that meets the needs of its present inhabitants, without compromising the ability of other people or future generations to meet their needs, and thus, does not exceed local or planetary environmental limitations, and where this is supported by ICT" (*Höjer & Wangel, 2015, p. 338). Hence, smart sustainable city models can be seen as a new strategy to revitalize democratic local governance (Soegiono & Asmorowati, 2018) by focusing on actual practices of citizen involvement. Ultimately, smart sustainable cities strive

to increase the competitiveness of local communities through innovation, while increasing the quality of life for its citizens (Appio, Lima, & Paroutis, 2019).

1.3 Citizen participation and social sustainability

Participatory decision-making processes related to economic, political, management, and cultural activities have been associated with positive outcomes on social sustainability of the society. These outcomes include empowerment (Colantonio, 2009), building a wider consensus, and increased public trust (Falco, 2019). In the context of participatory planning, citizens who are effectively engaged could experience increased sense of place, responsibility and attachment, community stability, and equity (Colantonio 2009).

Utilizing ICT is seen as a promising aspect, in terms of enhancing citizen involvements, which could improve social sustainability. Within the context of smart cities, Angelidou (2014) opined that soft strategies (i.e., developing human and social capitals through education, culture, social inclusion, and social innovation) are as equally important as hard strategies (i.e., smart buildings, smart energy grids, smart water management, and smart mobility). Boosting social sustainability through a wider and more enhanced citizen participation would have a great potential, given that the main goal of smart sustainable cities is to achieve better livable cities. Appio, Lima, and Paroutis (2019) claimed that work to improve the quality of life of a community through better participation practices in the social bonding domain must be managed using state-of-the-art technology. However, Levenda et al. (2020) clarified that such claims should be carefully examined against their practicality and efficacy despite their global attention and recognized potential. They argued that recent research have shown that technology does not necessarily enhance participatory planning.

1.4 Outline of research gap

Currently, there is a paucity of research on appropriate framework models to assess the impact of smartness on cities (Agbali, 2019). This is because smart city initiatives are contemporary emergent projects and therefore, decision makers have insufficient data to process. However, assessing the implications of smart cities' soft strategies (Angelidou, 2014) is particularly vital because the social dimension in smart cities has been underestimated in favor of understanding aspects of technology and assessing hard strategies (Anastasiu, 2019). For example, Bibri and Krogstie (2017) discussed ICT contribution to city development by focusing on urban challenges, yet they barely considered the social dimension. Studies by Alatalo et al. (2017), and Kimathi, Zhang, and Hu (2019) were more concerned with the features and functionalities of technologies utilized for citizen participation rather than their social implications. Consequently, overlooking the social dimension in smart city planning and execution has proven to be a failing factor in some major smart city initiatives. Songdo, a smart city in Northern Asia is described as a "Ghost City", which is mainly criticized for being a form of a top-down state-led process, with no or minimal citizen participation (Kim, 2014). Granier and Kudo (2016) argued that despite the potentials offered by ICT in facilitating citizen participation, only a few research have focused on assessing actual practices of citizen involvement in smart cities. This issue reflects on the importance of developing a framework to assess the maturity of city administrations and their citizens to adopt digital participation practices, as well as reflect on their social consequences. This aspect might be crucial for small cities and their disadvantaged areas that are struggling to compete with bigger cities that hold superior economic and social wealth, thus reinforcing the inequality gap. It is believed that the significance of this study does not solely rely on touching a vital, yet uncommon aspect of smart cities research, but also on being supported by an official city authority. This support has given the researcher better accessibility to the data and a clearer understanding of how

citizen participation works, while the city authority can used the findings to improve outputs and outcomes. This aspect differentiates this study from other studies. For example, Aurigi and Odendaal (2020) discussed similar implementations of smart technologies in cities in Brazil, but from the aspect of industry/authority collaboration. Thus, their study was implying the stereotype argument of meeting corporate branding needs being the dominant concern among smart cities. This study, on the contrary, emphasizes on the benefits of academy/authority collaboration. The focus of this study on less-advantaged areas might also be a differentiating factor. Meanwhile, Afzalan (2015) similarly researched digital participation tools, but without a specific context by focusing only on its usability, with respect to the authority or public administration.

1.5 Research context

Although the researcher is originally an architect, an interest in smart city planning and development was developed during her Master's study at the University of Girona. This interest is further developed after conducting an internship with Schiedam Municipality, the Netherlands, within the framework of her study. The researcher was tasked with exploring the challenges related to engaging citizens in public space designs, and how smart city models could enhance the process and the delivery of the outcome. Upon excellent evaluation of the internship outcome, Schiedam Municipality agreed to fund the doctoral research. **The Netherlands** has successfully presented a fruitful case study when it comes to investigating digital citizen participation for several reasons. First, the Netherlands is one of the leading countries when it comes to citizen participation. Second, this country hosts a highly "open-minded" and advanced community, with high rates of digital literacy (Michels & De Graaf, 2017). Meanwhile, Schiedam, as a city with a population of 80,000 inhabitants, is considered a small city (Dijkstra & Poelman, 2012). Small cities are cities with a population of between

50,000 and 100,000, which represent more than 50% of the total number of cities in Europe (Dijkstra & Poelman, 2012). **Small European cities** are claimed to play an important role in the economic and political development of the European union and hence, should be given more attention in research (Hughes et al., 2018; Varela-Álvares et al., 2019). This is crucial in social sustainability research since some small cities and their disadvantaged areas are struggling to compete with cities that are able to attract wealthy people. Their struggle reinforces the inequality gap, which is recently considered as one of the four most dangerous global risk factors (World Economic Forum, 2018).

This research has also reflected on the challenges of engaging people in **less-advantaged areas**. Previous studies, such as Mallan et al. (2010), Afzalan and Muller (2014), and Lopez (2016) have discussed the influence of socio-demographic characteristics of the community on the effectiveness of utilizing ICT in participatory planning. Additionally, Foth, Brynskov, and Ojala (2015) have criticized smart city initiatives that are focusing mainly on spreading ICT by arguing that marginalized groups are often excluded from the flow of information, hence, from decision-making.

Given the researcher's interest in architecture and design, **Digital Participatory Planning (DPP)** —which is defined as the utilization of technology (e.g., digital mapping tools, Geographic Information Systems (GIS), 3D-modelling, Global Positioning System (GPS), and interactive screens) to facilitate the participation of the citizens in designing and planning their cities, including co-designing public spaces, streets, and neighborhood redevelopment (Wallin et al., 2010)— was selected from the **Digital Citizen Participation (DCP)**. DCP is a wider concept and non-urban planning specific compared to DPP. It has been defined as "*technology-mediated interaction between the civil society sphere and the formal politics sphere*" (Sanford & Rose, 2007, p. 408), and could include electronic voting, e-government dash-boards, online

panels, citizen's data analysis, and collaborative city planning applications. This study started with the wider concept of DCP, as presented in Chapter Three, and was then narrowed down to the concept of DPP, as presented in Chapters Four and Five.

With the DPP paradigm, 3D-modelling interactive technology that has the potential of enhancing the experience of digital participatory planning (Afrooz et al., 2018; Tang, 2019) was chosen for this research, specifically, the **Three-Dimensional Digital Participatory Planning (3DDPP).** 3DDPP is defined in this thesis as a collaborative virtual environment, where users (citizens and planners) are immersed in a three-dimensional co-creative social space for designing and planning their own cities.

1.6 Research outline

The present research contributes to the body of knowledge in the previously mentioned context by addressing three main interconnected research questions:

1- **Can DCP play a role in advancing social sustainability in smart cities?**
2- **How can small cities prepare to introduce DPP under the umbrella of smart cities and how to assess a city's readiness for DPP?**
3- **What are the implications of utilizing 3DDPP on the participatory planning process in less-advantaged areas?**

This study has resulted in three articles that are presented sequentially in Chapter Three (Results) as Section 3.1, Section 3.2 and Section 3.3. Article 1 (Section 3.1) is a critical literature review that aimed to address the first research question. Article 2 (i.e., Section 3.2) and Article 3 (i.e., Section 3.3) are original research articles that showcased the results of several field works. These fieldworks were conducted between September 2017 and March 2019 in Schiedam City, in collaboration with the city's inhabitants and professionals from the

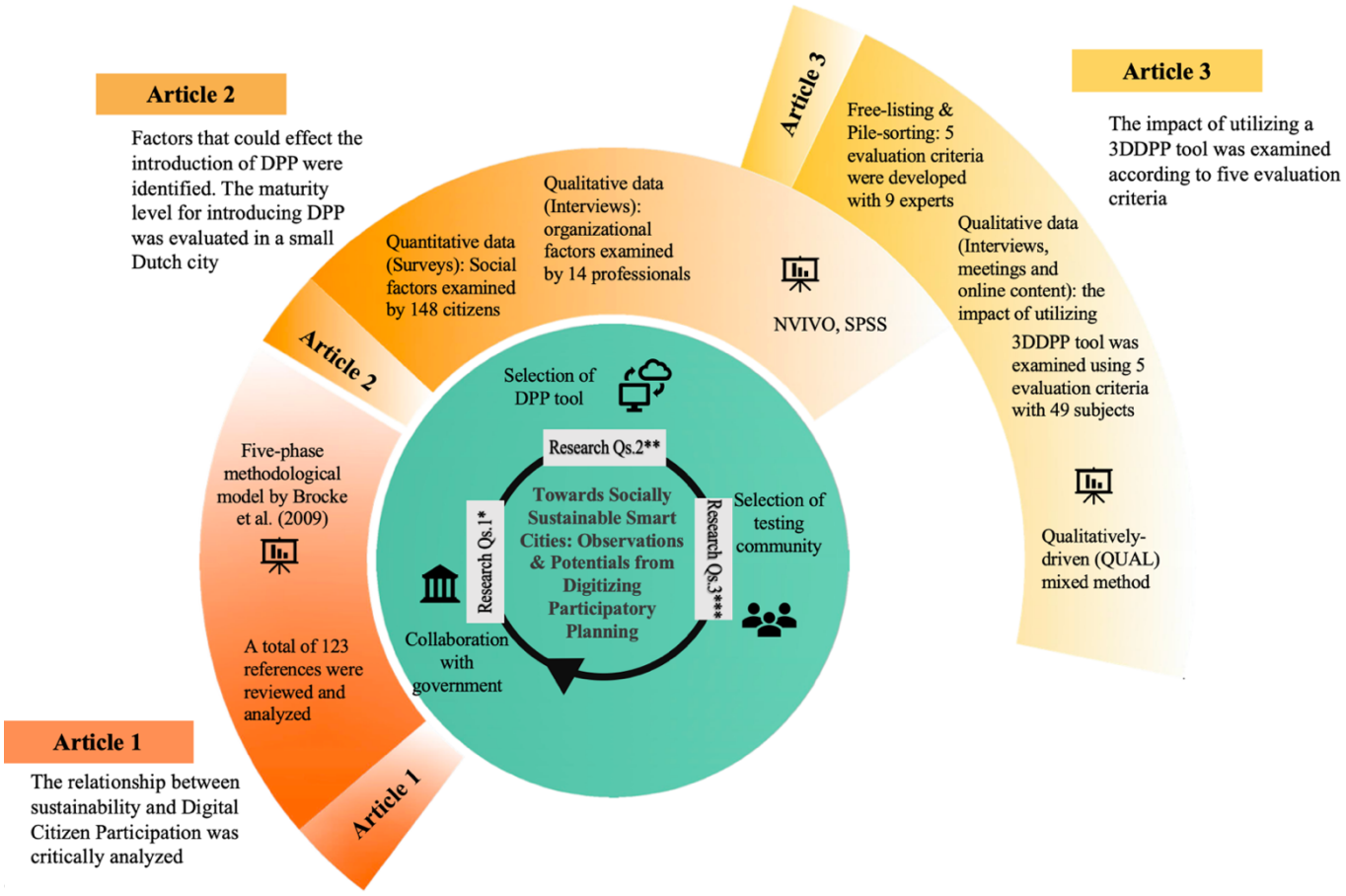
municipality. Article 2 and Article 3 addressed the second and third research questions, respectively. Chapter Three is followed by a general discussion (Chapter Four), and a conclusion and future outlook (Chapter Five).

Chapter Three Section 3.1 (i.e., Article 1) systematically explored the literature to acknowledge the role of digital citizen participation in the aspects of social sustainability of smart cities. This section analyzed how DCP relates to the broad concept of sustainability through a systematic critical analysis of the literature. Hence, it was able to explore the various ways that ICT can contribute to social sustainability through DCP. An important hierarchical connection between the two concepts was found to be exciting. Digital citizen participation was found to play a promising role in advancing the social sustainability of the community in this Digital Era. Hence, more research should be devoted to explore the social implications of digitizing citizen participation practices.

Chapter Three Section 3.2 (i.e., Article 2) explored the time when a city will be deemed mature enough to introduce DPP. This section has identified measures taken by organizations and society's maturity level to digitize participatory planning processes. Maturity factors were particularly examined for small cities using qualitative and quantitative methods. Small cities were chosen due to the current government's favoritism towards bigger cities and capitals, in terms of adopting smart initiatives. A carefully designed questionnaire with a sample of 145 citizens, and semi-structured interviews with 14 professionals from Schiedam municipality were used for data collection. The collected data were analyzed using SPSS and Nvivo software. The results suggested that for cities to be mature enough to introduce DPP, there should be an existing good practice of conventional participatory planning. This concept must be extensively practiced, as well as has a relatively high trust in community engagement

processes, with sufficiently high digital technology literacy among residents. This section has stressed that social choices and behavior can influence how technologies evolve.

Chapter Three Section 3.3 (i.e., Article 3) examined the implications of utilizing DPP on the participatory planning process, as well as the ability to foster community engagement, empowerment, and equality towards a socially sustainable smart city. A monitoring process was implemented on a development project in one of the less-advantaged neighborhoods in the Dutch city of Schiedam. Three-dimensional digital participatory planning tool, namely, *Modelo* (Modelo, 2014) was tested and its impact was qualitatively evaluated using the QUAL mixed-method approach (Morse, 2017). The evaluation was conducted according to five criteria, namely, Efficiency, Feasibility, Attractiveness, Interaction, and Satisfaction. The evaluation criteria were developed by a group of experts from the municipality using free-listing and pile-sorting methods. The results suggested that the socio-demographic characteristics of concerned communities should be considered when utilizing ICT in participatory planning. Nonetheless, to achieve a positive impact on the social sustainability of less-advantaged communities in Europe, it is recommended to reconsider the increased dependence on technology. Figure 1 illustrates the relationships between the research questions and the three articles.



Research Qs.1**: Can DCP play a role in advancing social sustainability in smart cities? ****Research Qs.2**: How can small cities prepare to introduce DPP under the umbrella of smart cities and how to assess a city's readiness for DPP? ** **Research Qs.3**: What are the implications of utilizing 3DDPP on the participatory planning process in less-advantaged area?

Figure 1. The relationships between the three articles included in the thesis

It is believed that the results of this research have provided a solid emphasis on the significant role played by the broad concept of DCP, particularly DPP, to achieve better social sustainability in smart cities. Decision makers in the planning arena are encouraged to consider social sustainability by preparing the epistemological and physical infrastructure required for effective digital participatory planning. Researchers and practitioners, on the other hand, are encouraged to level-up the quality of the developed technological interventions for digital participatory planning. Accordingly, this would likely allow a larger number of citizens to

participate in the planning processes. They can contribute towards overcoming the long-lasting challenges of low levels of participation experienced by city administrations around the world, which is an issue that need to be mitigated within the smart city concept. Awareness must be spread among professionals about the implications of utilizing ICT in participatory planning by showcasing real pilot projects and utilizing the latest software applications.

Chapter 2.

Objectives & Methodology

2.1 Objectives

Within the emerging smart city models and the current narrative linked to technology, researchers and practitioners have found themselves ringing alarm bells over the negative effect of favoring technology over environmental and social values. Although social sustainability plays a crucial role as one of the three pillars of sustainability, it is the least addressed in research (Marsal-Llacuna, 2016). Citizen participation, as one of the main endeavors to attain socially sustainable society, has been increasingly facilitated by technology. However, a limited number of research has focused on assessing actual practices of citizen involvement in smart cities.

Having established the research gaps, research questions, and within the framework of the research context, this research has focused on the following specific objectives:

1- Acknowledge the role of digital citizen participation in the social sustainability of smart cities:

1.1 Debate the kind of relationship fostered in the literature between sustainability and DCP.

1.2 Explore the role of community engagement practices as one of the key components of social sustainability.

1.3 Identify how ICT can contribute to community engagement and the social sustainability of smart cities within the context of DCP.

2- Examine when a small city will be mature enough to introduce DPP:

2.1 Develop a set of factors to measure the maturity level to introduce DPP.

2.2 Measure these factors in a small city.

2.3 Understand citizens' and authorities' level of maturity and attitude toward participatory planning processes prior to introducing technological interventions.

2.4 Conclude with recommendations to be considered before digitizing participatory planning processes.

3- Examine the implications of utilizing 3DDPP on the participatory planning process in less-advantaged areas

3.1 Implement a 3DDPP tool within the framework of a redevelopment project in a less-advantaged area.

3.2 Develop a list of evaluation criteria to assess the impact of utilizing the 3DDPP tool on the participatory planning process.

3.3 Report the impact of introducing 3DDPP on the participatory planning process in less-advantaged areas.

2.2 Research methodology

In response to the identified research objectives, a process by which these objectives could be addressed and efficiently fulfilled was needed. This is usually guided by different research philosophies and approaches, which in turn are informed by epistemological understandings.

Crotty (1998) explained that most research start with a real-life problem that proposes a set of questions, objectives, and/or hypotheses, upon which the research is planned. Then, researchers will relate this problem to a theoretical perspective and epistemological understanding in order to ground their claims and defend their processes as a form of human inquiry. In fact, this is

the way in which the current research was constructed. This research project was developed in three interrelated stages.

First, upon completing the internship with Schiedam Municipality, the researcher was confronted by a real life problem, which is the challenging aspect of engaging the citizens in participatory decision-making and how it could be potentially overcome. This inquiry was then related to a theoretical perspective, which is an abstract way to look at the world and understand its relationship with humans. This step involves dealing with knowledge, in which different epistemological approaches, or in other words 'how we know what we know', explain why theoretical perspectives are informed by epistemological understanding. Engaging the citizens effectively would have positive effects on the society, and digitization is happening and it is seen as the potential cure for every illness. However, an approach that holds the meanings that exist independently of human consciousness, and the ability to discover and relate them, is needed (Crotty, 1998). Thus, the first stage of this research was a systematic literature review that was conducted to determine and relate how DCP can potentially play a role in advancing social sustainability. The conclusions of this stage and the context of which this real-life problem was first consulted have opened the door to additional inquiries.

The second inquiry, which was how a small city can prepare to adopt DPP, resulted from the literature review and the research context. The city of Schiedam was facing a challenge in engaging its citizens in decision-making processes, particularly in participatory planning. Thus, the reasons behind this challenge must be investigated: Why does this challenge exist? How have the municipality regulations, professionals or the community somehow contributed to this challenge? How would this challenge affect their maturity to adopt DPP? These questions were the main fields of investigation. A particular innovative dimension to this stage was the use of a rigorous combination of qualitative and quantitative methods. This mixed approach was

utilized for data collection and the subsequent detailed analyses since several factors could be contributing to the cause of this challenge. Data from interviews and questionnaires were statistically and subjectively analyzed. The conclusions have led to the formulation of a framework that could guide small cities through the adoption of DPP. This framework was meant to help cities identify their strengths and weaknesses, which could foster or hinder the digitization of participatory planning processes. This framework was used and tested in the case study.

In turn, this phase in the study has highlighted the need to provide a deeper insight into the actual impact of adopting DPP. Results obtained from the second stage and other relevant research gaps led to the third stage. First, socio-demographic factors have been proven to play a role in the maturity of cities to introduce DPP, as influenced by the exploration of communities with specific characteristics that are often excluded from innovation research, implementation, and testing (Hughes et al., 2018; Varela-Álvares, Mahou-Lago, & López Viso, 2019). Second, the plethora of innovative collaborative design applications and the potentials these tools could have on enhancing the participatory planning experience (Afrooz et al., 2018; Tang, 2019) could influence the implementation of the 3DDPP tool. The third stage of this research was the longest because the implementation and testing phase was conducted at an actual development project that was planned by the municipality. They agreed to test the 3DDPP tool with the residents according to the usual planning of such development projects. Thus, this research had to follow the actual schedule of this project. Accordingly, three field works that the researcher conducted in the Netherlands took place over a course of two years. These field works ranged between one week and three weeks. During each field work, a conventional and online participatory planning workshop took place with the residents. A combination of qualitative methods were utilised for data collection. This was necessary given the diversity of the approaches, the number of participants (limited to the actual residents

of the project area), and the reported difficulties in less-advantaged areas. Data were gathered through free-listing and pile-sorting, interviews, observations, notes, and meetings. Sources of data included the municipality professionals, who were part of the development project, the residents, who participated in the project, the online participation content, and the researcher's own observations and minutes of meetings. The results of this stage have led to the formulation of the third article in this research. This article was concluded with unexpected results upon evaluating the impact of utilizing 3DDPP on planning practices, in relation to the context of the third stage, particularly among the less-advantaged communities. Figure 2 shows some of the participation events that were conducted with the municipality professionals and the residents. Meanwhile, the following Figure 3 shows the outline of the research methodology.

Figure 2. Participation events with the municipality professionals and the residents of Schiedam

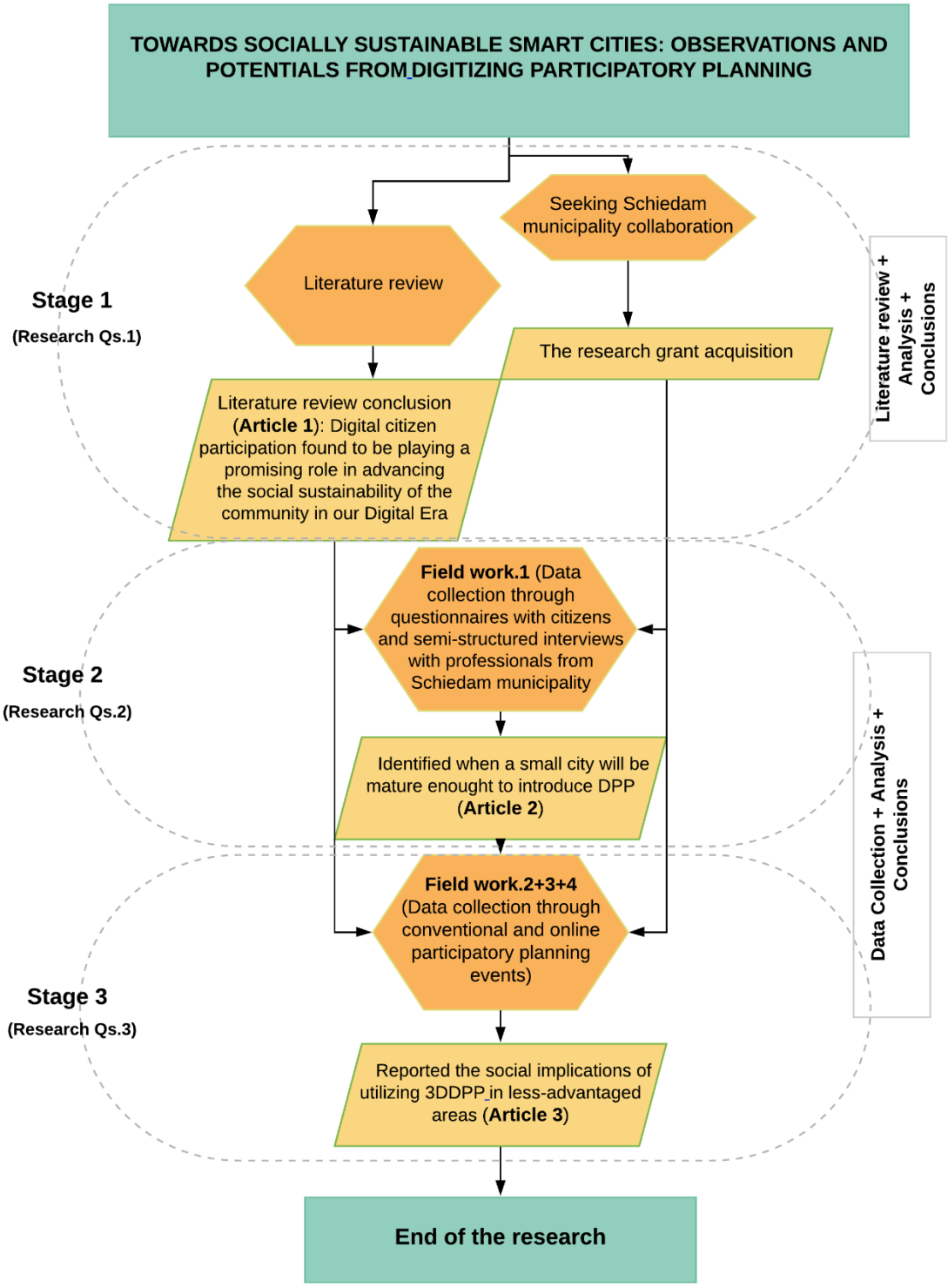


Figure 3. The outline of the research methodology

2.3 Research methods

A mixed methodological approach was used for data collection and analysis. Some of the research methods used in this study were purely qualitative, while some were of a quantitative and qualitative nature, but these methods were all interlinked, as shown in Table 1.

Table 1. Data collection and analysis methods used to address each research question

Method / Research Qs	Data Collection Methods					Data Analysis Methods		
	Systematic Literature Review: Phase 1, 2, and 3 (QL)*	Questionnaire (QN) (O)	Semi-structured Interview (QL) (F)	Free-listing & Pile-sorting (QL) (F)	(QUAL) Mixed-method (QL) (F)	Systematic Literature Review: Phases 4, and 5 (QL)	Statistical Techniques (QN)	Statistical Techniques (QL)
Can DCP play a role in advancing social sustainability in smart cities?	**x**					**x**		
How can small cities prepare to introduce DPP under the umbrella of smart cities and how to assess a city's readiness for DPP?		**x**	**x**				**x**	**x**
What is the implication of utilizing 3DDPP on the participatory planning process in less-advantaged area?			**x**	**x**	**x**			**x**

*(QL): Qualitative method; (QN): Quantitative method; (O): Online method; (F): Face-to-face method

A detailed explanation of each method and its limitations is provided in the respective relevant chapter. The following is a summary of the research methods adopted in this thesis:

- Systematic literature review

Literature review, as a systematic method to identify exploratory fields and new questions, was conducted to analyze the holistic concept of sustainability and how it relates to DCP. The

methodological model proposed by Brocke et al. (2009), in their study on the importance of rigor in documenting the literature search process, was particularly implemented. They proposed a five-phase methodological model for this process: (1) definition of the review scope; (2) conceptualization of topic; (3) literature search; (4) literature analysis and synthesis; and (5) research agenda.

- Questionnaire

To address the second research question, two sets of factors were suggested, namely, government organizational factors and societal factors. Factors related to the society were examined via a citizen questionnaire, which covered four factors, as well as questions related to the frequency of participation in citizen engagement events, education, and demographics. This questionnaire was available online because the sample set was as wide ranging as possible and varied, in terms of gender, age, education level, and area. An effort was made to balance the sample across the different demographics. A full description of questionnaire design and analysis is provided in Chapter Three Section 3.2.

- Semi-structured interview

Qualitative semi-structured interviews were conducted to assess the municipality's maturity to introduce DPP. The interview guide was designed based on the government organizational factors that were previously identified from the literature, and all questions were sourced from relevant sources. Interviews were conducted with representatives from the local government in Schiedam city. Interviewees were carefully selected to include the different expertise and specializations involved in the participatory planning processes within the municipality, as well as from different genders and educational backgrounds. More details on the selection of

interviewees and interview process, as well as the qualitative analysis, are provided in Chapter Three Section 3.2.

- Statistical techniques

Qualitative and quantitative statistical techniques were used to analyze the maturity level of the government organization and the society to adopt DPP. Qualitative techniques included a thematic content analysis using the NVivo software. Quantitative techniques included tests of differences (Monte Carlo exact significance method, Jonckheere's test), descriptive statistics (mode, median, inter-quartile, nominal levels of disagree vs. agree), and analysis of variance (Mann–Whitney U test, the Kruskal–Wallis test). The IBM SPSS software was used to perform the statistical tests. More details on the procedures and findings of the statistical analyses are provided in Chapter Three Section 3.2.

- Free-listing & pile-sorting

Free-listing is typically used to understand how groups collectively understand a certain domain (Bernard, 2006; Schrauf & Sanchez, 2010). Pile-sorting is a participatory approach that engages stakeholders into grouping and sorting piles to identify thematically consistent groups (Blake et al., 2007) by forming clusters of associated terms that make sense (Ensign & Gittelsohn, 1998) to them, and suggesting a title for each group. In this study, nine experts from the Schiedam municipality, who were previously involved in participatory planning projects, were included in the free-listing and pile-sorting workshops (Figure 4). The design, analyses, and results of the free-listing and pile-sorting activities are reported in Chapter Three Section 3.3.

Figure 4. Municipality professionals during the free-listing and pile-sorting workshop

- QUAL mixed-method

A qualitatively-driven (QUAL) mixed-method was utilized, as recommended by Morse (2017), for conducting evaluation research. This mixed method approach included a qualitative core component (QUAL) and three qualitatively supplemental components (*qual*) that were conducted simultaneously (Morse, 1991). The core component (QUAL) is represented by semi-structured interviews. The three supplemental components (*qual1*, *qual2 and, qual3*) are represented by meetings and participatory research. More details on the procedures, results, and findings are provided in Chapter Three Section 3.3.

Chapter 3.

Results

3.1 Towards Smart Sustainable Cities: A Review of the Role Digital Citizen Participation Could Play in Advancing Social Sustainability

This section is a transcription of the published paper:

Bouzguenda, Islam, Chaham Alalouch, and Nadia Fava. 2019. "Towards Smart Sustainable Cities: A Review of the Role Digital Citizen Participation Could Play in Advancing Social Sustainability". *Sustainable Cities and Society*, 50, 101627. DOI: 10.1016/J.SCS.2019.101627

This section aims to acknowledge the role of DCP in the social sustainability of smart cities by analyzing how DCP is related to the broad concept of sustainability through a systematic analysis of the literature. A hierarchical connection between the two concepts was found to be existing. This section discusses and concludes by identifying how ICT can contribute to the social sustainability of smart cities within the context of DCP.

Sustainable Cities and Society 50 (2019) 101627

Contents lists available at ScienceDirect

Sustainable Cities and Society

journal homepage: www.elsevier.com/locate/scs

Towards smart sustainable cities: A review of the role digital citizen participation could play in advancing social sustainability

Islam Bouzguenda[a,*,1], Chaham Alalouch[b], Nadia Fava[a]

[a] Geography Department, Universitat de Girona, Spain
[b] Department of Civil and Architectural Engineering, Sultan Qaboos University, Oman

ARTICLE INFO

Keywords:
Sustainability
Social sustainability
Community engagement
Digital citizen participation
Smart cities
ICT
Literature review

ABSTRACT

The notion of smart cities needs to be broadened beyond the fascination with technology to incorporate an approach that invests in the growth of human, social, and environmental capitals to generate 'smart sustainable cities'. One of the most recent debates in this context is digital citizen participation. This study aimed to identify the potential role of Information and Communications Technology (ICT) in citizen participation as a major contributor towards 'smart sustainable cities'. A systematic and exhaustive literature review, coupled with critical content analysis, was conducted. The focus was on a central research question: What kind of relationship is fostered in the literature between sustainability and digital citizen participation, and how can ICT contribute to social sustainability through digital citizen participation (DCP)? The results suggested a connection between smart sustainable cities and DCP. This article is concluded by emphasizing the role of ICT in citizen participation processes and its significant contribution to social sustainability and the creation of more-than-human smart cities.

1. Introduction

In the past 20 years, city management has been one of the primary challenges when integrating sustainability efforts (Alberti et al., 2007; Beatley & Kristy, 1997; Bibri & Krogstie, 2017; Jabareen, 2006; Sev, 2009). Cities around the world present different conditions and challenges for sustainable development. The current urban sustainability challenges cover a broad spectrum of environmental issues. These issues range from local traffic problems, air pollution, continuous growth in solid waste generation, high (and often inefficient) consumption of energy, and materials linked to climate change. Social issues, such as segregation and growing social tensions are also part of these challenges (Oksman, Väätänen, & Ylikauppila, 2014), including inappropriate urban design, and its related social deprivation and community disruption (Bibri & Krogstie, 2017), urban conflict and violence, social polarization, and rising urban poverty levels (Jabareen, 2015). These challenges can be mitigated by establishing socially inclusive, environmentally friendly, and economically sustainable cities (Yigitcanlar et al., 2019). These environmental and social challenges have forced the professional and academic circles to consider what innovative solutions, sophisticated methods, and advanced technology could potentially be offered for planning sustainable cities. Consequently, the concept of Smart City has evolved.

1.1. Smart city

In recent years, "the smart city model has been promoted as an ample instrument to manage aforementioned urban and environmental challenges" (Yigitcanlar et al., 2019, p. 349). Being "smart" is on the urban agenda of many cities (Yigitcanlar & Kamruzzaman, 2018). Although the notion of smart cities began almost a decade ago, with a rising popularity, the contemporary conceptualizations and practice of it are still in their infancy (Yigitcanlar, 2017; Praharaj, Han, & Hawken, 2018). There is currently no commonly agreed definition of smart cities (Yigitcanlar et al., 2018). Streams practicing or researching smart cities have a different take on the concept according to their domain orientation, for example, technology, economy, society, environment, and governance (Yigitcanlar, 2017). Thus, a variety of definitions are being used. However, the simple definition is the "*convergence of technology and the city*" (Yigitcanlar et al., 2018, p. 145). Although the original rational of the smart city concept was mostly related to the environmental urban challenges, current practices are mostly unidimensional, with technology at the core (Yigitcanlar, 2016). Smart cities today are seen as the hubs of technological innovation as opposed to cities of sustainable development (Yigitcanlar et al., 2018), leading to criticisms by practitioners and theorists. "Cities should be smart in every aspect, not just applying some hip or cool technologies to address specific

* Corresponding Author at: Geography Dept., Universitat de Girona, Girona, Spain.
E-mail address: ibouzguendaepalaswad@gmail.com (I. Bouzguenda).
[1] P.C. AlMawaleh North. Al Mouj street, building number: 9467 (1), Muscat, Oman.

https://doi.org/10.1016/j.scs.2019.101627
Received 5 November 2018; Received in revised form 16 May 2019; Accepted 23 May 2019
Available online 31 May 2019

urban challenges" (Yigitcanlar et al., 2019, p. 352). Costa and Oliveira (2017), and Almeida, Doneda, and Moreira (2018) have also highlighted the importance of moving beyond the obsession with technology to be able to achieve sustainability results. Noy and Givoni (2018) argued that nowadays, smart cities are focused more on technological profitability and economy than on reaching actual sustainability goals. Yigitcanlar (2018) stated boldly that "*smart city policy, planning, and developmental practice, at its best, are a zero-sum game for sustainability*" (p. 107). This is because smart cities tend to fail to keep their sustainability promises (Ahvenniemi, Huovila, Pinto-Seppä, & Airaksinen, 2017). This twist in the current practice from the original concept, along with rising impacts of global climate change, has shifted the emphasis on the concept of "smart sustainable cities".

1.2. Smart sustainable city

In smart sustainable cities, "sustainable" should be twined with "smart" to achieve the desired outcomes. Accordingly, the concept of smart and sustainable cities has become a global hot topic (Chang et al., 2018). Yigitcanlar (2016) underlined the growing interest among Western countries in establishing environmentally sustainable smart cities. The term "smart sustainable city" is defined as "a city that meets the needs of its present inhabitants, without compromising the ability of other people or future generations to meet their needs, and thus, does not exceed local or planetary environmental limitations, and where this is supported by ICT" (Höjer & Wangel, 2015, p. 338). Bibri and Krogstie (2016) claimed that in planning smart sustainable cities, ICT plays a key role, which includes supporting cities when planning, operating, and managing urban systems, and thus, contributing to sustainability. Yigitcanlar et al. (2019) suggested that cities could not be smart without being sustainable, even when evidences in the practical application of the "smartness" point to the contrary. Nevertheless, sustainability does not solely deal with environmental issues. It also incorporates social and economic dimensions, albeit the social dimension being the least addressed (Marsal-Llacuna, 2016).

1.3. Social sustainability

Social sustainability has been characterized by several dimensions and themes. It does not, however, have a specific definition because of its complexity (Colantonio, 2009). Effective community engagement practices were reported as having a positive effect on social sustainability (Colantonio, 2009; Dempsey, Bramley, Power, & Brown, 2011; Eizenberg & Jabareen, 2017; Missimer, Robèrt, & Broman, 2017; Opp, 2017). Despite recognizing the importance of implementing effective community engagement, the relationship between social sustainability and smart cities (Foth, Brynskov, & Ojala, 2015; Harvey, 2012; Shaw & Graham, 2017) have attracted less attention from scholars compared to the role of ICT in advancing the environmental sustainability of smart cities. Yigitcanlar et al. (2018) found that framework development and technological aspects of a smart city have a larger coverage in the literature compared to its community and policy aspects. Granier and Kudo (2016) similarly argued that despite the potential ICT has in facilitating public participation, little research has focused on actual practices of citizen involvement in smart cities. Bibri and Krogstie (2017), b) discussed ICT contribution to sustainable development, focusing on urban sustainability challenges, yet barely considered the social sustainability dimension. Beretta (2018) also argued that 'smart' projects developed in European cities were mostly focused on the efficient management of the environment. However, the social impact of these smart projects is not adequately investigated. In Northern Asia, smart cities, such as the Songdo, are criticized for being a form of a top-down state-led process, with no or minimal public participation. Kim (2014) stated that these state-led mega projects "are devoid of the planners' consciousness of the 'social'" (p. 352). The comprehension of smart cities in current practices could lead to a long-term dependency on technology and neglect of socio-spatial issues (Yigitcanlar, 2016). Thus, "the development of smart and sustainable city can only be accomplished through inclusive and sustainable growth using a healthy mixture of smart people, policies, and technologies" (Yigitcanlar et al., 2019, p. 360).

1.4. Study objectives

This article will discuss the role of community engagement practices as one of the key components of social sustainability. The digital citizen participation in the social sustainability of smart cities is also acknowledged. The literature review and critical content analysis showed the kind of relationship between sustainability and DCP are being fostered in the literature. How ICT can contribute to the social sustainability of smart cities within the context of DCP was also reviewed. This review was structured around four key terms, namely, sustainability, social sustainability, community engagement, and digital citizen participation. These terms were arranged in a hierarchal order, moving from the broadest to the most precise. This order bridged the gap between two sequential terms by summarizing the links that were identified in the literature to fulfill the aims of this review. These terms create three review "Nodes", as shown in Fig. 1. Node 1 identifies the links between sustainability and social sustainability by revising related policies and regulations, identifying relevant literature, and considering the inclusion of the social pillar of sustainability. Node 2 identifies the links between social sustainability and community engagement by identifying and assessing social sustainability themes and dimensions, and highlighting the inclusion of community engagement related themes. Finally, Node 3 identifies the links between community engagement and digital citizen participation by analyzing the literature related to participatory governance theories and smart governance in smart cities.

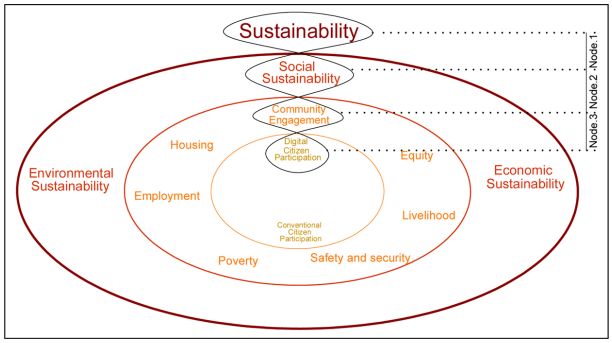


Fig. 1. The hierarchical order of the four terms, with their respective nodes that bridge sustainability and DCP.

Although the relationships between these four concepts are not necessarily linear, they are presented in a hierarchical manner to better understand their nature and to address the objectives of this study.

2. Method

The objective of this study was to critically analyze the relationship between sustainability and Digital Citizen Participation (DCP). Sustainability is a holistic concept that was analyzed using a focused and systematic literature review to identify exploratory fields and new questions. Hence, this review was conducted using the methodological model proposed by Brocke et al. (2009) in their study on the importance of rigor in documenting the literature search process. They proposed a five-phase methodological model for this process: (1) definition of the review scope; (2) conceptualization of topic; (3) literature search; (4) literature analysis and synthesis; and (5) research agenda (documented at the end of the article). This framework is described in the following sections.

2.1. Review scope definition

To define the scope of the literature review, an established taxonomy for literature reviews by Cooper (1988) was used. It consists of six characteristics, namely, focus, goals, structure, perspective, audience, and coverage.

a *Focus:* The aim of this study was to identify the relationships fostered in the literature between research theories and outcomes.
b *Goal.* The goal was to identify the central issues concerning DCP and its potential contribution to social sustainability via the application of ICT.
c *Structure*: Based on this goal, a combination of conceptual and historical structure was chosen.
d *Perspective:* An espousal position towards literature was adopted to confirm a belief that requires critical exploration of the literature to be justified.
e *Audience*: This study meant to reach researchers in the fields of urban design, ICT, smart cities, sustainable development, and community engagement, as well as policy-makers and facilitators, who conduct participation activities for urban planning/design projects and initiatives.
f *Coverage*: Multidisciplinary literature were addressed, and the sources were chosen to represent the hierarchal sequence, which was central to the relationship between each consecutive concept.

2.2. Conceptualization of the topic

To capture the main theme of the subject being addressed, Baker (2000) suggested consulting key resources, such as seminal textbooks, encyclopedias, or handbooks. Thus, this current review consulted “From social butterfly to engaged citizen” (Foth, 2011) and “Sharing cities” (McLaren & Agyeman, 2015). Consequently, the following key terms emerged: sustainability; social sustainability; community engagement; and digital citizen participation.

2.3. The literature search

The following steps were implemented (refer Fig. 2) using Brocke et al. (2009) methodological model for the literature search: (a) choose the database source; (b) choose the type of sources (books, dissertations, articles); (c) choose keywords and search criteria; (d) evaluate the sources; and (e) apply backward and forward reference searching.

a An online search was conducted using the Sultan Qaboos University Library’s search engine that connects to several databases, including ScienceDirect, ProQuest, Scopus, and Springer
b The methodological approach by Baker (2000) was followed. Thus, relevant sources that contain a summary or an overview of the key issues were sought, starting with PhD dissertations. Primary inclusion criteria were published dissertations and available online.
c The four key terms were utilized to search for related published dissertations. The Boolean search line for Node 1 was: ((Full Text Combined:(“sustainability”)) AND ((Full Text Combined:(Social Sustainability)). The Boolean search line for Node 2 was: ((Full Text Combined:(“social sustainability”)) AND ((Full Text Combined:(community engagement)). The Boolean search line for Node 3 was: ((Full Text Combined:(“community engagement”)) AND ((Full Text Combined:(digital citizen participation)). Initially, the results of the three Boolean search tasks came to a total of 18,000 dissertations.
d To reduce this to a manageable number and to limit the search to the most relevant and recent references, secondary inclusion and exclusion criteria were applied, such as dissertations available online in full text and published in English. The search was conducted in December 2017. Thus, the time span was also limited to a 5-year range to collect a reasonable representative subset, minus any outdated data. Accordingly, the results returned in total were 108 dissertations.
e Evaluating the resources, as suggested by Brocke et al. (2009) meant “limiting the amount of literature identified by keyword search to only those relevant to the topic at hand” (p. 10). The abstracts of the resulting dissertations were read and those found relevant were ‘eye-balled’ for consistency and accuracy of the keyword search (see Yin, 1994)) to identify the most relevant to the topic. The results then were reduced to 13 dissertations.
f These 13 dissertations were used for the backward references searching (identifying the references cited in the dissertations) and forward reference searching (identifying articles that cite the dissertations after being published), minus date constrains. As suggested by Webster and Watson (2002), to identify articles related to the four key terms. This resulted in 60 articles published in scientific journals and conference proceedings.

The 13 dissertations and 60 articles were carefully read, reviewed, and analyzed. However, other relevant articles were added during this process as a result of several revisions of the paper and as supporting material to better appreciate the background context and discuss the findings. The result was a total of 123 references, which were reviewed, cited, and quoted. This literature search process is illustrated in Fig. 2.

2.4. Literature analysis and synthesis (Content Analysis)

A subjective content analysis was conducted to conceptualize the hierarchical relationships between the key terms that had emerged during the preliminary analysis. The collected sources from the preceding step were meticulously eye-balled, which is sufficient to draw a conclusion or categorization (Yin, 1994). A coding strategy was employed to categorize the sources into the four terms to be analyzed. The relationships between these terms were organized into “Nodes”, as previously explained. The researchers were able to systematically explore the available literature, retrieve the existing body of knowledge, and explore the hierarchical relationships between the four terms of interest. However, a possible bias could occur from focusing on certain hypotheses that the analyst believed in over other facts, which could be subsequently neglected. To minimize this effect, more than one researcher would check the outputs of the other researchers. Then, they discussed the different opinions until they arrived to an agreement.

3. Review results

3.1. Introductory overview

Numerous articles have defined the concept of sustainability, as well as emphasizing on the social pillar of sustainable development. The literature on social sustainability introduces several themes and assessment methods that could be considered for the operationalization of

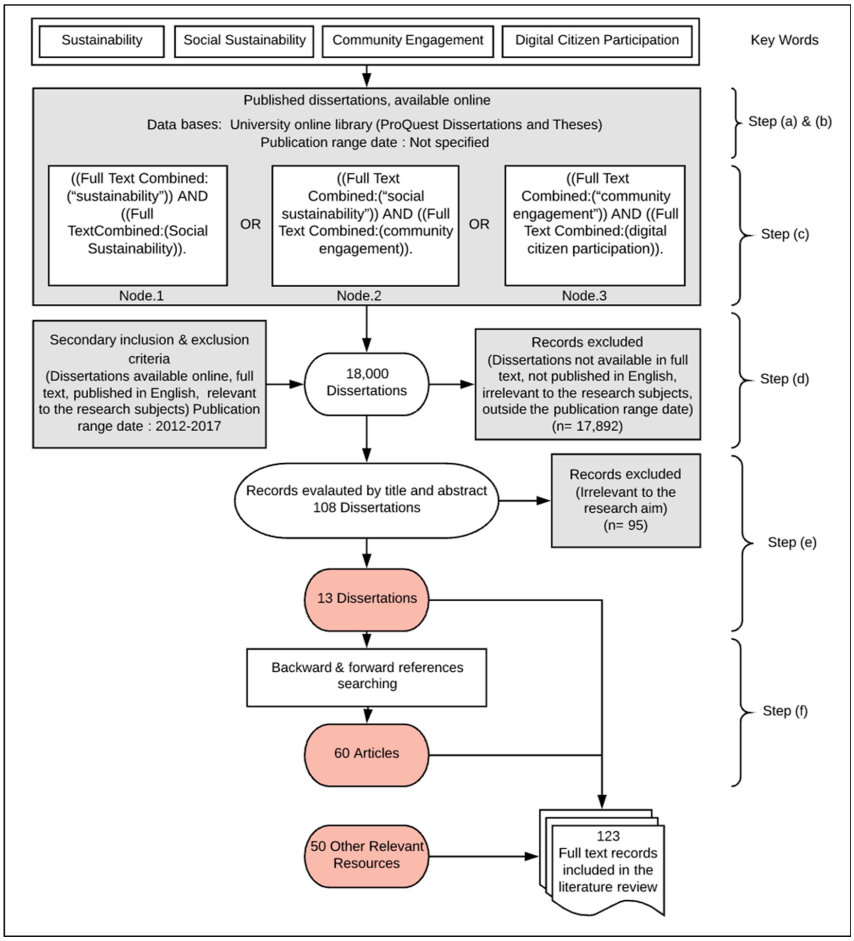


Fig. 2. Strategic steps of the literature search process.

the concept. Thus, this study had focused on the themes related to community engagement, empowerment, participation, democratic society, and on citizen participation in urban planning. This review questioned whether the traditional participation methods are effective in the digital age, within the discourse on smart cities and ICT. This is because the literature concerning sustainable development emphasizes the need to extend its boundaries, and incorporate what ICT can offer through innovative solutions and methods (Bibri & Krogstieb, 2017). The obsession with technologies in some of the current smart city initiatives should be shifted and utilized to generate smart sustainable cities. Findings from the content analysis, as summarized in Fig. 1, were used to establish the links between the aforementioned terms, thus, leading to a better understanding of how DCP could contribute to the sustainability agenda, under the umbrella of the smart cities concept.

3.2. Node 1 (sustainability & social sustainability)

The social dimension of sustainability is framed by specific challenges, such as the mounting levels of evolving risks and vulnerability resulting from social polarization (Secchi, 2013), rising urban poverty levels, urban conflict and violence, terrorism, and natural disasters (Giddens, 1998; Jabareen, 2015). Sustainability prominently entered the global political arena in 1972 via the UN Conference on the Human Environment in Stockholm, Sweden. This was the first international conference devoted exclusively to environmental issues. However, the concept of sustainable development was not officially introduced until 1987 in the Brundtland report (Keeble, 1987). To provide an overview of the emerging definitions of sustainability throughout its rise toward actual governmental implementations, along with why and when the social pillar was emphasized, the United Nations (UN) regulations on sustainability were reviewed. The historical milestones and events related to the conceptualization of both sustainability and social sustainability, and their key outputs and interpretation in the literature, are summarized in Table 1.

This literature review has interpreted that the 1972 conference was more concerned with identifying trade-offs between the environment and development, instead of promoting harmonious links between the two. Critiques suggested that these trade-offs are common in politics.

Table 1
Summary of the main milestones related to the conceptualization of sustainability and the literature interpretations (arranged in chronological order).

Year	Event	Location	Sustainability status/ Definition	Literature interpretation	Authors
1972	UN Conference on the Human Environment	Stockholm, Sweden	First conference devoted to environmental issues	• Environment and economic priorities are intrinsically two sides of the same coin • There was a need to create a harmonious link between environment and development instead of identifying trade-offs between them. • Trade-offs in favor of economic growth over social well-being and ecological viability have hampered the achievement of sustainability goals.	(Vogler, 2007); (Prizzia, 2007); (Gupta & Vegelin, 2016)
1987	Publication of the Brundtland Report by the World Commission on Environment and Development, entitled "Our Common Future"	Oslo	First definition "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission of Environment & Development, 1987)	• The concept of sustainable development was born, imposing the limited ability of the environment to meet present and future needs. • The Brundtland report raises public concern over the alarming phenomenon of global environmental change. • Realizing that the predominant paradigm of urban development was oblivious to the risks of environmental crises. • The Brundtland Report was optimistic and vague.	(Paul, 2008); (Vogler, 2007); (Bibri & Krogstieb, 2017); (Bartlett, 1994)
1992	UN Conference on the Environment and Development (Earth Summit)	Rio de Janeiro, Brazil	A"' Agenda 21: The resulting core document containing advices toward sustainable development including: Social and Economic Dimensions (United Nations, 1992)	• The concept of sustainable development arrives on the international scene. • The resulting Agenda 21 was the first to incorporate the social and economic dimensions to sustainable development. • Implementing social principles can only be accomplished if social, political, and economic systems have the flexibility to be redirected toward sustainability, integrated with each other and the environment	(Paul, 2008); Paul, 2008); (Prizzia, 2007, p.21)
2002	World Summit on Sustainable Development	Johannesburg, South Africa	Johannesburg Plan was generated to focus the world attention and direct action toward meeting difficult environmental, social, and economic challenges (United Nations, 2002).	• A progress was presented in moving the concept of sustainable development toward a more productive exploration of the relationship between economic development and environmental quality. • An increasing importance was devoted to the socioeconomic pillars of sustainable development.	(Asefa, 2005); (Paul, 2008)
2012	UN Conference on Sustainable Development (Rio + 20)	Rio de Janeiro, Brazil	A focused political outcome document (The Future We Want) contains clear and practical measures for implementing sustainable development (United Nations, 2012)	• Rio + 20: a conference with little substantive purpose • An agreed process to negotiate and develop consensus on the sustainable development goals. • Clear and practical measures for implementing sustainable development were produced. • Post-2015 development agenda was discussed	(Andresen & Underdal, 2012); (Stevens & Norichika, 2016); (United Nations, 2012)
2015	United Nations General Assembly	New York, USA	Formal adoption of the '2030 Agenda' for Sustainable Development, along with a set of 17 Sustainable Development Goals and 169 associated targets.	• Strong implications for the prioritization of actions and their effectiveness. • Transforms the dominant approaches to economic, social, and environmental challenges • An integrative agenda that includes environmental sustainability and social concerns. • Environmental and social sustainability are the defining characteristics of economic activity. • Recognizing the link between sustainable development and other relevant ongoing processes in the economic, social, and environmental fields.	(Weitz, Carlsen, Nilsson, & Skånberg, 2017); (Stevens & Norichika, 2016); (Weitz, Persson, Nilsson, & Tenggren, 2015); (United Nations, 2015)

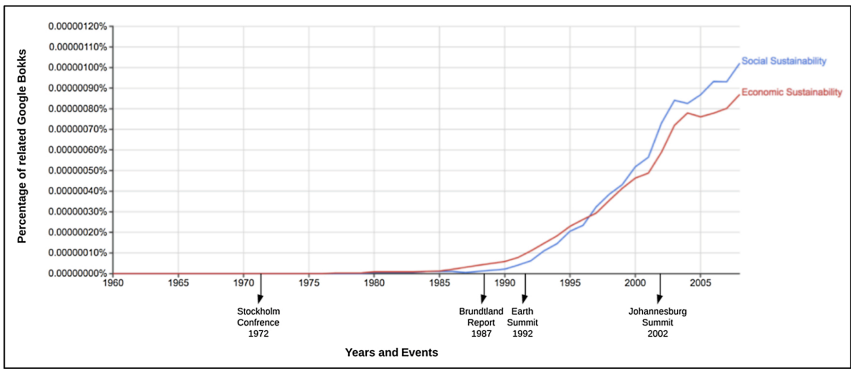


Fig. 3. Increase in publications related to social & economic sustainability, along with the main UN milestones related to the evolution of the concept of sustainability.

Lorek and Spangenberg (2014) argued that politicians tend to make trade-offs in favor of the economy at the expense of social and ecological issues. Similarly, Gupta and Vegelin (2016) suggested that "*literature on, and politics of, sustainable development shows that achieving strong sustainability, which implies no trade-offs between the economic, social, and ecological goals, is rare*" (p. 434). Because of such trade-offs, unequal allocation of resources through poorly regulated markets might concentrate these resources in the hands of a wealthy few. Fifteen years later, the 'Brundtland Report' (Keeble, 1987) disseminated a clear understanding of sustainable development and raised public awareness over the new and alarming phenomenon of global environmental changes. Consequently, Agenda 21 was developed in 1992, aimed at compensating for the unequal allocation of resources and political trade-offs. The agenda was the first to emphasize on the social and economic pillars by suggesting several themes, namely, quality of life, efficient use of natural resources, protection of the global commons, management of human settlements, and sustainable economic growth (Paul, 2008). The agenda also pushes for equity and recognizing that persistent severe poverty in some parts of the world, alongside a lifestyle based on wasteful consumption of resources in other parts, is not a sustainable model (Paul, 2008).

However, implementing these goals requires connections to be created between the social, political, economics, and environmental systems (Prizzia, 2007). Thus, the growing attention was oriented toward exploring the relationship between socioeconomic development and environmental quality, which was confirmed during the 2002 World Summit. Consequently, an upsurge was seen in publications related to social and economic sustainability (see Fig. 3). The figure illustrates, using Google Books Ngram Viewer, the percentages of "Social Sustainability" and "Economic Sustainability" related books that occupied all Google books written in English, and published in the United States between 1960 and 2008 (Michel et al., 2011). A peak in the number of books published between 2002 and 2003 can be seen, which demonstrated the increased attention toward socioeconomic dimensions. This trope continued until the generation of the '2030 Agenda' (United Nations, 2015), which emphasizes the importance of recognizing the links between sustainable development and other relevant ongoing processes in the economic, social, and environmental fields.

The sustainability literature suggested that the social pillar of sustainability became a trend that started in 1992 with the 'Agenda 21'. Social and economic dimensions were included as two of the core four sections, in response to escalating social inequalities and injustices. The main goal was to develop applicable approaches. However, the concept of social sustainability was still in its introductory phase at the time, thus, governments might have lacked the ability to implement appropriate initiatives. Until the issuing of the 2030 Agenda, the Sustainability Development Goals incorporated the social pillar as one of the core fundamentals of sustainable development. Goal 11 recognized that 'sustainable cities and communities' aim for a future in which cities provide opportunities for all, with access to basic services, energy, housing, and transportation. These evolutionary steps emphasize how much this concept has grown, from an issue related to environmental risks to a global phenomenon, concerning several aspects of living and highlighting the social pillar as a main contributing factor.

3.3. Node 2 (social sustainability & community engagement)

Community engagement was explored within the context of social sustainability to identify its significance and weight, along with its conceptual relatives in the operationalization of social sustainability. The conceptual relatives of community engagement can be defined as involving the public in policy-development and decision-making through civic engagement, public participation, and citizen participation. Although there are differences between these terms, for the purpose of this article, they were used interchangeably. Hence, the significance and weight of this concept were examined by searching the literature for definitions and social sustainability dimensions or themes, and how these conceptual relatives were considered. This review had also investigated how the literature identifies the potential contribution community engagement processes have made in meeting the challenges of developing social sustainability indicators and assessment metrics.

3.3.1. The inclusion of the conceptual relatives of community engagement in defining social sustainability

At the beginning of the twenty-first century, there was still a lack of the conceptualization and assessment approaches of social sustainability. Thus, this concept had little implicit meaning (Laguna, 2014). Nowadays, social sustainability is a wide-ranging multi-dimensional concept. With the underlying question of what the social goals of sustainable development are, as with the concept of sustainability, social sustainability is neither an absolute nor a constant, rather it is to be considered as a dynamic concept (Dempsey et al., 2011). The literature on social sustainability seems fragmented and several scholars have suggested that further research on conceptualizing this concept is needed. For example, Colantonio (2009) stated, "no consensus seems to exist on what criteria and perspectives should be adopted in defining social sustainability. Each author or policy-maker derives their own definition according to discipline-specific criteria or study perspective, making a generalized definition difficult to achieve" (p. 868). Without a

specific definition, scholars tend to define this concept by proposing their set of principles, themes or dimensions that could contribute to its understanding. One group of theorists argued that the lack of a general definition is because the dimensions and principles for this concept are grounded in practical understanding and political agendas, rather than theory (Littig & Griessler, 2005). Meanwhile, pluralism of definitions is considered as appropriate and preferable to that of a single definition (Boström, 2012; Dempsey et al., 2011; Kunz, 2006; McKenzie, 2005). Vallance, Perkins, and Dixon (2011) noted that "a review of the literature suggests, however, that it [social sustainability] is a concept in chaos" (p. 342). Based on these arguments, the work of five key authors on the concept of social sustainability are reported and summarized in Table 2. The table also shows an overview of the literary interpretations that identify social sustainability and the reasons for including community engagement's conceptual relatives. Based on the authors' observation, Colantonio (2009) and Dempsey et al. (2011) are the two most-cited work in the field of conceptualizing social sustainability. The other three publications were samples of the most recent and relevant work, with insights into previous work on the topic.

3.3.2. The role of community engagement in assessing social sustainability

The challenge of developing social sustainability indicators or metrics is emphasized because of its subjectivity and intangible nature. Sustainability indicators are often process indicators in that they analyze the processes through which sustainability principles and objectives are defined, themes agreed upon, and solutions implemented. The indicators allow the actual implementation of a project or a phenomenon to be monitored and assessed toward specific objectives in an interactive way (Colantonio, 2009). However, after the introduction of the emerging/soft themes (Colantonio, 2009), i.e., a sense of place and culture, happiness, and cohesion, the challenge of developing social sustainability indicators has increased. This is because it is even more challenging to measure these areas compared to traditional themes, such as poverty or unemployment rates, which can be reported through government records. In contrast, since sustainability was initially recognized as an environmental phenomenon, researches and practices related to environmental sustainability might be more advanced than the ones related to social and economic sustainability (Marsal-Llacuna, 2016). For instance, compared to social sustainability, researches concerning possible methods to assess the implementation of certain environmental policies are more developed (BREEAM UK 1990, LEED US 2000, CASBEE Japan 2001, and DGNB Germany 2007). Even though some traditional social assessment tools have been established between the 1970s and 2000, e.g., Social Impact Assessment (SIA), Health Impact Assessment (HIA), Equality Impact Assessment, and Sustainability Appraisal (SA) (Glasson & Wood, 2009), they were "accommodated by 'stretching' environmental assessment tools, such as, the Environmental Impact Assessment (EIA) and the Strategic Environmental Assessment (SEA), and by broadening the definition of 'environment'" (Colantonio, 2009, p. 876) to cover the social perspective. These tools were also criticized for being speculative in nature and lacking the ability to provide precise results (Colantonio, 2009). Scholars nowadays are focused on establishing assessment tools to help researchers and city planners measure how well a city is faring from a social sustainability perspective. Opp (2017), and Missimer et al. (2017) classified the concept of community engagement as an easy measurable indicator for social sustainability. This observation suggests that community engagement processes could be used as an assessment method to identify and measure how successful the integration of social sustainability policies was. For instance, measurable levels of community engagement, such as the percentage of participants in a collective decision-making process, could be considered as an indicator of social justice, or the level of trust and satisfaction. However, there are still weaknesses in measuring soft dimensions, such as a positive sense of identity, happiness or quality of life, and place attachment. The indicators suggested by Opp (2017) are useful in monitoring tangible indicators, such as access to education, affordable housing, or health. However, they are impractical for measuring happiness, or a sense of identity or belonging. Additionally, the monitoring approach suggested by Missimer et al. (2017) is oriented toward organizational plans and regulations, and not the real implications these principles have on the community. Thus, they are organization-oriented rather than community-oriented. Assessing the soft dimensions of social sustainability is still a challenging matter. However, the recent emergence of the 'smart city' concept and ICT could be perceived as a way to respond to such challenges. Foth et al. (2015) attempted to empower community engagement in the development of smart cities because they believe that this concept has been too technocratic and insensitive to the interests of society and community. Thus, they argued that smart cities should be open for the people and become sociable smart cities. In a sociable smart city, online streams of communications between citizens and governments should be prioritized. Hence, data collected via monitoring and benchmarking could indicate citizens' satisfaction or happiness. As such, the emerging ICT is a promising prospect to respond to the challenges of sustainable development (Batty et al., 2012; Bibri & Krogstieb, 2017; Marsal-Llacuna, 2016). Insight will come from the role ICT plays in community engagement practices and how it can be perceived as a promising response to the social sustainability challenges as well.

3.4. Node 3 (Community engagement & digital citizen participation)

At the end of the sixties, French philosopher, Henri Lefebvre outlined the "right to the city", arguing that "the great potential of urban life should be open to everyone, not just the powerful elites and large corporations that own and control so much of our cities" (Shaw & Graham, 2017, p. 7). In the same period, one of the earliest definitions of community engagement was proposed by Arnstein (1969), whereby "redistribution of power that enables the have-not citizens (powerless people or marginalized groups in society), presently excluded from the political and economic processes, to be deliberately included in the future" (p. 216). Although this definition incorporates the main components of the concept, a more comprehensive definition (Rowe & Frewer, 2004, p. 512) have been adopted using other synonyms, such as public participation, indicating that more power and influence should be given to the public; *"over the ways in which our cities are made and remade"* (Harvey, 2012, p. 5). Between 1980s and 1990s, with neoliberal policies and the West's predominance, new concepts have been associated with community engagement, such as 'Governance'. At the time, neoliberalism was supporting the transfer of control of economic factors from the public sector to the private sector. The 'Governance' movement was playing a similar role in transferring power from governments to stakeholders, which affected community engagement (Jakubowski, 2014). At the beginning of the twenty-first century, governance was defined as the institutions where authority is practiced (Pierre, 2000), which comprised of mechanisms, processes, and institutions through which citizens can express their interests, practice their rights, meet their obligations, and interpose their differences (United Nations, 2004). Bifulco, Tregua, and Amitrano (2017) suggested that the general aim of governance was to leverage activities concerned with sharing the power in decision-making. Fischer (2006) suggested that "the concept of governance has evolved to identify and explain new modes of decision-making that fill gaps created by the failure of traditional forms. Governance, given its emphasis on decentered citizen engagement, is touted for being a much more flexible and democratic way to deal with public problems" (p. 19). Cornwall (2002) emphasized that participatory governance practices provide intermediary spaces that adjust the boundaries between the state and its citizens, and establishing new places, where participants from both sides can engage. Governance has been characterized by Gil-Garcia, Ramon, and Taewoo (2015) as multiple stakeholders influencing decision-making processes through increased interaction and collaboration. Ruhlandt (2018) categorized governance stakeholders as public,

Table 2
An overview of the literature interpretation to identify social sustainability, highlighting the inclusion of community engagement's conceptual relatives.

Statement	Category					Source	Highlight of community engagement related concepts
	Definition	Dimensions	Principles	Conceptual Framework	Themes		
Social sustainability concepts: *Equity** encompasses three dimensions: Recognition: revalues unjustly devalued identities. Redistribution: the remedy for injustice is some form of economic restructuring, and Parity of Participation: promoting substantive public involvement in the production of space. *Safety*: the right to not only be safe but adopt all measures of adaptation and security to prevent future casualties and physical harm. *Eco-presumption:* modes of producing and gaining values in socially and environmentally responsible ways. *Urban forms:* promote a sense of community, safety, health, and place attachment, among other environmental objectives.				√		(Eizenberg & Jabareen, 2017, p. 12)	• The "Parity of Participation" (included in the equity concept) assumes that "justice requires social arrangements that permit all (adult) members of society to interact with one another as peers" (Eizenberg & Jabareen, 2017, 7), is crucial for achieving social sustainability. Such types of interaction could be achieved through equal chances for the community to be engaged locally.
In a socially sustainable society, people are not subject to structural obstacles to: Health: social conditions that could cause injury and illness, physically, mentally or emotionally. Influence*: participating in shaping the social systems they are part of; by suppression of free speech or neglect of opinions Competence: learning and developing competence individually and together. Impartiality: exposed to partial treatment Meaning-making: creating individual meaning and co-creating common meaning.			√			(Missimer et al., 2017, p. 47)	• The suggested SS principle "Influence" has a direct relationship with community engagement, because in a socially sustainable society, people should have the ability to participate in shaping the social system they are part of by speaking and expressing their opinions freely. This is one of the main goals of community engagement.
Social sustainability definitions: *Positive definition:* for a city to be labeled as socially sustainable, all people, must have the ability to enjoy equal access to public investment while also being able to satisfy their basic human needs. *Negative definition*: a community is not socially sustainable if a subset of the population faces greater exposure to environmental harms or is less able to enjoy or access the benefits of public investment Social sustainability dimensions: Equal access and opportunity*: accessibility to open spaces, recreation, jobs, and local services, transportation, education and procedural fairness. Health and environmental justice: local environmental quality and disamenity location and health. Community and the value of place*: social capital and social segregation. Basic human needs: affordable housing, safety and security and fair distribution of income.	√	√				(Opp, 2017, p. 291)	• The suggested dimension "Equal access and opportunity" includes "procedural fairness" that is concerned with fair citizen participation in decision-making. • The suggested dimension "community and the value of place" includes the social capital factor, which is defined as the networks and relationships in a community that create trust, shared knowledge, and the ability to work together for a common purpose (Putnam, 1993; Baines & Morgan, 2004). • Social capital is thought to be a strong predictor of political involvement, citizen engagement, career advancement, and the overall health and happiness of a person (Swanstrom, Dreier, & Mollenkopf, 2002; Leyden, 2003).

(*continued on next page*)

Table 2 (*continued*)

Statement	Category					Source	Highlight of community engagement related concepts
	Definition	Dimensions	Principles	Conceptual Framework	Themes		
Dimensions of social sustainability: Social Equity, the need for a local equitable access to key services such as education, housing, infrastructure, culture and recreation Sustainability of community* involves: social interaction between community members stability of the community participation in local collective institutions trust across the community security from threats and positive sense of identification		√				(Dempsey et al., 2011, p. 293-294)	● The suggested SS dimension "sustainability of community" involves sub-dimensions that are related to community engagement aspects such as participation in local collective institutions, e.g., participation in governmental decision making, levels of trust across the community and a positive sense of identification, which can be increased by effective community engagement approaches.
Social sustainability themes: Traditional/Hard themes: basic needs, including housing, environmental health, education, employment, equity, human rights and gender, poverty and social justice. Emerging/Soft themes*: demographic change, social mixing and cohesion, identity, sense of place and culture, empowerment, participation and access, health and safety, social capital and wellbeing, happiness and quality of life.					√	(Colantonio, 2009, p. 9)	● Empowerment, participation and a sense of place (which are community engagement related concepts) are considered part of the emerging soft SS themes that were not considered traditionally in the SS themes.

* Principles related to community engagement concept

private, academic, and civic categories. Lombardi, Giordano, Farouh, and Yousef (2012) observed the "Civic" category – citizens, civic groups, community organizations or communities, and non-profit organizations – as one of the key actors. Whereas, Bifulco et al. (2017) argued that the citizens play the most important role. Consequently, public participation has become a central feature of good governance across the political spectrum. Fischer (2006) stated that community engagement/public participation was incorporated into governance policies as a central principle and is the key to its success. In this context, Ridder and Pahl-Wostl (2005) argued that "it's no longer a question to carry out participation, but how to carry it out" (p. 190). Civic governance actors, such as social movements and non-governmental organizations are trying to respond to such an argument by carving out new arenas for different forms of participation (Fischer, 2006). Nevertheless, traditional participation forms, such as public consultations, public meetings, focus groups, surveys, citizen counsels or committees, have come under fire from several scholars. For example, Innes and Booher (2004), in a seminal article on the situation in the US, stated that, "It is time to face facts we know, but prefer to ignore. Legally required methods of public participation in government decision-making in the US—public hearings, review, and comment procedures in particular— do not work. They do not achieve genuine participation in planning or other decisions; they do not satisfy members of the public that they are being heard; they seldom can be said to improve the decisions that agencies and public officials make; and they do not incorporate a broad spectrum of the public". Similarly, Gordon and Manosevitch (2011) argued that the typical formats for public participation are impractical considering the complexity of the urban-social situation, adding that public participation is a complex process. Nonetheless, in practice, it is treated as a compulsory task. Bouzguenda (2016) outlined similar challenges based on a case study on public participation approaches in the city of Schiedam in the Netherlands. This case study showed that the city was facing similar challenges when incorporating traditional participation methods, such as attracting a broad spectrum of the public and increasing the number of interested participants. This was underpinned by the recognition that contemporary governmental institutions that are trying to incorporate "Governance" concepts are under serious pressure from the challenges brought by ICT, coupled with the increasing acceptance of the 'smart cities' concept. In their work, Cosgrave, Doody, and Walt (2014) highlighted that technological advancements and ICT are affecting cities worldwide, irrespective of whether they choose to integrate these technologies into their governance agenda or not. Cunha, Coelho, and Pozzebon (2013) suggested that there is a growing interest, both in academic research and governmental practice, in the new forms of relationships between the state and citizens, enhanced by ICT, especially in participatory decision-making. Foth (2018) discussed the four-stage revolution of the relationship between city governments and citizens. In the first stage, the city governments were the 'administrators' and the citizens were the 'residents'; in the second stage, city governments were the 'service providers' and the citizens were the 'consumers'. In the last two stages, the relationship was between 'facilitators' and 'participants', and between 'collaborators' and 'co-creators', respectively. These stages emphasized citizen-led city making and urban informatics initiatives instead of city governments being the initiators. Marek, Campbell, and Lily (2017) stated that, "smart technologies drive effective governance through the engagement of citizens" (p. 44). Meanwhile, "the development of ICT promises to transform urban governance into "smart governance" because ICT enables city governments to carry out their tasks more effectively and efficiently" (Lee, Phaal, & Sang-Ho, 2013, p. 290). Based on the publication by Ruhlandt (2018), Table 3 provides a summary of smart governance definitions. The table highlights the role of DCP as a key factor in the success of smart governance and consequently, the smart city.

Based on the defined smart governance, the majority of scholars were observed as utilizing participation-centeredness statements. The

Table 3
An overview of literature interpretation to identify smart governance, highlighting the inclusion of DCP.

Definition	Specific definition	Within the context of a smart city	Direct mention of the use of tech	Non-Direct mention of the use of tech	Source	Highlight of digital citizen participation concept
"Smart governance comprises aspects of political participation, services for citizens as well as the functioning of the administration." (p. 11)	√			√	(Giffinger et al., 2007)	• Political participation is one of the main aspects comprising smart governance.
"As urban planning based on governance with multiple stakeholders is pivotal to smart growth, smart city initiatives necessitate governance for their success." (p. 286)		√			(Nam & Pardo, 2011)	• Stakeholder participation in smart governance practices is key to the success of smart city initiatives
"The identified clusters are smart governance (participation), smart human capital (people), smart environment (natural resources), smart living (quality of life) and smart economy (competitiveness)." (p. 139)		√		√	(Lombardi et al., 2012)	• Smart governance is mainly concerned about participation and it is one of the smart city clusters.
"much stronger intelligence function is required for coordinating the many different components that comprise the smart city" (p. 497) "[…]the organization that is developed will be part of new governance structures […] that utilize much wider participation in decision-making as well as real time construction and use of a variety of simulations […] relevant to decision support systems." (p. 507)		√		√	(Batty et al., 2012)	• Intelligent governance is required to coordinate the different components of the smart city, utilizing wider participation in decision-making among other relevant instruments.
"cities need to develop smart governance systems that take all these factors [e.g. take a longer view, make greater use of innovation to improve the efficiency and sustainability of their services, improve communication and engage local residents in their projects] into account." (p. 52)	√			√	(Barrionuevo, Berrone, & Ricart, 2012)	• Several factors of smart governance are identified, including engaging residents in the decision-making process.
"governance-related elements of smart cities are: (1) e-governance, (2) engagement by stakeholders, citizens and communities, and (3) network- based relationships such as partnerships and collaborations." (p. 76)		√	√		(Gil-Garcia et al., 2015)	• Stakeholders and citizen engagement are elements that should be highlighted in relation to smart city governance, along with the use of electronic governance.
Smart city governance is "the processual interplay among a diverse set of stakeholders, equipped with different roles […], driven by technology, involving certain types of legislation and policies, for the purpose of achieving either substantive outputs for cities or procedural changes (or both)" (p.10)		√	√		(Ruhlandt, 2018)	• The interplay between the diverse set of stakeholders facilitated by technology is what characterizes a smart governance.

majority of these definitions are emphasized on the concept of participation as the main key to characterizing smart governance, and a key to the success of smart city initiatives. Nonetheless, most definitions fail to mention the use of technology as the main character to identify smart governance, although it was conceptualized within the context of "smart cities". This could be justified by the aspect that the use of technology in public participation is an emerging topic in the arena of smart cities As Viale-Pereira, Cunha, Lampoltshammer, Parycek, and Testa (2017) suggested that "*Smart interaction with stakeholders is a broader field of interest in smart governance research that has emanated from traditional electronic government research*" (p. 540). The most recent definitions by Gil-Garcia et al. (2015), and Ruhlandt (2018) directly mentioned using technology to facilitate public participation. Smart governance is now considered as one of the elements of a smart city (Manville et al., 2014). However, this might be misunderstood by some practitioners or policy makers as solely a form of electronic government service. This is not what this article aimed to emphasize. Smart governance should be seen as complementary to the original governance model, where participation is important, and is facilitated through ICT. Bibri and Krogstieb (2017); Gil-Garcia (2012), and Fountain (2004) have studied how new technologies could help strengthen the quality and effectiveness of government administrations in response to the challenges of the smart sustainable development. Smart cities, as a concept, do relate to the utilization of technology. However, in theory, smart cities should contribute to the formation of high quality living, modeled around the circular economy, with a little to zero impact on the environment because technology alone cannot be the universal cure to all development ills (Yigitcanlar et al., 2019). Accordingly, adopting a holistic collaborative approach toward the generation of smart sustainable cities was argued (Nam & Pardo, 2011; Yigitcanlar et al., 2018, 2019). Nam and Pardo (2011) attempted to conceptualize the drivers of 'smart cities' as technology, people, and institutions. Thus, through participatory governance, cities could be smart when investing in human/social capital and ICT to fuel sustainable growth and enhance the quality of life. Yigitcanlar et al. (2018) identified similar drivers of smart cities – community, technology, policy – linked to desired outcomes, in which governance is one of them. Martin, Evans, and Karvonen (2018) argued that "the potential to empower and include citizens represents the key to unlocking forms of smart-sustainable urban development that emphasize environmental protection and social equity" (p. 1). Innovative forms of participatory governance in smart sustainable cities are promoted as smart urban collaboration, which is based on utilizing ICT to adopt a more participative model of governance. This came in accordance with the rising debates to focus on the crucial participation of 'smart citizens' in city-making by connecting citizens with new ways and new platforms (Foth et al., 2015), such as smart sensors and feedback mechanisms (Shaw & Graham, 2017). Additionally, technology solutions are utilized in assessing community participation in terms of recruitment, consultation, feedback gathering, deliberation to co-design processes, and planning outcomes (Foth, 2018). Nonetheless, when it comes to implementing smart initiatives to improve livability, the power of having an inclusive diverse community is underpinned. Surowiecki (2005) suggested that diversity would trump expertise, i.e., a diverse group of people would be able to provide smarter solutions than an individual expert. This diverse group could also participate privately online, which will increase the capacity to access the expertise of quieter voices and empower them (Brabham, 2009). Thus, smart sustainable cities are not solely about local innovation, but also global collaboration. Based on these arguments, the authors propose that a 'smart sustainable city' could represent the fertile ground for the growth of DCP. The development and application of innovative solutions and sophisticated methods in the area of citizen participation can be increased, while technological solutions are embraced by smart governance initiatives.

4. Discussion and conclusions

This article has discussed the role of community engagement practices as one of the key components of social sustainability and proposed DCP as a key to the social sustainability of smart cities. This literature review was focused on the potential contribution that DCP could make for improving the sustainable city model if proper ICT is used. The concept of smart sustainable cities is emphasized in the literature in response to the challenges faced by cities when reacting to the sustainable development goals in this digital era. The ubiquity of ICT forces debates on sustainable development to consider utilizing innovative technologies to respond to such challenges. One of these challenges is the social sustainability of smart cities. The core questions in this review were what kind of relationship is fostered in the literature between sustainability and DCP, and how can ICT contribute to social sustainability. These questions were addressed by establishing nodes and links among the concepts in a hierarchical order (see Fig. 1). The results indicated that a relationship between each of the two concepts in one node does exist, but to varying degrees. This review concludes that the relationship between sustainability and social sustainability is clearly understood because social sustainability is considered as one of the main pillars of sustainability. However, the relationship between social sustainability and community engagement might be less clear. Finally, the relationship between community engagement and DCP is the least addressed due to its complexity and broad links to several areas of research. The correlations between these concepts, or nodes, are supported by the literature. Thus, sustainability and DCP are hierarchically linked to each other under the umbrella of the smart sustainable city concept. Several studies on DCP gravitated toward the field of smart cities, being concerned mostly with the technological aspect and paying less attention to the impact this has on the social sustainability of smart cities. This is because some studies are still characterizing smart cities as cities driven by technology (Hall et al., 2000; Harrison et al., 2010; Washburn et al., 2010). Attempts were also made in the field of DCP, focusing on the technical aspect of the digital tools utilized to facilitate participation (Alatalo, Koskela, Pouke, Alavesa, & Ojala, 2016, 2017) with respect to the organizations' abilities and decision-makers' requirements (Afzalan, 2015; Afzalan, Sanchez, & Evans-Cowley, 2017). While the plethora of DCP tools are appreciated, little attention is given to its capability to respond to the social sustainability challenges, such as empowerment, participation, access, and equity (Colantonio, 2009), inclusion (DFID, 1999), and pride and a sense of place (Bramley, Dempsey, Power, & Brown, 2006). Exploring the capability of DCP to contribute to the social sustainability challenges could be achieved in two ways. First, by researching how far DCP could enhance the participation of citizens in decision-making and responding accordingly to the challenges. This could be done, for example, by reaching a bigger number of citizens and diverse groups of people. Second, by assessing and measuring social sustainability, and developing social sustainability indicators. Although social sustainability is one of the main pillars of sustainability, it is a vague concept when it comes into practice (Marsal-Llacuna, 2016). Thus far, social sustainability is characterized by themes and dimensions that helped to understand the concept. However, from the practitioner's perspective, the question is how a city or a governmental institution could identify their level of social sustainability. The efforts to develop social sustainability indicators (Missimer et al., 2017; Opp, 2017) are appreciated. However, there are still weaknesses in measuring soft themes, unlike the more tangible/hard themes (Colantonio, 2009). The results of this review suggested that DCP processes could be utilized to generate indicators that could help to measure some of the hard-to-measure soft themes. Data can be collected and analyzed from online participation processes to provide valuable insight into the social dimension of such processes. Thus, how much these processes affect the social sustainability of this community can be understood. Table 4 illustrates how such data can be utilized to indicate the level of social sustainability.

Table 4
Example of the data collected through the DCP process that could indicate the level of social sustainability in accordance with certain soft themes.

Collected data	Social sustainability soft themes	Author
Number of participants (the number of participants registered online)	• Empowerment, participation and access • Democracy	(Colantonio, 2009); (Sachs, 1999)
Demographic information (Age, Sex, Address, Education level, Ethnicity)	• Equity • Inclusion • Equal opportunities to participate in a democratic society	(Colantonio, 2009); (DFID, 1999); (Hans-Böckler-Stiftung, 2001)
Nature of comments and discussion points (positive versus negative comments, level of trust expressed, level of responsibility, level of attachment, innovation)	• Identity, sense of place and culture • Pride and sense of place • Enabling of social innovation	(Colantonio, 2009); (Bramley et al., 2006); (Hans-Böckler-Stiftung, 2001)

Arguably, to have a meaningful indication, there should be certain limits with numerical values that one could refer to. These values should indicate the thresholds related to each category of the collected data. For example, to determine whether the number of participants in a decision-making process could represent the overall community, we should have a certain limit. These limits would indicate the average accepted number of participants in certain situations, depending on the size of the neighborhood, the number of residents, their demographics, and the size and nature of the project. This could be done by utilizing smart cities' constitutive technologies – data analytics capabilities, services, and novel applications – to identify the average accepted limits for each situation by referring to the collected data from online participation processes. Despite the positive potentials of digitizing citizen-participation processes, some scholars were concerned about it, arguing its consequences in terms of creating a digital division in society. For instance, Janowski (2015) suggested that every citizen has the right to receive and understand government notices. Since some citizens might not have internet access or the ability to use modern devices required for digital participation, this right is therefore unfulfilled. In the same context, Caroline W. (2017) argued that the field of public participation is being undermined by the dangers inherent in innovation and new technology, where there is little interaction or reciprocity. Thus, understanding the unintended consequences of utilizing DCP tools is an aspect that should be explored. From another perspective, the concept of participation itself is criticized, as it is seen as merely another face of the top-down decision-making approach since the decision makers are the facilitators and the controllers of the participation process, including the content of events and the final results. Scholars argue for this to be replaced with co-production, co-design, or co-creation. Thus, attention was also given to recent studies that investigated online co-production tools, with visualization and immersing technologies. The fact that digital applications and software producers are collecting data from the users for varying reasons, had given rise to the ethical issue of us being "digital laborers" and not only users (Shaw & Graham, 2017). Further investigation should be devoted to make the most of the available state-of-the-art technology, within the context of citizen participation traditions. Other related concepts being discussed in the sustainable smart city discourse are the concept of "more-than-human" smart cities and the concept of "non-anthropocentrism", which calls for smart cities to go beyond being human-centered to better account for other living entities, as well as the ecological needs of the earth (Forlano, 2016, 2017; Luusua, Ylipulli, & Rönkkö, 2017; Smith, Bardzell, & Bardzell, 2017; Houston, Hillier, MacCallum, Steele, & Byrne, 2018). This ideology sees whole systems as an intricately interconnected and entangled system (Luusua et al., 2017). In fact, the ecological dimension has not been completely absent from the sustainable smart city discourse. Yigitcanlar (2018) b) defined truly smart and sustainable urbanism as "an urban development paradigm that is the antidote of current spatially, structurally, socially, ecologically imbalanced, and vicious Anthropocentric urbanism practice" (p. 108). The application of the concept of more-than-human smart city lies in the possibility of using ICT to learn more about other species, and hence, consider them in city planning and urban designs toward the sustainability of this planet. Data from ICT could also be used to educate citizens about their environment and raise awareness to encourage them to be proactive and protect their surroundings (Light, Frauenberger, Preece, Strohmeier, & Ferrario, 2018). Within this context, the authors support the proposition that instead of focusing on the technological advancements that make cities smart, we should consider the relationships that these technologies could help us develop or understand. Doing so would likely blur the categorical boundaries and help us build a more holistic relationship with our surroundings (Luusua et al., 2017).

4.1. Implications of the study findings

This review had focused on a niche aspect of a much broader smart sustainable development area of research. It has implications on the theoretical, policy, and practical levels. From the theoretical perspective, this paper emphasizes the significant role of ICT in the move toward smart sustainable cities and proposes DCP as the key to achieve better social sustainability. This review offers a structured summary of the literature for the academic community aiming to pave the way for more practice-oriented research. At the policy level, it does strive to highlight to the decision makers the importance of considering ICT in the context of participatory planning in smart city initiatives as a contributor to the social sustainability of our future cities. It also encourages policy makers in the planning arena to consider social sustainability by preparing the physical and epistemological infrastructure required for effective digital participatory planning. At the practical level, this review calls for the development of digital participation tools that would allow a larger number of citizens to participate in the planning processes, to overcome the long-lasting challenge of low level participation that municipalities around the world have been experiencing. Such tools should be user-friendly, can be easily accessed by citizens, should allow two-way interaction; citizen-citizen and citizen-organization, should respect the privacy of the users, and should allow them to freely express their opinions and concerns. Nonetheless, the authors do not call for a universal tool, but rather calls on the municipalities, who are planning to smarten their cities, to develop their own tools that correspond to the nature of the demographics that it serves. Another practical implementation of these findings would be to spread awareness among professionals about the implications of utilizing ICT in participatory planning, showcasing best practices and latest software applications.

4.2. A future outlook

The purpose of this literature review was to explore the relationship between sustainability and DCP, as well as to establish an insightful future research agenda concerning the emerging technological solutions for DCP. This review had also determined how far these technologies could influence user engagement and overcome the challenges related to citizen participation processes, thus contributing to social

sustainability, while deploying the concept of smart sustainable cities. In conclusion, the following topics are recommended for future research in the area of smart sustainable cities:

- How does the concept of smart sustainable city contribute to the social and economic developments of our societies?
- How far could DCP enhance the participation of citizens in decision-making processes and respond accordingly to some of the social sustainability challenges?
- How can the social sustainability of our societies be measured and assessed using smart constitutive technologies, such as data analytics capabilities, services, and novel applications?
- How can DCP be enhanced further by making the most out of the available state-of-the-art technology?
- What are the unintended consequences of digitizing citizen participation practices, financially and ethically?
- What are the characteristics of effective digital participation tools?
- How can ICT be used in the context of co-creation or co-design?
- How can ICT contribute to the creation of more-than-human smart cities?

This review proposes that the move toward smart sustainable city requires bridging the gaps between sustainability, social sustainability, community engagement, and digital public participation through the application of ICT. It proposes that a new profession is required to bridge these gabs. This profession should be able to appreciate the "soft" dimensions of social sustainability and able to effectively use smart ICT. Such a profession could learn from several fields, such as planning, urban design, sociology, psychology, statistics, information technology, and computer sciences.

Although the focus of this paper was on the social sustainability of smart cities, it does not intend to convey the idea that the other aspects of sustainability have been fully covered and understood by the research community. Humanity still has a long way to respond to the environmental and economic sustainability challenges. Efforts should be combined toward developing an integrated and holistic approach for designing our future smart and sustainable city. Such an approach should not neglect one aspect of sustainability in favor of another.

4.3. Study limitations

Although extensive effort was made to collect the most relevant work and the synthetic process that was developed to analyze relevant knowledge, this method has several limitations. First, it is important to mention that the relationships between the concepts were assumed to be linear and sequential. This was necessary for practical reasons since this paper also aimed to demonstrate the kind of relationship fostered in the literature between sustainability and DCP, which could strengthen the connection between sustainability and smart city concepts. No claim has been made regarding the actual contribution these four concepts make as this is outside the scope of the current review and is left for future work. The structure presented in this paper is solely for organizational purposes and to facilitate better understanding by the concerned communities. Another limitation to this study was that the review data and content analysis were limited to the databases and search terms, as explained in the previous sections.

Competing interests

The authors declare that they have no financial or non–financial competing interests.

Funding

Research fund was provided by Schiedam Municipality, Netherlands and is hereby gratefully acknowledged. Schiedam Municipality is not involved in the study design, the collection, analysis resources, in the writing of the article, nor the decision to submit the article for publication.

Acknowledgement

This study is an integral part of a PhD research project being conducted at Universitat de Girona, Spain, and Sultan Qaboos University, Oman.

References

DFID (1999). *Department for International development. Sustainable livelihoods guidance sheets* London.
Afzalan, N. (2015). *Participatory plan making: Whether and how online participatory tools are useful.* PhD DissertationDenver: University of Colorado.
Afzalan, N., Sanchez, T. W., & Evans-Cowley, J. (2017). Creating smarter cities: Considerations for selecting online participatory tools. *Cities, 67*, 21–30.
Ahvenniemi, H., Huovila, A., Pinto-Seppä, I., & Airaksinen, M. (2017). What are the differences between sustainable and smart cities? *Cities, 60*, 234–245.
Alatalo, T., Pouke, M., Koskela, T., Hurskainen, T., Florea, C., & Ojala, T. (2017). Two real-world case studies on 3D web applications for participatory urban planning. *Proceedings of the 22nd International Conference on 3D Web Technology*, 11.
Alatalo, T., Koskela, T., Pouke, M., Alavesa, P., & Ojala, T. (2016). VirtualOulu: Collaborative, immersive and extensible 3D city model on the web. *Proceedings of the 21st International Conference on Web3D Technology*, 95–103.
Alberti, M., Booth, D., Hill, K., Coburn, B., Avolio, C., Coe, S., et al. (2007). The impact of urban patterns on aquatic ecosystems: An empirical analysis in Puget lowland sub-basins. *Landscape and Urban Planning, 80*(4), 345–361.
Almeida, V. A. F., Doneda, D., & da Costa, E. M. (2018). Humane Smart Cities: The need for governance. *IEEE Internet Computing, 22*(2), 91–95.
Andresen, S., & Underdal, A. (2012). We do not need more global sustainability conferences. *Earth System Governance*. Accessed 2 22, 2018 http://www.ieg.earthsystemgovernance.org/news/2012-06-19/we-do-not-need-more-global-sustainability-conferences.
Arnstein, S. (1969). A ladder of citizen participation. *Journal of the American Institute of Planners, 35*(4), 216–224.
Asefa, S. (2005). The concept of sustainable development: An introduction. *The Economics of Sustainable Development* (Upjohn Institute for Employment Research).
Baines, J., & Morgan, B. (2004). *Sustainability appraisal: A social perspective.* London: First Draft of Work in Progress, International Institute for Environment and Development95–112.
Baker, M. J. (2000). Writing a literature review. *The Marketing Review, 1*(2), 219–247.
Barrionuevo, J. M., Berrone, P., & Ricart, J. E. (2012). Smart cities, sustainable progress. *IESE Insight, 14*(14), 50–57.
Bartlett, A. (1994). Reflections on sustainability, population growth, and the environment. *Population and Environment, 16*(1), 5–35.
Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Ouzounis, G., & Portugali, Y. (2012). Smart cities of the future. *The European Physical Journal Special Topics, 214*(1), 481–518.
Beatley, T., & Kristy, M. (1997). *The ecology of place: Planning for environment, economy, and community.* washington, D.C: Island Press.
Beretta, I. (2018). The social effects of eco-innovations in Italian smart cities. *Cities, 72*, 115–121.
Bibri, S. E., & Krogstie, J. (2017). ICT of the new wave of computing for sustainable urban forms: Their big data and context-aware augmented typologies and design concepts. *Sustainable Cities and Society, 31*, 183–212.
Bibri, S. E., & Krogstie, J. (2016). On the social shaping dimensions of smart sustainable cities: A study in science, technology, and society. *Sustainable Cities and Society, 29*, 219–246.
Bibri, S. E., & Krogstieb, J. (2017). Smart sustainable cities of the future: An extensive interdisciplinary literature review. *Sustainable Cities and Society, 31*, 183–212.
Bifulco, F., Tregua, M., & Amitrano, C. C. (2017). Co-governing smart cities through living labs. Top evidences from EU. *Transylvanian Review of Administrative Sciences, 13*(50), 21–37.
Boström, M. (2012). A missing pillar? Challenges in theorizing and practicing social sustainability: Introduction to the special issue. *Sustainability Science Practice and Policy, 8*(1), 3–14.
Bouzguenda, I. (2016). *Perspectives on citizen participation for the digital age: Urban development based research and case study*Master Thesis. Girona: UdG Digital Repository: Universitat de Girona.
Brabham, D. C. (2009). Crowdsourcing the public participation process for planning projects. *Planning Theory, 8*(3), 242–262.
Bramley, G., Dempsey, N., Power, S., & Brown, C. (2006). What is 'social sustainability', and how do our existing urban forms perform in nurturing it. *Sustainable Communities and Green Futures' Conference*.
Brocke, J., Simons, A., Niehaves, B., Reimer, K., Plattfaut, R., & Cleven, A. (2009). Process, reconstructing the giant: On the importance of rigour in documenting the lite ture search. *ECIS 2009 Proceedings*, 161.
Chang, D. L., Sabatini-Marques, J., Da Costa, E. M., Selig, P. M., & Yigitcanlar, T. (2018). Knowledge-based, smart and sustainable cities: A provocation for a conceptual framework. *Journal of Open Innovation Technology Market and Complexity, 4*(1), 5.

Colantonio, A. (2009). *Social sustainability: A review and critique of traditional versus emerging themes and assessment methods.* 865–885.

Cooper, H. (1988). Organizing knowledge syntheses: A taxonomy of literature reviews. *Knowledge Technology & Policy, 1*(1), 104–126.

Cornwall, A. (2002). *Making spaces, changing places: Situating participation in development.* IDS working paperBrighton: Institute of development studies.

Cosgrave, E., Doody, Léan, & Walt, N. (2014). *Delivering the smart city–governing cities in the digital age.* London: Arup, Liveable Cities.

Costa, E. M., & Oliveira, Á. D. (2017). *Humane smart cities. The oxford handbook of interdisciplinarity*228–240.

Cunha, M. A., Coelho, T. R., & Pozzebon, M. (2013). *The use of ICT in public decision-making participation. Proceedings of the ECIS–21st European Conference on Information Systems*.

Dempsey, N., Bramley, G., Power, S.éad, & Brown, C. (2011). The social dimension of sustainable development: Defining urban social sustainability. *Sustainable Development, 19*(5), 289–300.

Eizenberg, E., & Jabareen, Y. (2017). Social sustainability: A new conceptual framework. *Sustainability, 9*(1), 68.

Fischer, F. (2006). Participatory governance as deliberative empowerment: The cultural politics of discursive space. *The American Review of Public Administration, 36*(1), 19–40.

Forlano, L. (2016). Decentering the human in the design of collaborative cities. *Design Issues, 32*(3), 42–54.

Forlano, L. (2017). Posthumanism and design. *She Ji: The Journal of Design, Economics, and Innovation, 3*(1), 16–29.

Foth, M. (2011). *From social butterfly to engaged citizen: Urban informatics, social media, ubiquitous computing, and mobile technology to support citizen*.

Foth, M. (2018). Participatory urban informatics: Towards citizen-ability. *Smart and Sustainable Built Environment, 7*(1), 4–19.

Foth, M., Brynskov, M., & Ojala, T. (2015). *Citizen's right to the digital city, Vol. 10*. Singapore: Springer.

Fountain, J. E. (2004). *Building the virtual state: Information technology and institutional change.* Brookings Institution Press.

Giddens, A. (1998). *Runaway world: How globalization is reshaping our lives*.

Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovic, N., & Meijers, E. (2007). *"Smart cities." Ranking of European medium-sized cities*Final report. Vienna UT: Centre of Regional Science.

Gil-Garcia, J. R. (2012). *Enacting electronic government success: An integrative study of government-wide websites, organizational capabilities, and institutions, Vol. 31*. Springer Science & Business Media.

Gil-Garcia, J., Ramon, T. A. P., & Taewoo, N. (2015). *Smarter as the new urban agenda: A comprehensive view of the 21st century city, Vol. 11*. Springer.

Glasson, J., & Wood, G. (2009). Urban regeneration and impact assessment for social sustainability. *Impact Assessment and Project Appraisal, 27*(4), 283–290.

Gordon, E., & Manosevitch, E. (2011). Augmented deliberation: Merging physical and virtual interaction to engage communities in urban planning. *New Media & Society, 13*(1), 75–95.

Granier, B., & Kudo, H. (2016). How are citizens involved in smart cities? Analysing citizen participation in Japanese "Smart Communities". *Information Polity, 21*(1), 61–76.

Gupta, J., & Vegelin, C. (2016). Sustainable development goals and inclusive development. *International Environmental Agreements, 16*(3), 433–448.

Höjer, M., & Wangel, J. (2015). Smart sustainable cities: Definition and challenges. *ICT Innovations for Sustainability. Advances in Intelligent Systems and Computing (Springer, Cham), 310*, 333–349.

Hall, R. E., Bowerman, B., Braverman, J., Taylor, J., Todosow, H., & Von Wimmersperg, U. (2000). *The vision of a smart city.* Upton, NY: Brookhaven National Lab.

Hans-Böckler-Stiftung (2001). *Pathways towards a sustainable future.* Setzkasten, Düsseldorf.

Harrison, C., Eckman, B., Hamilton, R., Hartswick, P., Kalagnanam, J., Paraszczak, J., et al. (2010). Foundations for smarter cities. *IBM Journal of Research and Development, 54*(4), 1–16.

Harvey, D. (2012). *Rebel cities: From the right to the city to the urban revolution. Verso books*.

Houston, D., Hillier, J., MacCallum, D., Steele, W., & Byrne, J. (2018). Make kin, not cities! Multispecies entanglements and 'becoming-world'in planning theory. *Planning Theory, 17*(2), 190–212.

Innes, J. E., & Booher, D. E. (2004). Reframing public participation: Strategies for the 21st century. *Planning Theory & Practice, 5*(4), 419–436.

Jabareen, Y. R. (2006). Sustainable urban forms their typologies, models, and concepts. *Journal of Planning Education and Research, 26*(1), 38–52.

Jabareen, Y. (2015). *The risk City, Vol. 29*. New York: Springer.

Jakubowski, S. L. (2014). *Public participation in urban development: Case studies from Cincinnati, Ohio*PhD Thesis. Ohio: Department of Geography, University of Cincinnati.

Janowski, T. (2015). Digital government evolution: From transformation to contextualization. *Governemnt Information Quartely, 32*(2), 221–236.

Keeble, B. R. (1987). The Brundtland report: 'Our common future. *Medicine and War, 4*(1), 17–25.

Kim, J. I. (2014). Making cities global: the new city development of Songdo Yujiapu and Lingang. *Planning Perspectives, 29*(3), 329–356.

Kunz, J. (2006). *Kunz, J. (2006). Social sustainability and community involvement in urban planning, Vol. 118*. Tampere: University of Tampere.

Laguna, J. M. (2014). *Institutional politics, power constellations, and Urban Social Sustainability: A comparative-historical analysis.* DissertationFlorida: ProQuest LLC5.

Lee, J. H., Phaal, R., & Sang-Ho, L. (2013). An integrated service-device-technology roadmap for smart city development. *Technological Forecasting and Social Change, 80*(2), 286–306.

Leyden, K. M. (2003). Social capital and the built environment: the importance of walkable neighborhoods. *American Journal of Public Health, 93*(9), 1546–1551.

Light, A., Frauenberger, C., Preece, J., Strohmeier, P., & Ferrario, M. A. (2018). Taking action in a changing world. *Inviting Young Scientists, 25*, 35.

Littig, B., & Griessler, E. (2005). Social sustainability: a catchword between political pragmatism and social theory. *International Journal of Sustainable Development, 8*(1–2), 65–79.

Lombardi, P., Giordano, S., Farouh, H., & Yousef, W. (2012). Modelling the smart city performance. *Innovation the European Journal of Social Science Research, 25*(2), 137–149.

Lorek, S., & Spangenberg, J. (2014). Sustainable consumption within a sustainable economy: Beyond green growth and green economies. *Journal of Cleaner Production, 62*, 33–44.

Luusua, A., Ylipulli, J., & Rönkkö, E. (2017). Nonanthropocentric design and smart cities in the anthropocene. *it-Information Technology, 59*(6), 295–304.

Manville, C., Cochrane, G., Cave, J., Millard, J., Rasmus Kåre, J. K. P., Liebe, A. T., Wissner, M., Massink, R., & Kotterink, B. (2014). *Mapping smart cities in the EU*.

Marek, L., Campbell, M., & Lily, B. (2017). Shaking for innovation: The (re) building of a (smart) city in a post disaster environment. *Cities, 63*, 41–50.

Marsal-Llacuna, M.-L. (2016). City indicators on social sustainability as standardization technologies for smarter (citizen-centered) governance of cities. *Social Indicators Research, 128*(3), 1193–1216.

Martin, C. J., Evans, J., & Karvonen, A. (2018). Smart and sustainable? Five tensions in the visions and practices of the smart-sustainable city in Europe and North America. *Technological Forecasting and Social Change, 133*, 269–278.

McKenzie, S. P. (2005). *Building institutions for sustainability: A New Zealand case study.* DissertationAuckland: Prod. ResearchSpace.

McLaren, D., & Agyeman, J. (2015). *Sharing cities: A case for truly smart and sustainable cities.* Cambridge, MA: The MIT Press.

Michel, J.-B., Shen, Y. K., Aiden, A. P., Veres, A., Gray, M. K., Pickett, J. P., et al. (2011). Quantitative analysis of culture using millions of digitized books. *science, 331*(6014), 176–182.

Missimer, M., Robèrt, K.-H., & Broman, Göran (2017). A strategic approach to social sustainability–Part 2: A principle-based definition. *Journal of Cleaner Production, 140*, 42–52.

Nam, T., & Pardo, T. A. (2011). Conceptualizing smart city with dimensions of technology, people, and institutions. *12th Annual International Digital Government Research Conference: Digital Government Innovation in Challenging Times,* 282–291.

Noy, K., & Givoni, M. (2018). Is 'Smart Mobility' sustainable? Examining the views and beliefs of transport's technological entrepreneurs. *Sustainability, 10*(2), 422.

Oksman, V., Väätänen, A., & Ylikauppila, M. (2014). Co-creation of sustainable smart cities users, participation and service design. *The Eighth International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies,* 189–195.

Opp, S. M. (2017). The forgotten pillar: a definition for the measurement of social sustainability in American cities. *Local Environment, 22*(3), 286–305.

Paul, B. D. (2008). A history of the concept of sustainable development: Literature review. *Annals of The University of Oradea, Economic Science Series, 17*(2), 581–585.

Pierre, J. (2000). *Debating governance: Authority, steering, and democracy.* OUP Oxford.

Praharaj, S., Han, J. H., & Hawken, S. (2018). Urban innovation through policy integration: Critical perspectives from 100 smart cities mission in India. *City Culture and Society, 12*, 35–43.

Prizzia, R. (2007). *Sustainable development in an International perspective. Handbook of globalization and the environment*. Boca Raton, FL: CRC Press19–42.

Putnam, R. (1993). What makes democracy work? *National Civic Review, 82*(2), 101–107.

Ridder, D., & Pahl-Wostl, C. (2005). Participatory Integrated Assessment in local level planninG. *Regional Environmental Change, 5*(4), 188–196.

Rowe, G., & Frewer, L. J. (2004). Evaluating public-participation exercises: A research agenda. *Science, Technology & Human Values, 29*(4), 512–556.

Ruhlandt, R. W. S. (2018). The governance of smart cities: A systematic literature review. *Cities*.

Sachs, I. (1999). Social sustainability and whole development: Exploring the dimensions of sustainable development. *Sustainability and the Social Sciences: A Cross-Disciplinary Approach to Integrating Environmental Considerations into Theoretical Reorientation,* 25–36.

Secchi, B. (2013). *La città dei ricchi e la città dei poveri. GLF Editori Laterza*.

Sev, A. (2009). How can the construction industry contribute to sustainable development? A conceptual framework. *Sustainable Development, 17*(3), 161–173.

Shaw, J., & Graham, M. (2017). *Our digital rights to the city.* Meatspace Press.

Smith, N., Bardzell, S., & Bardzell, J. (2017). Designing for cohabitation: Naturecultures, hybrids, and decentering the human in design. *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems,* 1714–1725.

Stevens, C., & Norichika, K. (2016). The transformative potential of the Sustainable Development Goals (SDGs). *International Environmental Agreements, 16*(3), 393–396.

Surowiecki, J. (2005). *The wisdom of crowds.* Anchor.

Swanstrom, T., Dreier, P., & Mollenkopf, J. (2002). Economic inequality and public policy: The power of place. *City & Community, 1*(4), 349–372.

United Nations (2012). *Future we want - outcome document.* Accessed 2 22, 2018United Nationshttps://sustainabledevelopment.un.org/rio20/futurewewant.

United Nations (2002). *World summit on sustainable development (WSSD), Johannesburg summit.* Accessed 2 22, 2018United Nationshttps://sustainabledevelopment.un.org/milesstones/wssd.

United Nations (1992). *Agenda 21.* Accessed 2 22, 2018United Nationshttps://sustainabledevelopment.un.org/index.php?page=view&nr=23&type=400&menu=35.

United Nations (2004). *Governance.* Accessed 2 23, 2018http://www.un.org/es/globalissues/governance/.

United Nations (2015). *Transforming our world: The 2030 agenda for sustainable development.* Resolution adopted by the General Assembly.
Vallance, S., Perkins, H. C., & Dixon, J. E. (2011). What is social sustainability? A clarification of concepts. *Geoforum, 42*(3), 342–348.
Viale-Pereira, G., Cunha, M.-A., Lampoltshammer, T. J., Parycek, P., & Testa, M. G. (2017). Increasing collaboration and participation in smart city governance: A cross-case analysis of smart city initiatives. *Information Technology for Development, 23*(3), 526–553.
Vogler, J. (2007). *The international politics of sustainable development. Handbook of sustainable development*.
Washburn, D., Sindhu, U., Balaouras, S., Dines, R. A., Hayes, N., & Nelson, L. E. (2010). Helping CIOs understand "smart city" initiatives. *Growth, 17*(2), 1–17.
Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a litera- ture review. *MIS Quarterly, 26*(2), xiii–xxiii.
Weitz, N., Carlsen, H., Nilsson, M., & Skånberg, K. (2017). Towards systemic and contextual priority setting for implementing the 2030 Agenda. *Sustainability Science,* 1–18.
Weitz, N., Persson, Å., Nilsson, M., & Tenggren, S. (2015). *Sustainable development goals for Sweden: Insights on setting a national agenda. Work paper.* Stockholm: SEI Working Paper.
World Commission of Environment and Development (1987). *Our common future.* Oxford, UK: Oxford University Press.
Yigitcanlar, T. (2017). Smart cities in the making. *International Journal of Knowledge-Based Development, 8*(3), 201–205.
Yigitcanlar, T. (2018). Smart City Policies Revisited: Considerations for a Truly Smart and Sustainable Urbanism Practice. *World Technopolis Review, 7*(2), 97–112.
Yigitcanlar, T. (2016). *Technology and the city: Systems, applications and implications.* Routledge.
Yigitcanlar, T., & Kamruzzaman, M. (2018). Smart cities and mobility: Does the smartness of Australian cities lead to sustainable commuting patterns? *Journal of Urban Technology,* 1–26.
Yigitcanlar, T., Kamruzzaman, M., Buys, L., Ioppolo, G., Sabatini-Marques, J., da Costa, E. M., et al. (2018). Understanding 'smart cities': Intertwining development drivers with desired outcomes in a multidimensional framework. *Cities, 81*, 145–160.
Yigitcanlar, T., Kamruzzaman, M., Foth, M., Sabatini, J., Costa, E., & Ioppolo, G. (2019). Can cities become smart without being sustainable? A systematic review of the literature. *Sustainable Cities and Society, 45*, 348–365.
Yin, R. K. (1994). Discovering the future of the case study. Method in evaluation research. *Evaluation Practice, 15*(3), 283–290.

3.2 Examining Digital Participatory Planning: Maturity Assessment in a Small Dutch City

This section is a transcription of the published paper:

Bouzguenda, I., Alalouch, C., & Fava, N. (2020). "Examining Digital Participatory Planning: a Maturity Assessment in a Small Dutch City". *Journal of Cleaner Production*, 264, 121706. DOI: 10.1016/j.jclepro.2020.121706

This section examines factors that are affecting the introduction of DPP, aiming at identifying the level of maturity towards the introduction of DPP in cities, with particular attention to small European cities. These two groups of factors were examined in Schiedam, Netherlands via a mixed-methods approach and analyzed using NVIVO and SPSS software. The results suggest that for cities to be mature enough to introduce DPP, there should be an existing good practice of conventional participatory planning where the concept is extensively practiced, as well as a relatively high trust in the community engagement processes and sufficiently high digital technology literacy among the residents.

Journal of Cleaner Production 264 (2020) 121706

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Examining digital participatory planning: Maturity assessment in a Small Dutch city

Islam Bouzguenda [a, *], Chaham Alalouch [b], Nadia Fava [c]

[a] Geography Department, Universitat de Girona, Spain
[b] Department of Civil and Architectural Engineering, Sultan Qaboos University, Oman
[c] Department of Architecture and Construction Engineering, Universitat de Girona, Spain

ARTICLE INFO

Article history:
Received 28 November 2019
Received in revised form
19 March 2020
Accepted 13 April 2020
Available online 18 April 2020

Handling editor: Jian Zuo

Keywords:
Digital participatory planning
Community engagement
Co-creation
Smart sustainable city
Government openness

ABSTRACT

This paper calls for a rational and gradual transition to Digital Participatory Planning (DPP) as part of the sustainable smart city model. In recent years, the role that Information and Communications Technology (ICT) could play in advancing participatory planning has been widely acknowledged. The literature suggests that several factors are affecting the introduction of DPP into smart city planning. This study examines organization-related and society-related factors, aiming at identifying the level of maturity towards the introduction of DPP in cities, with particular attention to small European cities. These two groups of factors were examined in Schiedam, Netherlands via a mixed-methods approach and analyzed using NVIVO and SPSS software. The results suggest that for cities to be mature enough to introduce DPP, there should be an existing good practice of conventional participatory planning where the concept is extensively practiced, as well as a relatively high trust in the community engagement processes and sufficiently high digital technology literacy among the residents. Thus, maturity levels in cities should be assessed and policies should be developed accordingly to ensure a successful transition toward sustainable smart cities, in light of the findings reported in this study.

1. Introduction

The concept of public participation has evolved over the past 30 years with continued dialogue between practice and theory. Participatory planning is one way of involving the public in decision making processes. Generally, public participation is a vital aspect of democracy, trust in governments, and a connection to the transition toward sustainable smart cities (Levenda et al., 2020). In addition, the positive effect that citizen participation has on social sustainability is widely acknowledged (Bouzguenda et al., 2019). This includes – but not limited to – feeling more responsible for public matters, increasing public engagement, encouraging people to listen to different opinions, and contributing to a higher degree of legitimacy of decisions (Spyra et al., 2019). Nonetheless, it could have a negative effect if not all relevant groups and interests are represented (Michels and De Graaf, 2017) or when governments attempt to listen to citizens, but make their final decisions based on inputs from their officers (Rosener, 1982). The introduction of compulsory public participation in most occidental countries has created a challenge for public actors. One of the key administrative issues confronting decision makers is how best to involve citizens in public decision making (Levenda et al., 2020). In the presence of Information and Communications Technology (ICT), the evolution of e-government and open government, and smart city models (Anthopoulos, 2017), several governmental authorities foresee the incorporation of technologies, such as web 2.0, digital mapping tools, Geographic Information Systems (GIS), 3D-modelling, Global Positioning System (GPS), and interactive screens (Wallin et al., 2010) as suitable responses to the challenges they are facing, particularly in terms of enhancing citizen participation in city planning (Afzalan et al., 2017). Thus, suggesting the incorporation of Digital Participatory Planning (DPP). However, our assumption is that prior to introducing technological interventions to the participation process, citizens' and authorities' level of maturity and attitude toward participatory planning processes must be understood. This will inevitably foster smoother introduction and integration of DPP. Smaller cities with a population between 50,000 and 100,000 that represent more than 50% of the total number of cities in Europe (Dijkstra and Poelman, 2012) should be given more

* Corresponding author. Geography Dept., Universitat de Girona, Girona, Spain.
E-mail address: ibouzguendaepalaswad@gmail.com (I. Bouzguenda).

https://doi.org/10.1016/j.jclepro.2020.121706
0959-6526/

attention (Hughes et al., 2018; Varela-Álvares et al., 2019). This leads us to our study question: What factors affect a city's DPP maturity? And when will a city be mature enough to introduce DPP? The aim of this study is two-fold. First, it aimed to identify some of the factors that affect the introduction of digital technology to participatory planning. Second, this study applied some of the identified factors to assess the maturity of Schiedam, a small city in The Netherlands, using qualitative and quantitative methods. These factors and the proposed assessment method aim to inform the development of a maturity assessment method that could guide small cities and towns on their way toward adopting DPP approaches, especially with the current emphasis on smart cities around the world. Equally important, this paper engages with the current debates around urban planning, sustainable smart cities, and community engagement and participation in small cities, by addressing a significant gap in the field that requires attention. Additionally, the factors could be utilized by cities to gauge their level of organizational and social maturity, and to take appropriate steps.

2. Background

Nasca et al. (2019, p. 2) defined participatory planning as "*a bottom-up planning approach that employs non-traditional engagement techniques, combines citizen knowledge with professional knowledge, promotes open dialogue, and involves community members throughout all phases of the planning process*". Participatory planning practices provide intermediary spaces for knowledge sharing and consideration of local experiences that close the boundaries between the state and its citizens (Spyra et al., 2019), and establish new places in which collaborators can engage with each other to better envision their cities (Cornwall, 2002). On the other hand, DPP can be defined, with reference to the definition by Healey (1998), as arenas within which stakeholders can collaboratively develop and convey visions of how the city could be by using ICT. DPP handled mainly by governmental organizations can be incorporated to drive government evolution with the use of innovation starting with the evolution of both digital (e−) and open government, and smart cities at a local level towards a smart government (Anthopoulos, 2017). The e-government handles the deployment of smart services (e.g., e-payments) and the open government operates based on openness, with regards to service delivery and decision making (e.g., citizen participation). The smart city addresses city government, while smart solutions helps improve local economy and evidence-based policy making (Anthopoulos, 2017). Thus, DPP could be implemented within the e-government context as a service deployed by the government, within the context of open government as it engages citizens in decision making, and within the context of smart city, as governance (Gil-Garcia et al., 2014) and city management play a significant role in smart city development (Anthopoulos, 2019). On the European level, different policies, such as the European e-government action plan (2011−2015) (European Commission, 2010) and the Malmö ministerial declaration on e-government (eGovernment policy of the European Union, 2009), have been proposed to increase citizen participation. This effort is important for enabling greater participation and increased civic commitment (Komito, 2005). However, the obsession with technology in the deployment of the smart city model has raised concerns over the importance of emphasizing human and more-than-human-centered smart cities that are collaboratively designed with citizens based on their needs, while respecting other living creatures (see for example, Yigitcanlar et al., 2019; Foth, 2018; Dezuanni et al., 2017). These concerns are emphasizing that cities cannot be smart without being socially, economically, and environmentally sustainable. Works that largely sought to explore new means to use ICT for sustainability (Foth et al., 2009) have begun over a decade ago. Yet, these works have been criticized for their limited consideration of new means to influence and impact the broader political, societal, and planetary dimensions (Foth and Caldwell, 2018). However, this is changing because governments are currently developing participatory approaches to address sustainability challenges (Boukherroub, D'amours, & Rönnqvist, 2018; Fuldauer et al., 2019) in the attempt to help societies become more sustainable (Clarke et al., 2019). One of the latest generations of smart city model is described as the "Responsive Smart City" (Yigitcanlar et al., 2019). This is a city that provides citizens with active engagement in the usage of smart solutions to improve living standards and urban sustainability (Goldsmith and Crawford, 2014). This type of cities gives the citizens the power to use smart technology to contribute toward planning, designing, and managing their cities (Yigitcanlar et al., 2019). Thus, attention should be devoted to the mature incorporation of technologies. This is particularly important when dealing with technologies that have a social perspective or could affect the social sustainability of the society, such as citizen participation (Bouzguenda et al., 2019). Several studies on the implementation of digital citizen participation were focused on the organization, administrative, and managerial aspects of the professionalization of public participation (Slotterback, 2011; Bherer et al., 2017; Afzalan et al., 2017). Other research fields are focused on the community's abilities and citizens' perspectives, and their level of satisfaction with such processes (Michels and De Graaf, 2017), as well as the level of acceptance to such technologies in terms of their features and functionalities (system quality) (Kimathi et al., 2019). However, an extension of these efforts is recommended (Okyere-Kwakye et al., 2016; Sichone et al., 2018) to explore the mutual perspectives between the community (users) and the organization (facilitator). In the same context, Anthopoulos and Tougountzoglou (2012) suggested that the cooperation between the provider (organization) and the receiver of the service (citizen) is considered even more crucial to ensure the viability of such smart initiatives. The viability of digital interventions has been questioned because of low participation, poor input quality, and managerial inefficiencies and trust. The success of smart initiatives has to be secured since huge funding supports its implementation and social implications accompany its deployment. Nonetheless, smart cities initiatives are contemporary projects; therefore, insufficient data can hinder the job of decision makers. Information on the economic and social dimensions of these projects is also scarce. Indices and factors concerning geographical, financial, socio-political, cultural, legal, technical, environmental, and social perspectives can indicate the viability of DPP. They can also contribute to a smooth and mature introduction of digital initiatives.

2.1. Factors contributing to the introduction of DPP

Several factors could be taken into consideration when introducing digital technologies to participatory planning to ensure an effective process.

The first group of factors deals with the maturity of the organization itself and the factors that are related to issues within the organization (Lodato and DiSalvo, 2018). Blahna and Yonts-Shepard (1989) suggested several conventional evaluation "themes," or criteria that are related to efficient deployment of public participation in planning. Such criteria include representativeness, transparency, influence, and information access. In light of the ubiquity of ICT, Rowe and Frewer (2000) suggested a set of acceptability features that could make a participatory method acceptable to the wider public to ensure effective functionality.

These features include the representativeness of the targeted population, the independence of participants' selection, the early involvement of the participants, and the clear and effective management of expectations. Laurian and Shaw (2009), on the other hand, argued that "increased trust" is a central factor when deploying participatory planning. Mutual trust between the organization and the community does influence the efficiency of public participation, and the same is applicable when introducing technologies to the participation process. Other factors that were discussed are the attitudes and perceptions of the planners towards public participation (Slotterback, 2011; McAfee et al., 2012), whether they were negative, cynical, indifferent, positive, or enthusiastic (Schroeter and Houghton, 2011). Additionally, their personal experience in the use of technology (Houghton et al., 2014), can influence the usefulness of the proposed technological intervention. Furthermore, the significance of strategic support (Kahila-Tani et al., 2016) and policy support (Fredericks et al., 2019) for the planners were emphasized. First, expertise in designing the participation processes, and information regarding the variety of digital tools and supporting software. Second, policy support for the participatory planning process in terms of city coverage, nature, and maturity. Afzalan, Sanchez, and Evans-Cowley (2017) were able to identify factors that can influence the adoption of ICT technologies by planning organizations, such as the organizations' attitudes toward public participation, and the planners' behaviors and attitudes.

The second group of factors is related to the characteristics and attitude of the concerned community. Putnam (1993) related the quality of life among local communities to different levels of civic engagement. On the other hand, the community's overall level of education, attitude, and perception toward the concept of public participation in general, and toward utilizing technologies in particular, were seen as influencing factors (Harrison and Thomas, 2009; Palen et al., 2010). The socio-demographic characteristics of the concerned community should also be considered when utilizing ICT in participatory planning as they might affect how people receive and use these technologies (Mallan et al., 2010; Afzalan and Muller, 2014; Lopez, 2016). Krasnova et al. (2009) & Fredericks and Foth (2013), argued that the community perception of privacy and sharing their identities in online environments need to be carefully considered (Table 1).

Another group of factors that was discussed in the literature is the project-related factors. Brown and Chin (2013), and Schroeter et al. (2012) argued that the place component and the geographic coordinates of the planning project could contribute to the usability of the DPP practice. Felin and Zenger (2014), and Gil-García, Ramón, and Pardo (2005) further argued that the characteristics of the project and its environment, and the effectiveness of introducing DPP technologies are related. However, our concern was that the project-related factors are specific to each project and might not indicate the maturity of the city as a whole. Thus, this group of factors was not considered.

3. Methodology

To address the objectives of this study, a mixed method approach was adopted and applied to the case study, namely, Schiedam City, Netherland. Semi-structured interviews were conducted to examine the maturity of the municipality to introduce DPP, with regards to the governmental organization factors. Factors related to the society were determined via a citizen questionnaire. In addition, the city demographics were obtained from the municipality's official records.

3.1. The case study: Schiedam, Netherlands

The field of inquiry was The Netherlands, one of the leading countries where public participation is mandated by law and widely practiced. The Netherlands has a broad experience with various forms of participatory decision making since citizen participation gained its importance by the late 1960s (Michels, 2006). Schiedam is a small city located in the providence of South Holland, which is part of the Rotterdam-The Hague metropolitan area. In 2018, it only has 77,897 residents compared to Rotterdam with a population of 651,446. Historically, the city has faced a substantial increase in residents with lower socio-economic background. Towns and cities of this size play a significant role in the economic and social life in Europe (Hughes et al., 2018). The city's local authority has introduced a program to promote the smart city initiatives, including DPP. Generally, participatory planning is practiced in Schiedam according to a protocol that follows Arnstein's (1969) ladder of participation. The main goal of the administration is to maximize participation, with no restrictions on the applied methods, aiming for the higher rungs of the ladder (Arnstein, 1969). Participatory projects are often focused on the development of central areas, the renewal of old neighborhoods,

Table 1
Factors related to digital participatory planning.

Factors	Source
Factors Related to Governmental Organization	
G.1. Level of trust expressed by the organization in the citizens' opinions and ideas	Laurian & Shaw (2009)
G.2. Planner's behavior and attitude toward citizen participation	Briones et al. (2011); McAfee et al. (2012); Slotterback (2011); Kahila-Tani et al. (2016); Norton, 2008; Schroeter and Houghton (2011)
G.3. Strategic support/availability of online resources (IT experts + software)	Afzalan et al. (2017); Houghton et al. (2014)
Factors Related to the Society	
S.1. Neighborhood/population demographic characteristics	Putnam (1993); Afzalan and Muller (2014); Lopez (2016); Afzalan et al. (2017); Mallan et al., 2010
S.2. Level of trust in the concept of citizen participation in city planning	Palen et al. (2010); Stutzman (2006); Harrison and Thomas (2009)
S.3. Level of trust in the influence of the community's opinion on the organization's decision.	Laurian & Shaw (2009)
S.4. Technology utilization tendencies	Palen et al. (2010); Stutzman (2006); Harrison and Thomas (2009); Lopez (2016); Afzalan et al. (2017)
S.5. Privacy concerns within online environments	Krasnova et al. (2009); Foth et al., 2011; Fredericks and Foth (2013)

Table 2
Main questions in the interview guide and the source for each one.

Category	Question	Source
Level of trust expressed by the organization in the citizens' opinions and ideas	• Do you believe in the communities' capabilities of generating new knowledge and ideas? • How far do you respond to the participant's requests? • How do you describe the level of maturity of the participants' requests and comments?	Edmiston (2003); Gillett et al. (2004); Innes and Booher (2004)
Planners' behaviors and attitude toward citizen participation	• How important do you think it is to apply the concept of citizen participation in city planning? • What are your main goals when working on citizen participation projects?	Estevez and Janowski (2013); Palfrey and Gasser (2012); Townsend (2013)
Strategic support/availability of online resources	• Does the organization have a dedicated city office for information technology (IT)? • If yes, do planners or community engagement specialists within the city benefit from this office? • Was there any technology introduced to the participation projects? • If yes, how skilled were the planners in terms of using this technology?	Briones et al. (2011); McAfee et al. (2012); Palen et al. (2010); Stutzman (2006); Harrison and Thomas (2009); Krasnova et al. (2009)

Table 3
Sample breakdown of the semi-structured interviews ($n = 14$).

	Gender		Position					Background				
	M	F	Project managers/ leaders	Policy advisor	Community engagement specialists	Architects	Administration	Engineering	Landscape architecture	City planning	Economics	Unknown
Number	8	6	9	1	1	1	2	4	3	3	3	1

and the construction of public amenities.

3.2. Governmental organization interviews

Qualitative semi-structured interviews were conducted to assess the municipality's maturity to introduce DPP. The interview guide was designed based on the governmental organization factors that were previously identified from the literature, and all questions were sourced from relevant sources (Table 2).

In total, 14 interviews were conducted in September 2017, with representatives from the local government in Schiedam city. Interviewees were carefully selected to include the different expertise and specializations involved in the participatory planning processes within the municipality, as well as from different genders and different educational backgrounds. However, all participants have experiences in participatory planning activities run by the municipality (Table 3).

Interviews lasted between 45 and 90 min and new questions that followed interviewee's replies were asked. All interviews were recorded, transcribed, and analyzed using thematic content analysis using NVIVO software, as suggested and used by several authors (Dooling et al., 2006; Woolley et al., 2010; Neuendorf, 2016).

3.3. Citizen questionnaire

Society-related factors were examined through an online questionnaire. The questionnaire was posted on the official municipality website and Facebook for two weeks, and a total of 148 responses were collected. Flyers containing a brief introduction about the survey and a QR code with a link to the survey were distributed among the local community during two participatory events, and delivered to the mailboxes of local residents. No incentives of any kind were provided to the community members to complete the questionnaire. The questionnaire covered the four factors related to the society, as well as questions related to the frequency of participation in citizen engagement events, education, and demographics. The sample was as wide ranging as possible and varied in gender, age, education level, and area. Although efforts were made to ensure a suitable balance across these variables, no claim is made about the representativeness of the sample for the general population as a whole. The sample breakdown is shown in Table 4.

A five-point Likert scale was used to capture the participants' perception of carefully designed attitudinal statements pertaining to the factors related to the society. For the purpose of this study, only eight Likert items are reported, as listed in Table 5.

The collected data were statistically analyzed using the IBM SPSS software. Jamieson (2004) recommended to first analyze the Likert items using the mode, median, inter-quartile, and nominal levels of disagree vs. agree. This method was also used in other studies when analyzing Likert data (see Alalouch, 2018). Then, the data were inferentially analyzed using the Mann-Whitney U and the Kruskal-Wallis tests. The Monte Carlo Exact significant method and Jonckheere's test were also performed to unveil the underpinning differences among the subgroups of the population, as categorized by age, gender, previous experience participating conventionally, and previous experience participating online. These tests are recommended by Field (2013) when the data is nominal, similar to the Likert scale data collected in this study. The Monte Carlo Exact significant method was used for both tests since this method is more accurate in calculating the significance level compared with the conventional asymptotic method. In addition, the effect size was calculated using Rosenthal's (1991) method (i.e., $r = Z/\sqrt{N}$,

Table 4
Sample breakdown of the citizen questionnaire ($n = 148$).

Variables		Percentage
Gender	Male	41.9%
	Female	58.1%
Age	18–30	7.5%
	31–40	11.5%
	41–50	16.2%
	51–60	25%
	60+	34.4%
	Missing	5.4%
Education level	Lower than high school	1.4%
	High school	11.5%
	MBO[a] or similar	15.5%
	HBO[b] or similar	56.7%
	WO[c]/University or higher	13.5%
	Missing	1.4%
Participation in participatory planning events	Always	10.1%
	Sometimes	48.6%
	Never	39.9%
	Missing	1.4%
Participation in online debates regarding the neighborhood	Always	10.8%
	Sometimes	33.1%
	Never	56.1%

[a] MBO: middle-level applied education.
[b] HBO: applied university education.
[c] WO: academic university education.

Table 5
Survey items related to societal factors.

Seq.	Statement	Code
Level of trust in the concept of citizen participation in city planning		
1	I trust the concept of citizen participation.	SF.1
2	Engaging the citizens in participatory planning has positive effects on the community.	SF.2
Level of trust in the influence of the community's opinion on the organization's decision		
3	The municipality is giving high priority to engage the citizens effectively.	SF.3
4	I trust that my opinions are influential in the planning projects I participate in.	SF.4
5	I am satisfied with the participation methods applied by the municipality.	SF.5
Technology utilization tendencies		
6	I am an active online citizen (i.e., I do most of my tasks online).	SF.6
7	I am satisfied with the online services provided by the municipality.	SF.7
Privacy concerns within online environments		
8	I use my real name when I participate in online participation activities.	SF.8

Table 6
Factors related to the governmental organization, along with the related qualifiers.

Factor	Qualifiers
G.1. Level of trust expressed by the organization in the citizens' opinions and ideas	• "Yes, communities are capable of generating new ideas, but you need to work on it" (I12)[a] • "It is very important to reflect the residents' comments in your plans and reflect them boldly. It is very good for them to say; "Oh, this is the idea I gave," or "This is the plan we agreed on." (I11)[a] • "We shouldn't allow the citizens to participate in the design because we are good in design and not the people" (I9)[a] • "The level of maturity of the participant's comments depends on the education level" (I4, I5)[a]
G.2. Planners' behaviors and attitude toward citizen participation	• "I believe that participation is very important for planning because the residents always see the space differently as they are the everyday users" (I14)[a] • "My personal goal from participation is to create higher quality plans that respond to public interests" (I11, I12)[a] • "I engage citizens to satisfy mandates" (I9).
G.3. Strategic support/availability of online resources	• "We have a specialized communication team on the 13th floor" (I4)[a] • "There was a Facebook page made specifically for the project" (I1)[a] • "Virtual reality, to get the people to experience the feeling of cycling inside the tunnels, to get their opinions about the existing tunnels in the city" (I8). • "A digital voting tool was used for the parking problem. And there is a plan to introduce a digital platform (Next Door), for neighborhood activities and news" (I12)*

[a] Interviewee ID.

where Z is the z-score of the test, and N is the number of observations) for the statically significant results.

4. Results

4.1. Factors related to the governmental organization

The results of the interviews are shown in Table 6. The first factor (G1) was related to the level of trust expressed by the organization in the citizens' opinions. This was addressed by examining the organization's belief in the community's capabilities of generating new knowledge and ideas. Results showed that the municipality representatives who are engaged in public participation have different opinions. 80% of the interviewees clearly expressed their belief in the community's ability to generate new ideas. However, they did emphasize that these ideas should be well refined. Others confirmed that residents' ideas should be totally incorporated and responded to. However, 20% argued that the municipality is giving too much power to the citizens. Additionally, 60% of the interviewees linked the level of trust in citizens' ideas to their level of education.

The second factor (G2) was focused on planners' behaviors and attitude toward citizen participation. Results showed that 80% of the interviewees agreed on the importance of the concept of the residents being the everyday users, and thus, the experts of the districts. The majority of the interviewees stated that when it comes to citizen participation, their main goal is to create higher quality plans that respond to the public interests. However, 10% of the interviewees indicated that their main goal is only to satisfy the participation obligation.

The third factor (G3) was related to strategic support, and the availability of online and IT resources. Interviewees clarified that there is a dedicated team in the organization, who specialize in online communications. Planners do refer to this team to facilitate their online communications with citizens during the participation process. In terms of the introduction of digital resources to citizen participation projects, results suggested that a variety of online resources are employed, such as online surveys and digital voting tools, as well as social media and specialized webpages. Advanced digital tools, such as virtual reality are also used. However, external assistance at some stages was required.

4.2. Factors related to the society

4.2.1. Neighborhood demographic characteristics

The first society-related factor is the neighborhood demographic characteristics. The data regarding the city's characteristics, population, and demographics were available from the official department of city data (Municipal Register of Inhabitants, National Institute of Statistics, and Regional Employment Service). Percentage of adults aged between 18 and 64 years old, who were able to participate was 63.4%. Percentage of inhabitants with Dutch background, who were the dominant participants according to the municipality representatives was 58.3% compared to 76.9% in the Netherlands as a whole. Percentage of inhabitants with migration background was 41.7% compared to 23.1% in the Netherlands as a whole. The average household net income was 35,000 EUR/year, which was lower than the average household net income in the Netherlands of 39,600 EUR/year. The percentage of inhabitants with a university degree or other higher professional education was 24.3% compared to 36% in the Netherlands as a whole. The percentage of non-employed jobseekers aged between 15 and 75 years old was 6.7%, which was higher than the percentage in The Netherlands as a whole at 4.8% (Labor Market service, n.d.). Thus, several demographic characteristics of Schiedam city appeared to be lower than the national average, mainly in terms of the education level, the average household net income, and the percentage of non-employed jobseekers. However, the percentage of inhabitants with migration background was higher than the national average.

4.2.2. Level of trust, technology tendency, and privacy concern

The four societal factors were examined using a citizen survey and analyzed using SPSS software. The results showed that the evaluation of the statements ranged between neutral to positive (median and mode between 3 and 5), as shown in Table 7. The level of trust in the concept of citizen participation in city planning was positively evaluated by the participants (median and mode of 3.5; Agree at 64.4%, Disagree at 18.9%). The test of differences confirmed that the differences between the Agree and Disagree groups were statically significant. However, respondents tended to agree more on the positive effect of engaging the citizens has on the community, as shown in the results of statement SF.2. This is in contrast to the results of statement SF.1 within the same factor, where respondents felt neutral about their trust in the citizen participation concept. Unlike the first social factor, respondents felt neutral toward the influence their opinions might have on the organization's decision (median of 3.0 and mode of 3.3). In fact, the nominal levels of agree/disagree suggested that they have no trust in the fact that the community opinion is influential in the planning process, and they were relatively unsatisfied with the participation methods applied by the municipality. Regarding the technology utilization tendencies, the results suggested that the community has a decent level of technology utilization (median of 3.5 and mode of 3; Agree at 76%, Disagree at 18.1%). Respondents agreed that they are active online citizens, in which they do most of their tasks online and they felt neutral regarding the online services provided by the municipality. Lastly, respondents showed minimal privacy concerns regarding utilizing online environments where they tend to use their real names (median and mode of 4 and 5, respectively; Agree at 75.3%, Disagree at 12.8%).

The analysis presented in this section proved that the community of this case study has a decent level of trust in the concept of participation. They were good technology users and they had no major concerns regarding online privacy. On the other hand, they had no trust that the government organization would consider their opinion and that the outputs of the participation process were influential factors in the planning process.

4.2.3. The differences among subgroups

This study analyzed whether the gender, age, frequency of conventional participation, and frequency of online participation have any effect on the participants' perceptions of the societal factors. The non-parametric Mann-Whitney U test and the Kruskal–Wallis test were also used and the results are shown in Table 8. The results showed that Gender can be associated with the differences in the participants' responses for one statement only, which was SF4 ($U = 1882$, $Z = -2.133$, $p < 0.05$). The mean rank showed that female participants (mean rank = 75.98) were significantly more confident than male participants (mean rank = 61.90) that their opinions would be taken into account by the authority and have a real impact. Meanwhile, both Age and Education showed no significant association with the differences in the answers of any of the statements. This result indicated that the introduction of DPP is not affected by age groups or by the variation in the education level of the population. Interestingly, the frequencies of conventional and online participations have shown significant influence on statements SF1 and SF2. These two statements measured one societal factor related to the trust in the participatory planning as a concept. First, the level of trust in the concept of participatory planning was significantly affected by the

Table 7
Survey results as per the method recommended by Jamieson (2004).

Item[a]	Median	Mode	(Q1-Q3)	Agree %[b]	Disagree %	Differences (Agree vs. Disagree)
Level of trust in the concept of citizen participation in city planning						
SF.1	3.0	3.0	(2–4)	27.2%	33.3%	
SF.2	4.0	4.0	(4–5)	78.3%	7.0%	
Average	*3.5*	*3.5*	*(3–4)*	*64.4%*	*18.9%*	*t = 18.4; df =118; p < 0.01*
Level of trust in the influence the community opinion might have on the organization's decision						
SF.3	3.0	3.0	(2–4)	36.7%	28.8%	
SF.4	3.0	3.0	(2–4)	31.1%	35.5%	
SF.5	3.0	3.0	(2–3)	23.2%	36.2%	
Average	*3.0*	*3.3*	*(2.3-3.7)*	*42.3%*	*44.4%*	*t = 18.6; df =116; p < 0.01*
Technology utilization tendencies						
SF.6	3.5	3.0	(3–4)	50.0%	19.3%	
SF.7	3.0	3.0	(3–4)	37.6%	19.9%	
Average	*3.5*	*3.0*	*(3–4)*	*76.0%*	*18.1%*	*t = 15.1; df =100; p < 0.01*
Privacy concerns within online environments						
SF.8	*4*	*5.0*	*(3.5-5)*	*75.3%*	*12.8%*	*t = 21.1; df =101; p < 0.01*

[a] Full text of each Likert item is given in Table 5.
[b] Agree/disagree values do not add up to 100% because of the "Neutral" answers.

Table 8
The differences among subgroups.

Independent variables (Likert items)		SF.1	SF.2	SF.3	SF.4	SF.5	SF.6	SF.7	SF.8
Gender [a]	Mann-Whitney *U*	2614.5	2522	2019	1882	2160.5	2378	2009.5	1632.5
	Wilcoxon W	6269.5	4413	3730	3652	3930	4148	3839	3777.5
	Z	-.084	-.041	−1.352	−2.133	-.767	-.052	−1.853	-.334
	Monte Carlo Sig.	.934	.970	.174	***.033**	.446	.956	.063	.741
	r [c]				−0.18				
Age [b]	Chi-Square	7.709	6.279	1.723	2.357	1.367	2.705	.464	8.262
	df	4	4	4	4	4	4	4	4
	Monte Carlo Sig.	.104	.181	.791	.678	.859	.616	.979	.077
Education [b]	Chi-Square	8.164	6.600	1.699	8.499	4.409	6.946	9.458	7.900
	df	4	4	4	4	4	4	4	4
	Monte Carlo Sig.	.077	.156	.804	.063	.369	.135	.051	.083
Frequency of participating in participatory planning events [b]	Chi-Square	14.024	4.819	4.037	1.749	4.960	4.760	4.849	1.965
	df	2	2	2	2	2	2	2	2
	Monte Carlo Sig.	***.001**	.088	.133	.414	.079	.095	.086	.385
	r [c]	−0.13							
Frequency of participation in online debates regarding the neighborhood [b]	Chi-Square	.269	6.138	.314	.073	.550	8.885	.246	3.151
	df	2	2	2	2	2	2	2	2
	Monte Carlo Sig.	.874	***.047**	.857	.961	.763	***.011**	.881	.208
	r [c]		−0.13				−0.24		

*Significant at 0.05.
[a] Mann-Whitney *U* test.
[b] Kruskal–Wallis test.
[c] $r = Z/\sqrt{N}$ (Effect size).

frequency of participating in participatory planning events ($H(2) = 14.024$, $p < 0.01$). This finding was further analyzed using the Jonckheere's test. The results revealed a significant trend in the data whereby the more frequently a participant participate in participatory planning events, the more he/she will trust the concept of participatory planning ($j = 2194.5$, $z = -3.558$, $p < 0.01$). The mean rank of the independent variable confirmed this trend (mean rank: Always = 104, Sometimes = 76.81, Never = 61.70). The frequency of participation in online debates regarding the neighborhood had a significant effect on the participants' agreement to the statement related to the positive effect of citizen engagement practices on the community ($H(2) = 6.138$, $p < 0.05$). However, Jonckheere's test did not show a significant trend in the data (j = 2546, z = −1.47, p = 0.14). Inspection of the mean rank showed a noticeable difference between those who "always" participate in online debates (mean rank = 95.97) and those who "sometimes" do (mean rank = 69.83). On the other hand, the difference in the mean ranks between those who answered "sometimes" and those who answered "never" (mean rank = 69.67) was negligible. To further explore this issue, a new Mann-Whitney *U* test was performed between the "always" and "sometimes" groups. The results confirmed that these two groups have significantly different answers ($U = 223$, $Z = -2.306$, $p < 0.05$), with the "always" group significantly agreeing more to the statement than the "sometimes" group. Therefore, citizens who frequently participate in online activities related to planning are more likely to appreciate the positive effects that the citizen participation process might have on the community. Meanwhile, occasional participation in online engagement activities did not improve citizens' perception about the positive effects of the process. The other significant results were related to statement SF6 ($H(2) = 8.885$, $p < 0.05$), with Jonckheere's test showing a significant trend in the data ($j = 2565.5$, $z = -2.860$, $p < 0.01$). Those who were active online citizens had participated more in online debates regarding their neighborhoods. This finding indicated that if participatory planning processes are to be digitized, then, the general use of the internet should be first promoted and encouraged, internet accessibility should be facilitated, and all segments of the population should be granted online access.

The next question was which participation method (conventional or online) has contributed more to the social factors that

Table 9
The effect of having previous experience in the conventional vs. online participation on the social factors.

Independent variables (Likert items)		Level of trust in the concept of citizen participation in city planning	Level of trust in the influence of the community's opinion might have on the organization's decision
Participated in participatory planning events (Yes, Never) [a]	Mann-Whitney *U*	1843.5	1695.0
	Wilcoxon W	3554.5	3235.0
	Z	−2.504	−2.278
	Monte Carlo Sig.	***0.012**	***0.022**
	r [b]	−0.21	−0.20
Participated in online debates regarding the neighborhood (Yes, Never) [a]	Mann-Whitney *U*	2468.5	2265.5
	Wilcoxon W	5789.5	3976.5
	Z	−0.176	−0.112
	Monte Carlo Sig.	0.86	0.91

*Significant at the 0.05.
[a] Mann-Whitney *U* test.
[b] $r = Z/\sqrt{N}$ (Effect size).

were found to be associated with the differences in the previous analysis? To answer this question, the average Likert score for each group of statements that measured the first two social factors were calculated. The independent variables were also transformed into the binary format (Yes, No). Then, new Mann-Whitney U tests were performed on these variables, as listed in Table 9. Having previous experiences in participating in a conventional engagement activity has a significant effect on two social factors ($U = 1843.5$, $Z = -2.504$, $p < 0.05$; $U = 1695$, $Z = -2.278$, $p < 0.05$). Those who have participated in participatory planning events showed a higher level of trust in the participatory planning as a concept (mean rank: yes = 78.55, never = 61.28), as well as in the influence the community has on the authority's decision (mean rank: yes = 74.31, never = 58.82). Unexpectedly, previous experience in online engagement activities has no significant effect on any of the two social factors.

5. Discussion

The purpose of this study was to allow small cities in Europe to critically reflect on their level of maturity toward the introduction of digital participatory planning. This is critical due to the exponential increase in digital interventions that has left little time for critical reflection and effective self-assessment. Cities are racing toward being smart without identifying if they are ready to be smart embracing the co-creation of the smart city model (Boyd, 2015). This seems to be more crucial in small cities, because these cities have attracted less attention from the research community. They often have fewer resources compared to larger cities and thus, need to optimize the use of these resources (Manda and Backhouse, 2019; Varela-Álvares et al., 2019). Additionally (Dezuanni et al., 2017), argued that small cities need different policies, instead of just blindly copying "smart city" and "growth" strategies and policies from their metropolitan counterparts (and by doing so, introducing the same problems large cities face). Small cities should not start the transition to DPP before testing their maturity because the social and economic costs would be higher in case of failure. This study considered two main groups of factors that might be affecting the maturity of the city to introduce DPP, namely, factors related to governmental organizations and factors related to the society. These factors were examined in Schiedam city, Netherlands, using a mixed-methods approach to answer the question of whether Schiedam city is mature enough to be introduced to DPP.

5.1. Factors related to the governmental organization

Varying results were obtained regarding whether governmental representatives trust the citizens' opinions and whether they think participation processes are important. However, most of the interviewees showed reasonable levels of trust in the citizens' input, while others expressed resistance to the participation as a concept and thought that the government is giving too much power to the citizens. Similarly, the results showed that the majority of the governmental representatives believe in the positive effect of the concept of citizen participation and they often aim to create high quality plans that respond to the public interests. This suggests that while there is a general acceptance among the governmental representatives regarding the importance of applying the concept of citizen participation in city planning, they seemed to still question the community's capability and maturity to generate feasible ideas and new knowledge. However, the level of trust in the community's opinion was linked to the education level of citizens who are involved in the participation activities. This result is in line with previous research, which suggested that citizen's education level could affect the quality of participation (Palen et al., 2010). Nevertheless, the perceptions of several governmental representatives, who were against participatory planning and whose goal was just to satisfy mandates, were indeed alarming and might affect the readiness of the city to introduce DPP. This undesirable attitude toward the participation concept might be due to a complex array of reasons that starts with not wanting to deal with opposition from the community and does not end with the extra workload often associated with the participation process. Christensen and McQuestin (2019) found that the time required for citizen participation is the biggest challenge facing governmental representatives while delivering participatory planning projects, which might cause resistance or dis-appreciation. Finally, in terms of the availability of IT resources and the familiarity of utilizing ICT to facilitate participatory planning, the city's level of maturity for introducing DPP was found to be adequate. Having a dedicated team in the organization that is specialized in online communication was found to be useful and effective in facilitating the transition to DPP. However, attention should also be given to emerging ICT that might better facilitate the participation process. Technologies, such as virtual reality and augmented reality could have great potential (Alatalo et al., 2017; Mueller et al., 2018). However, cautionary from the bedazzlement effect (Foth et al., 2018) such technologies can trigger should be carefully addressed.

5.2. Factors related to the society

First, the collected data for the city of Schiedam suggested that it generally has lower socioeconomic levels compared to the national average. However, this generalization does not apply for the whole city because participation levels were claimed to be higher in neighborhoods with upper socioeconomic levels. Additionally, the sociodemographic characteristics seem to influence their maturity to being introduced to DPP (Mallan et al., 2010). Public administrations might consider the customization of the participation processes according to the sociodemographic characteristics to improve competences and facilitate the participation of certain under-represented social groups (Wood and Landry, 2007; Parra-Agudelo et al., 2018). Anthopoulos (2019) suggested that social coherence challenges can be addressed by aligning with the latest ICT policies. By focusing on the needs of the local population, meeting citizens' expectations, and solving community problems, the successful evolvement into a smart city can be achieved. Second, the results have revealed that the participants trusted the positive effect of the community engagement practices on the society more than their trust in the citizen participation as a concept. This might be related to the level of trust in the government itself. Previous work in this field suggested that trust in administrative organizations does affect the levels of involvement and conviction for the citizen participation concept and processes (Smith et al., 2013; Spyra et al., 2019). Age, gender, and education level have no effect neither on the level of trust in the participation concept nor on its impact. However, the inferential analysis provided evidences that those who frequently attend conventional participation activities were more likely to trust participation as a concept, whereas those who frequently participate in online debates were more likely to appreciate the positive effect of the process on the community. This observation suggests that the higher frequency of participation would lead to more trust. Similarly, Fredericks and Foth (2013) suggest that people who are sympathetic to local issues and are already informed are more likely to seek out public participation activities, both through traditional channels or online.

Therefore, municipalities should strive to attract citizens to attend participation activities more frequently to enhance their maturity to the introduction of DPP. Third, the participants showed relatively low levels of trust that their opinions were influential. They were also relatively unsatisfied with the participation methods applied by the municipality. In particular, males were significantly less confident that the output of the participation activities would influence the decision of the municipality when compared with female participants. Other demographic characteristics, such as age and education showed no association with this factor. This seems to be a very important finding, which is likely to hinder the introduction of DPP. Authorities should take this issue seriously if they want to smarten their participation processes and transit to DPP. They should demonstrate to the community that their opinions are being taken into consideration during the planning process and that some of the requests of the community have been implemented (Anthopoulos, 2019). They should also explain the reasons, the practical obstacles, and the administrative limitations in cases where the community's desires could not be met. Fourth, the participants have shown a high level of technology utilization tendencies. They were familiar with online environments, and they were satisfied with the online services provided by the municipality in which they tend to do most of their administrative tasks. The results also showed that participants who are active online users participated more in online debates regarding their neighborhoods. The findings confirmed that technology utilization tendencies are a significant factor when introducing DPP. Accordingly, the concerned community showed relatively high level of maturity to the introduction of DPP against this factor. However, as recently argued by Costa and Oliveira (2017), Almeida et al. (2018), and Yigitcanlar et al. (2019), technology by itself cannot create smart cities. Thus, the high levels of technology utilization tendencies do not contradict the fact that the city is not fully mature to the introduction of DPP based on its performance against other social factors.

Lastly, citizens showed minimal privacy concerns when it comes to utilizing online environments, given the high levels of digital literacy. This observation confirmed their familiarity with technology utilization and the community's maturity toward the introduction of DPP.

Further analysis showed that having previous experience in attending conventional participation activities has significant effect on the first two social factors, which were both related to trust. Participants who previously took part in participation activities showed a higher level of trust in the concept of participation, as well as in the influence the community has on the authority's decision. Nonetheless, having previous experience in online engagement event has shown no significant effect on any of the two social factors. Therefore, it was concluded that during the planning process, conventional participation methods that are based on getting people together to discuss and deliberate the future of their cities are still a pre-requisite for successful participation practices. Such engagement events seemed to nourish citizens' appreciation of the participation concept and enhance their confidence in the authorities.

5.3. Practical implications

This study proposes a framework that would allow governmental and administrative organizations to assess their level of maturity to be introduced to DPP as part of the transition toward sustainable smart cities. This framework allows them to identify their strength and weakness that might foster or hinder the introduction of DPP. The findings of this study could be utilized beyond the field of citizen participation or smart governance and be cast on other smart city initiatives, such as smart mobility or smart economy. At the organizational level, raising awareness on the importance of applying the concept of participatory planning among employees is an important part of enhancing the social sustainability of a city. Civil servants who are engaged in citizen participation activities should be well-informed of the positive impacts of the process. They should be carefully selected to ensure successful implementation and full maturity for the introduction of DPP. Municipality might run periodic training courses to explain the challenges involved in participatory activities and ways to deal with them based on best practices and findings from credited research. In addition, adequate resources and staff should be allocated for the participation process. This might be best practiced by allocating specialized staff, who are responsible for engaging the public in participatory planning, in addition to having community engagement specialists. In all cases, digital support should be available to everyone involved in the participation process at any time. To enhance the level of maturity of the city, the organization should also initiate awareness campaigns and reach out to citizens, especially male citizens, via a variety of online and conventional channels to explain the participation process, encourage involvement, and nourish interest. Governmental organizations should also foster the involvement of female citizens in participatory planning and enhance the level of trust in their decisions by considering citizen input effectively. Similarly, when the community desires could not be met, the reasons and rational behind them should be made clear to the community. Such information might be communicated to the citizens via online channels, flayers, reports,

seminars, and social events. However, this effort might come with some time and cost limitations. Although we agree that the future is geared toward smartening cities via participatory planning, our results suggested that DPP should be coupled with conventional methods that encourage freedom in expressing opinions, in-person discussions, direct feedback on the process, and face-to-face deliberation among community members. This is likely to enhance trust and improve the mutual relationship between both parties. Hence, our general observation is that to be fully mature for the introduction of DPP, cities should already have good conventional citizen participation practices, where the concept is well known, the trust in the process and the government is relatively high, and technology utilization tendencies are high.

5.4. Study limitations & recommendations for future research

Although this study has shed light into several significant, yet underemphasized issues related to DPP, it has some limitations. First, the list of factors that were analyzed in this study might not be exhaustive. Thus, future research should build upon our work and include additional factors in the assessment framework. Second, this study was focused on a single city. Although no claim is made regarding the generalization of the results, the findings of this study have provided useful insights into what could foster or hinder the introduction of DPP in small European cities. These findings could form guidelines for other governmental organizations to reflect on and act upon to improve their readiness to develop sustainable smart cities. Third, the field of inquiry (The Netherlands) hosts a highly "open-minded" and advanced community with high rates of digital literacy. Results derived from such case studies might not be applicable to cities with extremely different circumstances. Accordingly, future research should compare the results presented in this work with the results from other cities and look for common trends and shared characteristics. Future endeavors should explore the role of the "invisible voices" in the development of an inclusive and socially sustainable smart city. Lastly, the capabilities of the technocratic approaches for addressing environmental, economical, and social challenges should be investigated. Recent studies have reported that smart cities initiatives are failing to live up to environmental sustainability expectations (Yigitcanlar et al., 2019). This, in turn, opens up questions about social and economic sustainability expectations.

6. Conclusion

This paper calls for a rational and gradual move toward implementing DPP in small cities in an effort to smarten these cities. This study has tested a framework that would allow governmental organizations to assess the extent to which their civil servants and their communities are mature enough to introduce DPP. The findings suggested that in cases where the city is not fully mature to introduce DPP, efforts should be made to overcome issues related to the governmental organizations themselves, and issues related to the society. Both civil servants and the community appeared to be adequately literate in terms of using digital tools. However, issues related to the attitude of some of the planners involved in the participation process, and the lack of trust in the community's ability to generate feasible ideas in one hand, and the citizens' uncertainty over the influence that their opinions has on governmental organization's decisions in the other, were found to be the main obstacles that might hinder the transition to DPP in this city. This study has found that male participants trusted the governmental organization lesser than their female counterparts; and that more frequent attendance to conventional participation activities is likely to enhance citizens' trust in the participation process. This paper concludes with a call for widespread awareness campaigns targeting at male citizens, promoting the participation of more female citizens, and maintaining the practice of conventional participation methods, which are based on in-person interactions and face-to-face deliberations, parallel to the gradual transition to DPP. The proposed maturity assessment method can be used by municipalities to guide the development of evidence-based and tailored policies, and remedial solutions to enhance the transition to smart and sustainable participatory planning practices under the umbrella of smart cities concept. The findings have emphasized that participatory planning is a matter of attitude, which has to be developed gradually in a community and not imposed due to the availability of technology. Social choices and behavior can influence how technologies evolve, implemented, and achieve their performance.

Funding

Research fund was provided by Schiedam Municipality, Netherlands under contract number (28082017) and is hereby gratefully acknowledged. Schiedam Municipality is not involved in the study design, the collection, analysis resources, in the writing of the article, nor the decision to submit the article for publication.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Islam Bouzguenda: Conceptualization, Methodology, Investigation, Formal analysis, Writing - original draft, Funding acquisition. **Chaham Alalouch:** Conceptualization, Formal analysis, Writing - review & editing, Supervision. **Nadia Fava:** Conceptualization, Writing - review & editing, Supervision.

Acknowledgement

This study is an integral part of a PhD research project being conducted at Universitat de Girona, Spain, and in collaboration with Sultan Qaboos University, Oman.

References

Afzalan, Nader, Muller, Brian, 2014. The role of social media in green infrastructure planning: a case study of neighborhood participation in park siting. J. Urban Technol. 21 (3), 67–83.
Afzalan, Nader, Sanchez, Thomas W., Evans-Cowley, Jennifer, 2017. Creating smarter cities: considerations for selecting online participatory tools. Cities 67, 21–30.
Alalouch, Chaham, 2018. A pedagogical approach to integrate parametric thinking in early design studios. Archnet-IJAR: Int. J. Architect. Res. 12 (2), 162.
Alatalo, Toni, Pouke, Matti, Koskela, Timo, Hurskainen, Tomi, Florea, Ciprian, Ojala, Timo, 2017. Two real-world case studies on 3D web applications for participatory urban planning. In: Proceedings of the 22nd International Conference on 3D Web Technology, 11. ACM.
Almeida, Virgilio AF., Doneda, Danilo, Moreira da Costa, Eduardo, 2018. Humane smart cities: the need for governance. IEEE. Inter. Comput. 22 (2), 91–95.
Anthopoulos, Leonidas G., 2017. Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?, 22. Springer International Publishing, Cham.
Anthopoulos, Leonidas G., Tougountzoglou, Theologis E., 2012. A viability model for digital cities: economic and acceptability factors. In: Reddick, C., Aikins, S. (Eds.), Web 2.0 Technologies and Democratic Governance. Public Administration and Information Technology, 1. Springer, New York, NY.
Anthopoulos, Leonidas, 2019. 7 - the smart city of Trikala. In: Smart City Emergence. Leonidas Anthopoulos. Elsevier.
Arnstein, Sherry, 1969. A ladder of citizen participation. J. Am. Inst. Plan. 35 (4), 216–224.

Bherer, Laurence, Gauthier, Mario, Simard, Louis, 2017. The Professionalization of Public Participation. Taylor & Francis.
Blahna, Dale J., Yonts-Shepard, Susan, 1989. Public involvement in resource planning: toward bridging the gap between policy and implementation. Soc. Nat. Resour. 2 (1), 209–227.
Boukherroub, Tasseda, D'amours, Sophie, Rönnqvist, Mikael, 2018. Sustainable forest management using decision theaters: rethinking participatory planning. J. Clean. Prod. 179, 567–580.
Bouzguenda, Islam, Alalouch, Chaham, Fava, Nadia, 2019. Towards smart sustainable cities: a review of the role digital citizen participation could play in advancing social sustainability. Sustain. Cities Soc. 101627.
Boyd, Cohen, 2015. The 3 Generations of Smart Cities.
Briones, Rowena L., Kuch, Beth, Liu, Brooke Fisher, Jin, Yan, 2011. Keeping up with the digital age: how the American Red Cross uses social media to build relationships. Publ. Relat. Rev. 37 (1), 37–43.
Brown, Greg, Chin, Sean Yeong Wei, 2013. Assessing the effectiveness of public participation in neighbourhood planning. Plann. Pract. Res. 28 (5), 563–588.
Christensen, Helen E., McQuestin, Dana, 2019. Community engagement in Australian local governments: a closer look and strategic implications. Local Govern. Stud. 45 (4), 453–480.
Cornwall, Andrea, 2002. Making Spaces, Changing Places: Situating Participation in Development. IDS Working Paper. Institute of development studies, Brighton.
Clarke, Rachel, Heitlinger, Sara, Light, Ann, Forlano, Laura, Foth, Marcus, DiSalvo, Carl, 2019. More-than-human participation: design for sustainable smart city futures. Interactions 26 (3), 60–63.
Costa, E.M., Oliveira, A.D., 2017. Humane smart cities. In: The Oxford Handbook of Interdisciplinarity, pp. 228–240.
Dezuanni, Michael, Foth, Marcus, Mallan, Kerry, Hughes, Hilary, 2017. Digital Participation through Social Living Labs: Valuing Local Knowledge, Enhancing Engagement. Chandos Publishing.
Dijkstra, Lewis, Poelman, Hugo, 2012. Cities in Europe: the new OECD-EC definition. Reg. Focus 1, 1–13.
Dooling, Sarah, Simon, Gregory, Yocom, Ken, 2006. Place-based urban ecology: a century of park planning in Seattle. Urban Ecosyst. 9 (4), 299–321.
Edmiston, Kelly D., 2003. State and local e-government: prospects and challenges. Am. Rev. Publ. Adm. 33 (1), 20–45.
eGovernment policy of the European Union, 2009. Ministerial Declaration on eGovernment. Malmö.
Estevez, Elsa, Janowski, Tomasz, 2013. Electronic governance for sustainable development—conceptual framework and state of research. Govern. Inf. Q. 30, S94–S109.
European Commission, 2010. The European eGovernment Action Plan 2011-2015 Harnessing ICT to Promote Smart, Sustainable & Innovative Government. Action Plan, Brussels.
Felin, Teppo, Zenger, Todd R., 2014. Closed or open innovation? Problem solving and the governance choice. Res. Pol. 43 (5), 914–925.
Field, Andy, 2013. Discovering Statistics Using IBM SPSS Statistics. sage.
Foth, Marcus, Caldwell, Glenda Amayo, 2018. More-than-human media architecture. In: Proceedings of the 4th Media Architecture Biennale Conference, pp. 66–75.
Foth, Marcus, Paulos, Eric, Satchell, Christine, Paul, Dourish, 2009. Pervasive computing and environmental sustainability: two conference workshops. IEEE Pervasive Comput 8 (1), 78–81.
Foth, Marcus, Caldwell, Glenda Amayo, Fredericks, Joel, Volz, Kirsty, 2018. Augmenting cities beyond bedazzlement: empowering local communities through immersive urban technologies. In: Workshop Proceedings of Augmenting Cities and Architecture with Immersive Technologies. Media Architecture Biennale (MAB), Beijing, China.
Foth, Marcus, Forlano, Laura, Satchell, Christine, Gibbs, Martin, 2011. From Social Butterfly to Engaged Citizen : Urban Informatics, Social Media, Ubiquitous Computing, and Mobile Technology to Support Citizen Engagement. The MIT Press, Cambridge, Mass.
Foth, Marcus, 2018. Participatory urban informatics: towards citizen-ability. Smart. Sustain. Build. Environ. 7 (1), 4–19.
Fredericks, Joel, Foth, Marcus, 2013. Augmenting public participation: enhancing planning outcomes through the use of social media and web 2.0. Aust. Plan. 50 (3), 244–256.
Fredericks, Joel, Caldwell, Glenda Amayo, Foth, Marcus, Tomitsch, Martin, 2019. The city as perpetual beta: fostering systemic urban acupuncture. In: The Hackable City,. Springer, Singapore, pp. 67–92.
Fuldauer, Lena I., Ives, Matthew C., Adshead, Daniel, Scott, Thacker, Hall, Jim W., 2019. Participatory planning of the future of waste management in small island developing states to deliver on the Sustainable Development Goals. J. Clean. Prod. 223, 147–162.
Gil-García, J. Ramón, Pardo, Theresa A., 2005. E-government success factors: mapping practical tools to theoretical foundations. Govern. Inf. Q. 22 (2), 187–216.
Gil-Garcia, J. Ramon, Helbig, Natalie, Ojo, Adegboyega, 2014. Being Smart: Emerging Technologies and Innovation in the Public Sector, 31. Government Information Quarterly, pp. I1–I8.
Gillett, Sharon E., Lehr, William H., Osorio, Carlos, 2004. Local government broadband initiatives. Telecommun. Pol. 28 (7–8), 537–558.
Goldsmith, Stephen, Crawford, Susan, 2014. The Responsive City: Engaging Communities through Data-Smart Governance. John Wiley & Sons.
Harrison, Richard, Thomas, Michael, 2009. Identity in online communities: social networking sites and language learning. Int. J. Emerg. Technol. Soc. 7 (2), 109–124.
Healey, Patsy, 1998. Collaborative planning in a stakeholder society. Town Plan. Rev. 69 (1), 1.
Houghton, Kirralie, Miller, Evonne, Foth, Marcus, 2014. Integrating ICT into the planning process: impacts, opportunities and challenges. Aust. Plan. 51 (1), 24–33.
Hughes, Hilary, Foth, Marcus, Dezuanni, Michael, Mallan, Kerry, Allan, Cherie, 2018. Fostering digital participation and communication through social living labs: a qualitative case study from regional Australia. Commun. Res. Practice. 4 (2), 183–206.
Innes, Judith E., Booher, David E., 2004. Reframing public participation: strategies for the 21st century. Plann. Theor. Pract. 5 (4), 419–436.
Jamieson, Susan, 2004. Likert scales: how to (ab) use them. Med. Educ. 38 (12), 1217–1218.
Kahila-Tani, Maarit, Broberg, Anna, Kyttä, Marketta, Taylor, Tyger, 2016. Let the citizens map—public participation GIS as a planning support system in the helsinki master plan process. Plann. Pract. Res. 31 (2), 195–214.
Kimathi, Flora A., Zhang, Yi, Hu, Longji, 2019. Citizens' acceptance of E-government service: examining E-tax filing and payment system (ETFPS) in Tanzania. Afr. J. Libr. Arch. Inf. Sci. 29 (1), 45–62.
Komito, Lee, 2005. e-Participation and Governance: widening the net. Electron. J. eGovernment 3 (1), 39–48.
Krasnova, Hanna, Günther, Oliver, Spiekermann, Sarah, Koroleva, Ksenia, 2009. Privacy concerns and identity in online social networks. Ident. Info. Soc. 2 (1), 39–63.
n.d Labor Market service. Labor market information, Accessed march 2018. https://www.uwv.nl/overuwv/pers/dossiers/arbeidsmarktinformatie/detail/werkloosheid.
Laurian, Lucie, Shaw, Mary Margaret, 2009. Evaluation of public participation: the practices of certified planners. J. Plann. Educ. Res. 28 (3), 293–309.
Levenda, Anthony M., Keough, Noel, Rock, Melanie, Miller, Byron, 2020. Rethinking public participation in the smart city. The Canadian Geographer / Le Géographe canadien 1–15.
Lodato, Thomas, DiSalvo, Carl, 2018. Institutional constraints: the forms and limits of participatory design in the public realm. In: Proceedings of the 15th Participatory Design Conference.Full Papers-Volume, 5. ACM.
Lopez, Claudia, 2016. Modeling Sustainability of Participatory Information Systems for Urban Communities: A Mixed-Method Approach. PhD dissertation. University of Pittsburgh.
Mallan, Kerry, Foth, Marcus, Greenaway, Ruth, Greg, T., Young, 2010. Serious playground: using Second Life to engage high school students in urban planning. Learn. Media Technol. 35 (2), 203–225.
Manda, More Ickson, Backhouse, Judy, 2019. Smart governance for inclusive socio-economic transformation in South Africa: are we there yet?. In: E-participation in Smart Cities: Technologies and Models of Governance for Citizen Engagement. Springer, Cham, pp. 179–201.
McAfee, Andrew, Brynjolfsson, Erik, Davenport, Thomas H., Patil, D.J., Barton, Dominic, 2012. Big data: the management revolution. Harv. Bus. Rev. 90 (10), 60–68.
Michels, Ank, De Graaf, Laurens, 2017. Examining citizen participation: local participatory policy making and democracy revisited. Local Govern. Stud. 36 (4), 477–491.
Michels, Ank M.B., 2006. Citizen participation and democracy in The Netherlands. Democratization 13 (2), 323–339.
Mueller, Johannes, Lu, Hangxin, Chirkin, Artem, Klein, Bernhard, Schmitt, Gerhard, 2018. Citizen Design Science: a strategy for crowd-creative urban design. Cities 72, 181–188.
Nasca, Tessa F., Changfoot, Nadine, Hill, Stephen D., 2019. Participatory planning in a low-income neighbourhood in Ontario, Canada: building capacity and collaborative interactions for influence. Community Dev. J. 54 (4), 622–642.
Neuendorf, Kimberly A., 2016. The Content Analysis Guidebook. Sage.
Norton, Richard K., 2008. Using content analysis to evaluate local master plans and zoning codes. Land Use Pol. 25 (3), 432–454.
Okyere-Kwakye, Eugene, Nor, Khalil Md, Andrew, C., Ologbo, 2016. Technology Acceptance: examining the intentions of Ghanaian teachers to use computer for teaching. Afr. J. Libr. Arch. Inf. Sci. 26 (2), 119.
Palen, Leysia, Anderson, Kenneth M., Mark, Gloria, Martin, James, Douglas, Sicker, Palmer, Martha, Grunwald, Dirk, 2010. A vision for technology-mediated support for public participation & assistance in mass emergencies & disasters. In: 2010 ACM-BCS Visions of Computer Science Conference, 8. British Computer Society.
Palfrey, John, Gasser, Urs, 2012. Interop: the Promise and Perils of Highly Interconnected Systems. Basic Books (AZ).
Parra-Agudelo, Leonardo, Choi, Jaz Hee-jeong, Foth, Marcus, Estrada, Carlos, 2018. Creativity and design to articulate difference in the conflicted city: collective intelligence in Bogota's grassroots organisations. AI Soc. 33 (1), 147–158.
Putnam, Robert D., 1993. Making Democracy Work: Civic Traditions in Modern Italy. Princeton University Press, NJ.
Rosener, Judy B., 1982. Making bureaucrats responsive: a study of the impact of citizen participation and staff recommendations on regulatory decision making. Publ. Adm. Rev. 339, 345.
Rosenthal, Robert, 1991. Meta-analytic Procedures for Social Research. Sage, Newbury Park, CA.
Rowe, Gene, Frewer, Lynn J., 2000. Public participation methods: a framework for evaluation. Technol. Human. Value. 25 (1), 3.

Schroeter, Ronald, Houghton, Kirralie, 2011. Neo-planning: location-based social media to engage Australia's new digital locals. Aust. Plan. 48 (3), 191–202.
Schroeter, Ronald, Foth, Marcus, Satchell, Christine, 2012. People, content, location: sweet spotting urban screens for situated engagement. In: Proceedings of the Designing Interactive Systems Conference. ACM, pp. 146–155.
Sichone, Joyce, Milano, Rufina, Kimea, Alfred, 2018. The influence of facilitating conditions, perceived benefits, and perceived risk on intention to adopt e-filing in Tanzania. Bus. Manag. Rev. 20 (2), 50–59.
Slotterback, Carissa Schively, 2011. Planners' perspectives on using technology in participatory processes. Environ. Plann. Plann. Des. 38 (3), 468–485.
Smith, Jordan, W., JessicaLeahy, E., DorothyAnderson, H., Mae, A. Davenport., 2013. Community/agency trust and public involvement in resource planning. Soc. Nat. Resour. 264, 452–471.
Spyra, Marcin, Kleemann, Janina, Cetin, Nuket Ipek, Navarrete, Cesar Jesús Vázquez, Albert, Christian, Palacios-Agundez, Igone, Ametzaga-Arregi, Ibone, et al., 2019. The ecosystem services concept: a new Esperanto to facilitate participatory planning processes? Landsc. Ecol. 34 (7), 1715–1735.
Stutzman, Frederic, 2006. An evaluation of identity-sharing behavior in social network communities. J. Int. Dig. Media. Art. Assoc. 3 (1), 10–18.
Townsend, Anthony M., 2013. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia. WW Norton & Company.
Varela-Álvares, Enrique José, Mahou-Lago, Xosé María, Viso, Mónica López, 2019. Do smart cities really provide opportunities for citizen participation? A case study of the RECI cities in Spain (2017). In: E-participation in Smart Cities: Technologies and Models of Governance for Citizen Engagement. Springer, cham, pp. 37–58.
Wallin, Sirkku, Horelli, Liisa, Saad-Sulonen, Joanna, 2010. Digital Tools in Participatory Planning. Centre for Urban and Regional Studies Publications, Espoo.
Wood, Phil, Landry, Charles, 2007. The Intercultural City: Planning to Make the Most of Diversity. Earthscan.
Woolley, Julia K., Limperos, Anthony M., Oliver, Mary Beth, 2010. The 2008 presidential election, 2.0: a content analysis of user-generated political Facebook groups. Mass Commun. Soc. 13 (5), 631–652.
Yigitcanlar, Tan, Kamruzzaman, Md, Foth, Marcus, Sabatini, Jamile, da Costa, Eduardo, Ioppolo, Giuseppe, 2019. Can cities become smart without being sustainable? A systematic review of the literature. Sustain. Cities Soc. 45, 348–365.
Yigitcanlar, Tan, Foth, Marcus, Kamruzzaman, Md, 2019. Towards post- anthropocentric cities: reconceptualizing smart cities to evade urban ecocide. J. Urban Technol. 26 (2), 147–152.

3.3 Would 3D Digital Participatory Planning Improve Social Sustainability in Smart Cities? An Empirical Evaluation Study in Less-advantaged Areas

This section is a transcription of the revised version of the (under-peer review)[2] paper: Bouzguenda, I., Fava, N., & Alalouch, C. "Would 3D Digital Participatory Planning Improve Social Sustainability in Smart Cities? An Empirical Evaluation Study in Less-advantaged Areas". *Journal of Urban Technology.*

This section examined the implications of utilizing DPP on the participatory planning process and accordingly the ability to foster community engagement, empowerment, and equality towards a socially sustainable smart city. A monitoring process was implemented on a real development project in one of the less-advantaged neighborhoods in the Dutch city of Schiedam. Results suggest that the socio-demographic characteristics of the concerned community should be considered when utilizing ICT in participatory planning.

[2] The authors have submitted a revised version of the manuscript to the Journal of Urban Technology since the second of September 2020.

Would 3D Digital Participatory Planning Improve Social Sustainability in Smart Cities? An Empirical Evaluation Study in Less-advantaged Areas

Islam Bouzguenda[1*], Nadia Fava[2], Chaham Alalouch[3]

[1]*Geography Department, Universitat de Girona*

[2]*Department of Architecture and Construction Engineering, Universitat de Girona, Spain*

[3]*Department of Civil and Architectural Engineering, Sultan Qaboos University*

Abstract

This study evaluates the impact of utilizing three-dimensional digital participatory planning (3DDPP) on planning practices. This method was tested within the framework of a redevelopment project in one of the less-advantaged neighborhoods in the Dutch city of Schiedam. An interactive 3DDPP tool was utilized by a group of residents who co-designed public spaces in the neighborhood. Residents were given the opportunity to visualize online the project area in 3D format, suggest their ideas, comment on the design proposal, produce interactive graphical designs online, and interact with each other. The impact of this process was tested according to five criteria (efficiency, feasibility, attractiveness, interaction, and satisfaction) developed via free-listing and pile-sorting methods in collaboration with nine experts. A qualitatively-driven (QUAL) mixed method was used to analyze the data collected from a sample of 62 subjects, which include professionals and citizens. The results showed that the utilization of 3DDPP tools can potentially enhance community engagement in decision-making. This article concludes by emphasizing that socio-economic, political, and demographic challenges, which might decrease the residents'

willingness to be actively engaged in collaborative decision-making, might not solely be solved via technologies.

Keywords

E-participation, Co-creation, Participatory planning assessment, Community engagement, Smart cities, Europe

1. Introduction

Contemporary occidental cities are increasingly laced with interactive technologies and sensors, often embedded in an omnipresent smart city infrastructure. There is no doubt that the digital age is affecting our life in which cities are increasingly becoming a playground for social action and co-production supported by social media (Mulder, 2015). Although the social dimension in smart cities has been underestimated in favor of understanding aspects of technology (Anastasiu, 2019), effective engagement of the society as part of these co-production efforts could be crucial for a sustainable transition and for reducing inequality. Some small cities and their disadvantaged areas are struggling to compete with cities that are able to attract wealthy people, thus reinforcing the inequality gap, which is recently considered as one of the four most dangerous global risk factors (World Economic Forum, 2018). Accordingly, in order to establish socioeconomic equality, which is an essential element of smart cities, Yigitcanlar et al. (2018, 156) have stated that "*we need to develop our cities, wired with smart urban technologies, to not only be exclusive to urban elites, but also inclusive to the unfortunate*". Considerably, far fewer researchers advocate the implementation of smart city initiatives in less-advantaged areas as it comes with some risks (Angelidou, 2014; Paskaleva, 2011; Giffinger & Gudrun, 2010). Implementing technological solutions that allows

citizens from specific target groups (e.g., the elderly, unemployed, immigrants or people with special needs) to have easy access to the flow of information would promote social and territorial cohesion in smart and sustainable cities (Santinha & De Castro, 2010). In this context, citizen participation is increasingly associated with social sustainability goals as a form of empowerment and equality (Bouzguenda, Alalouch, & Fava, 2019). Thus, facilitating it digitally is one of the promising aspects associated with the smart and sustainable city agenda. Digital citizen participation is defined as "*technology-mediated interaction between the civil society sphere and the formal politics sphere*" (Sanford & Rose, 2007, 408). Several forms of digital citizen participation are available, such as political participation through social media or web 2.0 applications (Fredericks & Foth, 2013), city development through living labs (Mulder, 2015), participation in online forums (Afzalan, 2015), and collaborative city planning applications (Zhang et al., 2019). Our concern in this study was how collaborative city planning applications can be utilized to engage the citizens in city design and planning (participatory planning), particularly in less-advantaged areas. Mallan et al. (2010), Afzalan and Muller (2014), and Lopez (2016) discussed the influence of socio-demographic characteristics of the community on the effectiveness of utilizing Information and Communications Technology (ICT) in participatory planning. Foth, Brynskov, and Ojala (2015) criticized smart city initiatives that are focusing mainly on spreading ICT by arguing that marginalized groups are often excluded from the flow of information, hence, from decision-making. Participatory planning might include co-designing public amenities, public spaces, streets and neighborhood redevelopment. This study has specifically chosen one of the technologies that is claimed to have the potential of enhancing the experience of digital participatory planning (Afrooz et al., 2018; Tang, 2019), called the Three-Dimensional Digital Participatory Planning (3DDPP). 3DDPP can be defined as a collaborative virtual environment where users (citizens and planners) are immersed in a three-dimensional co-creative social space for designing and

planning their own cities. Tang (2019) addressed the conditions under which 3DDPP methods are likely to work and what can be achieved, as well as how it could foresee the informative power by ICT. This current study reports the impact of introducing 3DDPP in participatory planning practices in less-advantaged areas. Our main research question was what is the impact of introducing 3DDPP on the participatory planning process in less-advantaged areas? To answer this question, a collaboration with a government body was considered. The collaboration with the Dutch city of Schiedam presented a fruitful case study when it comes to investigating digital participatory planning for several reasons. First, the Netherlands is one of the leading countries when it comes to citizen participation. Second, this country hosts a highly "open-minded" and advanced community, with high rates of digital literacy (Michels & De Graaf, 2017). Accordingly, the impact of utilizing a 3DDPP tool in the Dutch city of Schiedam was evaluated according to five evaluation criteria. These criteria were developed using a free-listing and pile-sorting method with some members of the city development team in Schiedam municipality who are usually involved in participatory planning. These criteria include Efficiency, Feasibility, Attractiveness, Interaction, and Satisfaction. The implementation of the 3DDPP tool was tested within the framework of a redevelopment project in Oost, Schiedam. The 3DDPP tool was utilized by a group of residents to co-design a redevelopment project in the neighborhood. Residents were allowed to visualize the project area in 3D format, suggest their ideas, comment on the design proposal, and produce interactive graphical designs online. The results of this study were expected to enrich the learning processes and to separate the good from the bad practices (Santinha & De Castro, 2010). The development of indicators can be used to appraise and monitor the impact of ICT services, and adjust the necessary measures to fulfill peoples' expectations toward creating socially sustainable smart cities. The following sections will present a literature review of the revolutionary evolvement of participatory planning and its relation to smart cities, followed by an exploration of related evaluative

frameworks. Next is an introduction to the research methodology, including the development of the evaluation criteria and the experiment evaluation. This is followed by the developmental results of the evaluation criteria, the final list of the criteria, followed by the results of the experiment evaluation. The final section will reflect on several conditions for successful implementation and recommendations for decision makers.

2. Background

2.1 Community engagement and governance

In a world with more than half of its population living in cities (United Nations, 2014), overwhelmed governments have been increasingly moving toward collaborative forms of governance. Hence, a greater dialogue is needed between governments and the people to improve the effectiveness and inclusiveness of participatory decision-making processes (Fredericks, 2020). Participatory decision-making processes related to economic, political, management, and cultural activities have been associated with having positive outcomes on the social sustainability of the society. These outcomes included empowerment (Colantonio, 2009), building a wider consensus, and increased public trust (Falco, 2019). In the context of participatory planning, citizens who are effectively engaged could experience an increased sense of place, responsibility and attachment, community stability, and equity (Colantonio, 2009). However, conventional methods of participatory planning, such as face-to-face workshops, community forums, and public hearings, can only reach certain demographics of the population. As a result, opinions of community members who are classified as 'hard to reach' are not reflected in the overall engagement process (Fredericks et al. 2019). Utilizing ICT in the context of smart cities model is a promising aspect, in terms of enhancing citizen involvement, which could improve social sustainability. Boosting social sustainability through

a wider and more enhanced citizen participation would have a great potential, given that the main goal of modern cities is to achieve better livable cities (Yigitcanlar et al., 2019).

2.2 Participatory planning in smart sustainable cities

In the context of smart cities, human fascination with technology in the current practice has rung the alarm bells with the shifting emphasis on the concept of "smart sustainable cities", whereby "sustainable" is now entwined with "smart" to achieve the desired outcomes. A smart sustainable city is defined as "*a city that meets the needs of its present inhabitants, without compromising the ability of other people or future generations to meet their needs, and thus, does not exceed local or planetary environmental limitations, and where this is supported by ICT" (*Höjer & Wangel, 2015, p. 338). Martin, Evans, and Karvonen (2018) suggested that the potential to empower and include citizens in planning smart cities represents the key to unlocking various forms of smart sustainable urban development that emphasizes on social equity. While smart sustainable cities are increasingly advocated by governments and the private sector as the primary means to deliver urban sustainability, the enrolment of citizens as efficient components of the smart sustainable city has not been specifically addressed in the literature (Martin, Evans, and Karvonen, 2018). Governmental organizations in developed countries are racing toward smartening their cities and citizens. Hence, participationary practices are embracing smart tools and applications that have been applied often without careful consideration to their impacts (Yigitcanlar et al., 2019; Levenda et al., 2020). Ahvenniemi et al. (2017) suggested that the performance of digital participatory planning initiatives must be measured in terms of their environmental, economic, and social benefits according to the three pillars of sustainability. Martin, Evans, and Karvonen (2018) have added that the efficacy of these digital initiatives remain largely unexplored. Agbali (2019) has stressed that there is a paucity of research on appropriate framework models to assess the

impact of smartness on cities. Assessing the implications of smart cities' social strategies (Angelidou, 2014) is particularly vital as suggested by Anastasiu (2019).

2.3 Participatory planning evaluation

Several frameworks have been developed to assess conventional participatory planning initiatives, in addition to several comprehensive lists of criteria that could be utilized to measure the impact of digital tools on participatory planning practices. Sager (1981) assessed formalized evaluation techniques in participatory planning to explore which characteristics can affect the number of people participating, the intensity of their involvement, and the ability to reduce the possibility of ignoring the interest of silent groups. His assessment suggested that a thorough analysis on effects that are central to each participating group is valuable from the view point of public participation in planning. Sarkissian et al. (2009) developed the following eight-point measure toward a successful collaborative community engagement: (1) people know more than they realize; (2) people cannot satisfactorily participate unless they can understand the language being used; (3) people often fear giving opinions, especially in their local community; (4) the people's involvement improves the quality of the local government; (5) synergy is more likely to occur when people collaborate; (6) specific skills are required; (7) relevant professionals should be involved from the start; and (8) there is a community value in sharing participatory experiences. Kusters et al. (2018) proposed a general framework to evaluate the strategies, processes, and performance of multi-stakeholder platforms that are utilized to facilitate integrated landscape initiatives to 'co-design', for example, agricultural fields, rivers, and settlements. Their results showed that the method's success largely depends on having a clear and common understanding among the participants about how the results will be used, and ensuring that participants understand how much their knowledge and participation are valued and appreciated, as well as the importance of a skilled facilitator. Fredericks et al.

(2019) presented an urban acupuncture framework for undertaking localized urban pop-up interventions to guide designers and policy-makers' city-making strategies and encourage active citizen engagement. Their framework consists of six stages, namely, context, objectives, elements, approach, deployment, and outcome. Each stage consists of different concepts that require consideration when creating and deploying a pop-up intervention (Fredericks et al., 2019). In terms of digitalized 3D participatory planning, Hayek (2011) has developed a list of evaluation criteria for measuring how well abstract versus realistic 3D visualization fulfil their required functions. The evaluation minimally touched on the social functions of the media that support social behavior and actions of the stakeholders. Panagopoulos, Jankovska, and Straupe (2012) studied the opportunities of having an interactive 3D virtual environment, known as "second-life", in urban planning with participatory governance. Their study suggested that citizens could be interested if the purpose of urban development is connected to reality, tailored to their needs, and appealing. Herbert and Chen (2015) researched the usability and usefulness of 3D visualization for urban planning by examining the preferences of urban planning professionals with respect to 2D and 3D visualizations. The findings suggested that the benefits of using a 2D or 3D visualization are closely related to the types of planning tasks undertaken. The primary focus of 3D participatory planning evaluative studies should be on the characteristics of 3D visualization tools and usability settings to promote decision-making or on how user-friendly the technology is, as well as on the technical aspects of the technology (Alatalo et al., 2016; Alatalo et al., 2017; Afzalan, Sanchez, & Evans-Cowley, 2017). Thus, it is necessary to develop an assessment method that fits the specific aims of this study, in collaboration with the other stakeholders.

3. Research methodology

To answer the following research question: what is the impact of introducing 3DDPP on the participatory planning process in less-advantaged areas, a redevelopment project in one of the less-advantaged neighborhoods in the Dutch city of Schiedam was selected as a sample in an experiment that utilized a 3D digital participatory planning tool, named 'Modelo' (Modelo, 2014). This experiment was then evaluated using a list of evaluation criteria that were developed simultaneously during the experiment using free-listing and pile-sorting methods. Figure 1 Illustrates the stages of this research.

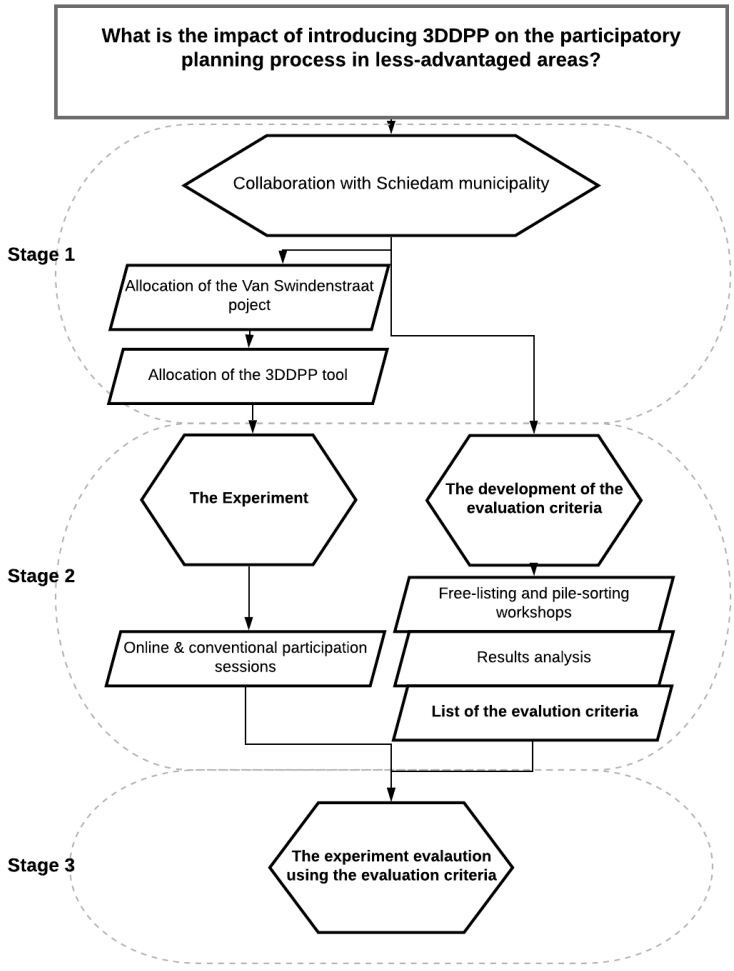


Figure 1 Stages of the research project.

3.1. Van Swindenstraat project

The Netherlands is one of the countries where public participation is widely practiced and mandated by law. The city of Schiedam practices participatory planning in city development projects according to a protocol that follows Arnstein's ladder (Arnstein, 1969). However, the city administration does not restrict the utilization of any participation method aiming to maximize participation. Participatory projects are often focused on the development of central areas, the renewal of old neighborhoods, and the construction of public amenities. The Van Swindenstraat project in the Oost neighborhood was under the category of renewing old neighborhoods, with a population of 755 inhabitants in a total area of 0.25 km^2. The project scope was to redesign the streets, renew the streets' furniture, and reorganize parking spaces and the surrounding landscape. Such participatory planning projects have a social dimension in terms of increasing residents' attachment and sense of place by engaging them in the decision-making process regarding their streets and public spaces. The project area was characterized according to the city council data (Municipal Register of Inhabitants, National Institute of Statistics, and Regional Employment Service) as a young and diverse population, with many young single adults (percentage of adults between 18–64 years old is 73%), a few children (16.7%), and a relatively high percentage of males (54%). The majority of the inhabitants have a migration background (69.1% compared to 41.7% in the city as a whole), especially from Eastern Europe and non-Western countries. Incomes were relatively low (the average household net income was 27,500 Euros/year compared to 35,000 Euros/year in the city as a whole) and unemployment was relatively high. The percentage of non-employed jobseekers under 15–75 years was 7.5% compared to 6.7% in the city as a whole (Labor Market service, n.d.).

3.1.1 3DDPP tool

The 3DDPP tool known as Modelo (Modelo, 2014) was chosen. Although it was basically developed to be utilized within the architecture and construction industry, it supports 3D interactive co-design and total immersion into the 3D model of the project. This can be done via rotating, zooming, walking through the project, and visualizing sections. Thus, an enhanced understanding of the proposed plans could be achieved compared to 2D plans that are typically discussed with the residents in conventional participatory planning events. Other visualized digital participatory planning tools, such as Maptionnaire and Citizenlab are mostly limited to the utilization of large scaled city maps, surveys, and commenting and chatting. The residents do not have the ability to visualize and be immersed within the 3D model of his/her own house or be able to visually collaborate in designing his/her own street. Additionally, Modelo allows participants to suggest their ideas or modifications on the 3D design proposal through 2D sketches and graphical comments. A chatting feature is also available to allow the participants to discuss and review their comments and ideas. This tool also supports uploading pictures from other devices that could help with clarifying the suggested ideas by the participants. Figure 2 Shows the interface of the tool.

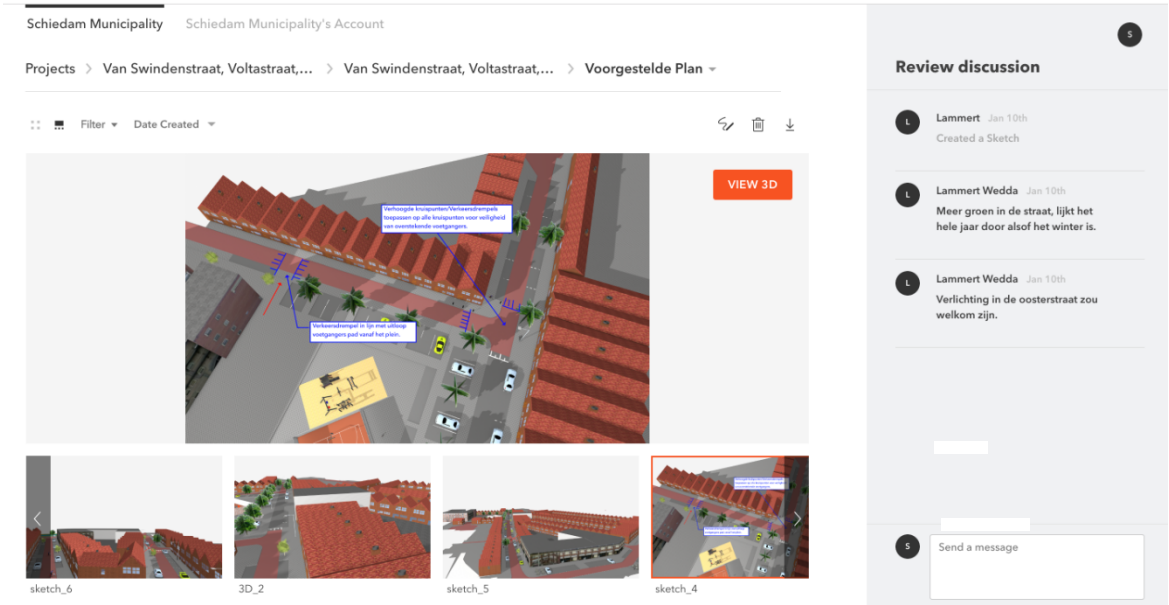


Figure 2 Modelo interface during citizens online participation

To facilitate the utilization of this tool by the residents of the Van Swindenstraat project area, a website was created (virtual participation for all, 2018) to link the selected project to the tool. This website included a 'Home' page where the idea for this experiment was explained. Its 'How it works' page explains to the citizens how they can use the 3DDPP tool. A registration page was set up to collect data about the participants in this research.

3.2 The experiment

The process of conducting this experiment was in line with the usual schedule of the participatory project. Online participation was included within this project as an additional feature made available for the citizens according to the plan shown in Figure 3. This experiment was not restricted to solely utilizing the 3DDPP to give residents, who might lack the expertise to use ICT technologies, the ability to participate. Residents in the project area were informed about the 3DDPP via a returned invitation letters. They were asked to return the letter with their email addresses. The residents were also informed about the 3DDPP experiment during the first participation evening. The researcher explained to the attendees the aim, the procedures, and how the 3DDPP tool can be utilized in this experiment. The whole experiment process took place from June 2018 until March 2019. A total of three conventional participation evenings were conducted with the citizens and two online participation sessions were also conducted by the citizens utilizing the 3DDPP tool. Initially, 32 citizens registered their interest to utilize the 3DDPP tool. Subsequently, 56 citizens attended the three participatory planning meetings.

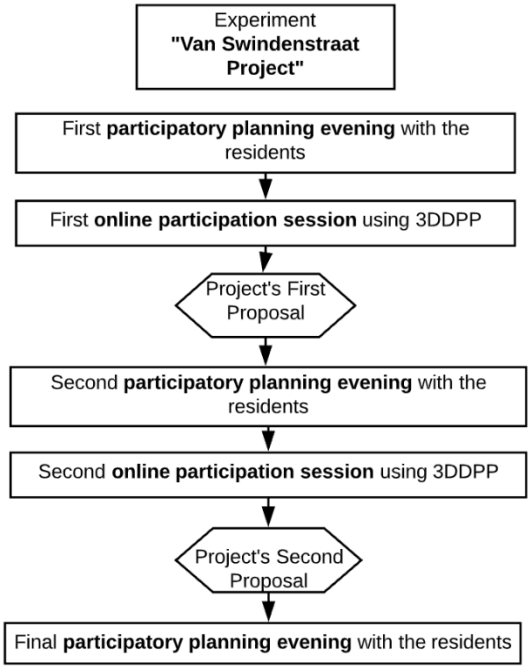


Figure 3 The experiment plan (June 2018 to March 2019)

3.3 Development of the evaluation criteria

This study has identified a list of evaluation criteria by utilizing two of the participatory decision-making methods, named 'Free-Listing' and 'Pile Sorting'. The Free-Listing and Pile Sorting methods were selected due to their practicality and ease of use, in addition to allowing for discussion and building consensus. Free-listing is typically used to model how groups collectively understand a certain domain (Bernard, 2006; Schrauf & Sanchez, 2010). It elicits stakeholders' understanding and consistently ensuring parity between participants by affording each an equal role in the contribution of views (Thomson et al., 2012). In this study, nine experts (five males and four females) from the Schiedam municipality, who were previously involved in participatory planning projects, were asked the following question: what criteria do you think should be considered to evaluate the impact of utilizing 3DDPP on participatory planning practices? Each participant was given a pile of sticky notes and was given a maximum of 5 min to list whatever comes to their minds. Accordingly, the free-listed terms were then

sorted into piles. Pile-sorting is a participatory approach that engages stakeholders into grouping and sorting these piles to identify thematically consistent groups (Blake et al., 2007) by forming clusters of associated terms that make sense (Ensign & Gittelsohn, 1998) to them and suggest a title to each group. The results of this method were then discussed and compared with the relevant literature to create a comprehensive list of evaluation criteria (Table 8), which was utilized later to perform the experiment evaluation.

3.4 The experiment evaluation

To evaluate the impact of introducing the 3DDPP tool on the participatory planning process, a qualitatively-driven (QUAL) mixed method was utilized, as recommended by Morse (2017) for conducting evaluation research. This mixed method included a qualitative core component (QUAL) and three qualitatively supplemental components (*quals*) that were conducted simultaneously (Morse, 1991) according to the following design equation (Figure 4):

$$\text{QUAL} + qual1 + qual2 + qual3$$

The core component (QUAL) was represented by semi-structured interviews. The three supplemental components (*qual1*, *qual2*, *and qual3*) were represented by meetings and participatory research. The sampling strategy was purposeful (Rapley, 2014); only municipality professionals who were involved in the project and residents of the project area were invited to participate. The collected data were analyzed using qualitative content analysis (Flick, 2013; Neuendorf, 2016). First, every single part of the data that was in any way relevant to the research question was examined. Second, relevant segments of the material were assigned to the categories of a theoretical-driven coding frame, as suggested by Schreier (2012). This frame was developed according to the five criteria in Table 8. All data were entered into a coding sheet, where the coding units are the rows and the main categories are the columns. The sub-criteria (Table 8) to which each unit of coding was assigned to was

entered into these cells. Additionally, a secondary layer of analysis, which was a comparative analysis between online and conventional participation, was conducted to further investigate the effect of utilizing the 3DDPP tools. The list of criteria developed according to the theoretical drive was utilized to report the results and discussion.

3.4.1 Data sources & samples

3.4.1.1 Core somponent (QUAL) (Municipality professionals n=10)

Qualitative semi-structured interviews were conducted with 10 municipality professionals who were involved in the Van Swindenstraat project through its full duration. 80% of the interviewees were between 31–50 years old. 90% of them hold a Bachelor's degree or a Master's degree. Their positions in the municipality varied between project managers/leaders, policy advisors, communication advisors, civil/infrastructure engineers, and architects/landscape designers. The sample breakdown is shown in Table 1. The interview guide was designed based on the five evaluation criteria (Table 8). Interviewees were asked to evaluate the experiment in terms of its efficiency, feasibility, attractiveness, interaction, and satisfaction when compared to previous participatory planning projects they were involved in. Table 2 shows some examples of the interview questions. Interviews lasted between 30 to 60 minutes and new questions that followed interviewee's replies were asked. All interviews were recorded, transcribed, and analyzed using qualitative content analysis.

Table 1 Sample breakdown of municipality professionals (n = 10)

Variables		**Percentage**
Gender	Male	50 %
	Female	50 %
Age	21–30	0 %
	31–40	40 %
	41–50	40 %
	51–60	10%
	60+	10%
Position	Project leader	10%
	Project manager	20%
	Communication advisor	10%
	Policy advisor	10%
	Civil/infrastructure engineer	20%
	Architect/landscape designer	10%
	District director	10%
	Junior project leader	10%

Table 2 Examples of the interview questions

Criteria	**Interview questions**
Efficiency	Compared to the conventional participatory planning methods, e.g., evenings, work-groups, to what extent do you think 3DDPP has enabled the generation of more effective and applicable comments by the citizens?
	Do you find it more efficient to mix conventional participation with online participation?
Feasibility	What do you think about the time and budget consumed by the 3DDPP compared to the conventional methods?
Attractiveness	Did the utilization of the 3DDPP enable the participation of a larger and wider spectrum of citizens in terms of age group, educational level, and gender?
	Did the 3DDPP method present some digital-divide issues (e.g., excluding non-internet users)?
	What do you think about applying the 3DDPP method in a neighborhood other than Oost?
	Did you find the number of participants, both online and conventionally, represent the size of the project area, the number of residents, and the location of the project well?
Interaction	Did the 3DDPP method encourage the initiation of new discussion areas between the citizens?
Satisfaction	Did you find the 3DDPP method useful and would you consider using it in your future projects?
	In general, how satisfied are you with the 3DDPP method?

3.4.1.2 Supplemental component (*qual1*) (Interested residents n=30)

The researchers participated in the participatory planning meetings with the residents of the Van Swindenstraat area for 10 months between 2018 and 2019. Meetings were facilitated by

the municipality professionals, and discussions between the residents and the municipality professionals were focused around the possible changes that could be made on the new design proposal. The researchers did facilitate in parts of the meeting concerning the experiment and the implementation of the 3DDPP tool. After the meeting, the researchers approached some of the attendees and discussed with them the project and the implementation of the 3DDPP tool. The discussions explored local participation practices, policies, local challenges, their potential interest in online participation, and their general feedback about the tool. Meeting minutes and freehand notes were reviewed. A total of 30 residents (12 females and 18 males), who attended the meetings, were approached. The sample breakdown is shown in Table 3.

Table 3 Sample breakdown of interested residents (n = 30)

Variables		**Percentage**
Gender	Male	60%
	Female	40%
Age	21–30	26.6%
	31–40	13.3%
	41–50	20%
	51–60	23.3%
	60+	10%
	Missing	6%
Education level	Lower than high school	6%
	High school	0%
	MBO* or similar	10%
	HBO** or similar	20%
	WO***/University or higher	23.3%
	Missing	40%

*MBO: middle-level applied education **HBO: applied university education ***WO: academic university education

3.4.1.3 Supplemental component (*qual2*) (Online participants n=9)

The residents' written and graphical comments that were received via the 3DDPP tool, Modelo, along with their discussions using the 'Review Discussion' feature (Figure 1), were collected and coded. A total of nine residents (five males and four females) registered using Modelo by creating a user name and password for their accounts, with four (44%) of them being younger than 34 years old, as shown in Table 4. The registered residents were able to access the online 3D interactive model of the Van Swindenstraat project during the first and second online

participation sessions (Figure 2). Each session lasted for two weeks. All the received comments, sketches, and the running discussions were found to be relevant to the project's aim in terms of what modifications could be done on the urban design.

Table 4 Sample breakdown of online participants (n = 9)

Variables		**Percentage**
Gender	Male	55.6%
	Female	44.4%
Age	21–30	44.4%
	31–40	22.2%
	41–50	11%
	51–60	11%
	60+	11%
	Missing	0%
Education level	Lower than high school	0%
	High school	0%
	MBO* or similar	11%
	HBO** or similar	0%
	WO***/University or higher	33.3%
	Missing	55.5%

*MBO: middle-level applied education **HBO: applied university education ***WO: academic university education

3.4.1.4 Supplemental component (*qual3*) (Conventional participants, n = 13)

The verbal comments that were given by the residents during the conventional participatory planning meetings were collected and coded. A total of 13 residents made some comments during the conventional participatory planning meetings (Table 5). This number might be different than the total number of attendees (39) since not all the attendees were active participants during the session, many were just listeners. The third supplemental component (*qual3*) was mainly utilized to conduct a secondary layer of analysis, which was a comparative analysis between the conventional and online participations. Figure 4 illustrates the nature of the assessment method, including the comparative analysis.

Table 5 Sample breakdown of conventional participants (n = 13)

Variables		Percentage
Gender	Male	69.2%
	Female	30.7%
Age	21–30	23%
	31–40	15.4%
	41–50	15.4%
	51–60	30.7%
	60+	15.4%
	Missing	0%

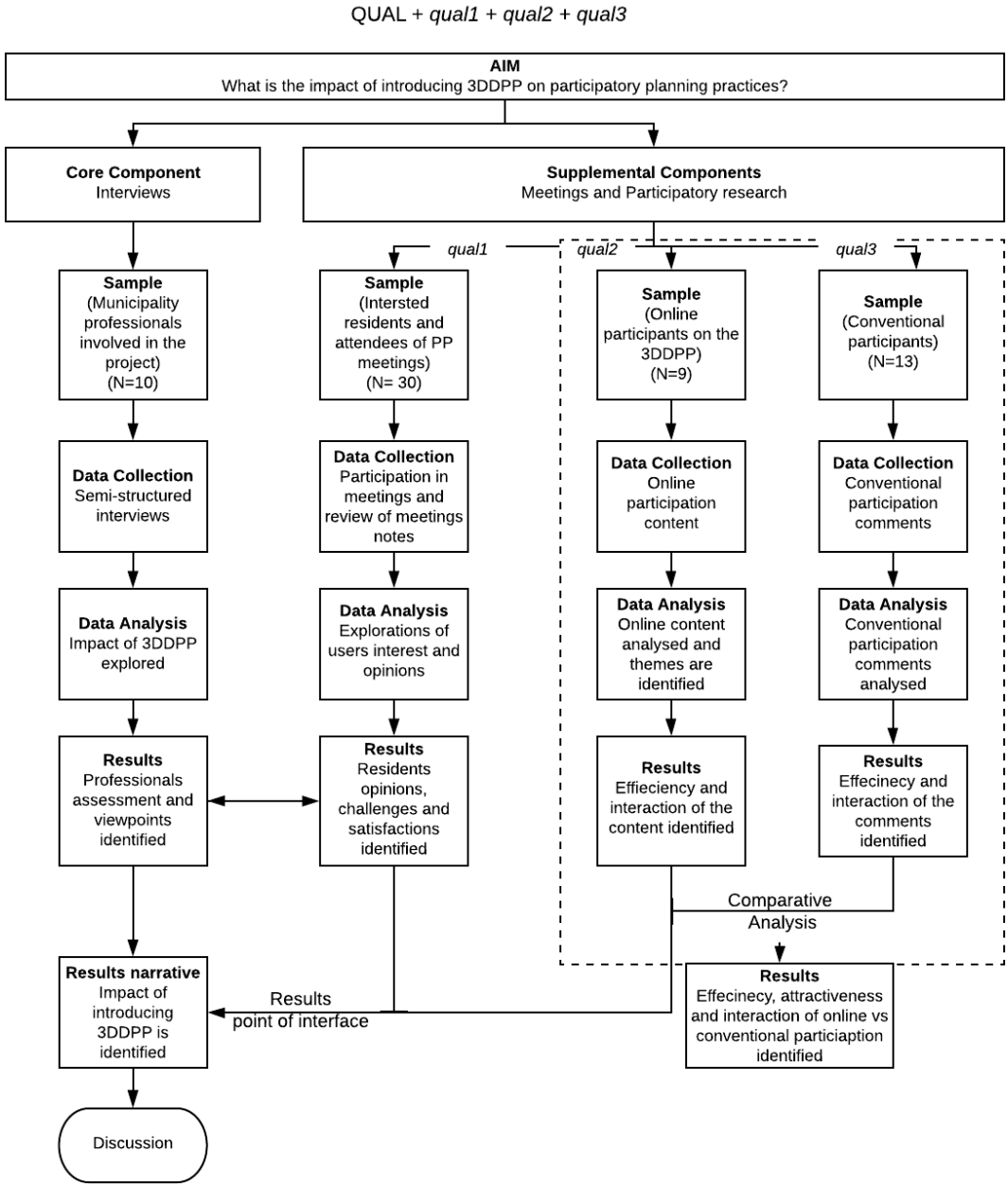


Figure 4 Assessment method that was designed according to the qualitatively-driven (QUAL) mixed method by Morse (2017).

4. Results

To be able to evaluate the experiment, the development of the evaluation criteria was first finalized. The results of the free-listing and pile-sorting workshops were analyzed and discussed against relevant literature to create a comprehensive list of evaluation criteria (Table 8), which was utilized later to perform the experiment evaluation.

4.1 Results of the development of the evaluation criteria

The free-listing exercise resulted in a total of 34 terms and six clusters were formed in the pile-sorting exercise, as shown in Figure 5. The six clusters included Demographics, Time, Discussions, Success of the outcome, Clarity for the user, and one Miscellaneous cluster. Cluster constitution (Table 6) varied from three to ten terms. Stakeholders considered the majority of these clusters thematically consistent, except for the Miscellaneous cluster, which comprised of non-thematically consistent terms. Accordingly, the Miscellaneous cluster was considered insufficiently salient for adoption, and was removed from further analysis and discussion.

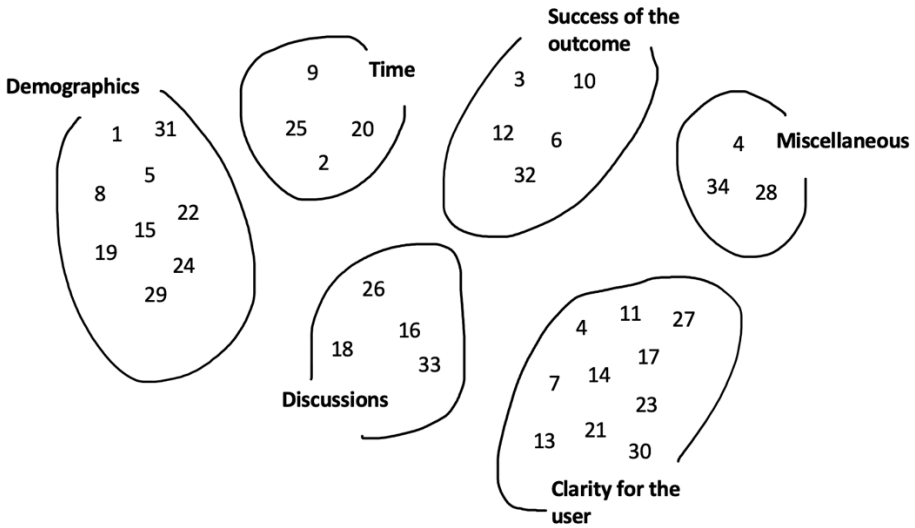


Figure.5 Affinity diagram resulting from pile-sorting activity (Item codes correspond to the codes in Table 6)

Table.6 Clustered terms grouped by stakeholders

Clarity for the user	***Time***	***Demographics***	***Discussions***	***Success of the outcome***	***Miscellaneous***
4.Realistic way of realization	9.Time (less time to make a plan)	1.Average age of the members of both groups	16. Residents' discussions with each other	3.Investments costs	4.Level of detailing between 3D and 2D
7.Number of good ideas and counterproductive ideas	20.Time (online is faster)	5.Amount of participants	18.Anonymous discussion	6.Percentage of ideas that made it into future designs	28.Sequence of the process
11.Public versus private interest (not in my backyard)	25.Time	8.Reaching more and new people for participation	26. Amount of questions asked in the process	10. Satisfaction of the city	34.Possibility of residents saying what they want
13.Quality of design	2.Time of the process	15.Not all citizens can work online	33.Conflicts (what do we do with conflicts?)	32.Actions and consequences	
14.Better plans closer to what the people want		19.Younger people will join us online			
17.Frames (what is possible and what's not)		22.Difficulty for older people			
21.Rules and frameworks					
23.Handling "Not in my backyard"		24.Number of participants during the process			
27.Relationship between ideas and the location of their residence		29.Effect of the participants inviting each other (neighbors)			
30.Unconventional good ideas		31.Local ideas and activities			

4.1.1 Framing the free-listing & pile-sorting outcome

The free-listing and pile-sorting results were set out using the existing literature to develop a workable framework to assess the impact of the proposed 3DDPP tool on participatory planning practices. In order to do so, key literature on this topic was reviewed to frame the clusters from the pile sorting. The results are shown in Table 7, while the final assessment criteria are listed in Table 8.

4.1.1.1 Clarity for the user

The majority of the terms under the 'Clarity for the user' cluster were related to the ideas and comments received by the residents in participatory planning projects. The stakeholders suggested that the quality of the ideas, how realistic they are, and how far they respond to the rules and frameworks should be considered when evaluating the 3DDPP process. However, the literature discussed this issue from another perspective. What is called 'Good' ideas presented in a participatory approach can be influenced by the type and quality of content, and how it is communicated to the residents (Bonsón, Royo, & Ratkai, 2015). Tang (2019) argued that the most challenging part in participatory planning is keeping everyone on the same page in a complex context. Stakeholders usually find it difficult to express their ideas to professionals. On the other hand, ordinary citizens could have difficulty in understanding the true intention of experts (Lopez, 2016; Tang, 2019). This challenge has led participatory planning professionals to claim that the ideas and opinions of the public are non-efficient or non-applicable (Bouzguenda et al., 2020), thus causing extra challenges related to the general trust in the process itself since participants' requests are not met. This led us to another resulting term in this cluster, concerning how far the residents' ideas were reflected in the design proposals. Two stakeholders found it crucial to evaluate these ideas in terms of responding to the public interest versus the private interest. According to some stakeholders, the NIMBY (Not In My BackYard) phenomenon is also a concern in this Dutch city as citizens tend to only care about their own properties without being concerned about their surroundings.

However, Lake (1993) and Schively (2007) argued that governments usually relay on the NIMBY phenomenon to discredit actively engaged citizens and as an excuse to ignore their requests. Evaluating the impact of the 3DDPP against this element could lead to a finding related to social sustainability that could indicate the level of responsibility and level of

attachment required from the citizens (Colantonio, 2009), as well as how far this could reflect on an anti-NIMBYism phenomenon.

4.1.1.2 Time

Although 'Time' was listed by only four stakeholders, it was mentioned in the literature by several authors. Claims were made that engaging the citizens in the planning process would require additional costs and could delay the execution of the projects (Christensen & McQuestin, 2019). The time required to engage the citizens in participatory planning is the biggest challenge faced by governmental representatives, which might lead to resistance and resentment. Gordon and Manosevitch (2011, 85) justified this sentiment by referring to the fact that citizen participation is a complex process that requires careful design. However, they also claimed that "*in practice, it is most often treated as a compulsory task and typically slotted into an existing format that does not consider the complexities of the urban social situation*". In the same context, Oksman, Väätänen, and Ylikauppila (2014) suggested that when planning problems can be clearly discussed with the citizens and detected at an early stage, economic risks could be minimized. The accompanying cost of the participatory processes was also listed by one of the stakeholders, which was clustered under 'Success of the outcome'.

4.1.1.3 Demographics

Stakeholders seemed to agree that the number and the type of attracted participants are crucial to evaluate the impact of utilizing 3DDPP. Age group and the difficulties that older people could face when interacting in online environments are of concern since a diverse group of participants should be present in order to be significantly impactful and ensure a valuable outcome (Niitamo et al., 2006; Fredericks, 2020). Michels and De Graaf (2017) provided evidences that well-educated, civically active, and politically interested citizens are overrepresented in all forms of citizen participation. New technologies are claimed to be able

to empower urban citizens to step higher up the ladder of citizen participation (Arnstein, 1969). Thus, a reduction in the access barrier could be achieved; an increase in the quantity of participation and an improved quality of participation can be attained, as well as the quality of the outcome of participation (Anastasiu, 2019).

4.1.1.4 Discussions

One of the aims of participatory planning is a successful and fruitful discussion that can lead to an insightful outcome. The type of discussion and interaction between the citizens, and the conflicts that could happen were listed by the stakeholders. During the workshop, they discussed the idea that physical interaction cannot be replaced by virtual interaction. Face-to-face meetings cannot have the same result as when the citizens are anonymously interacting with each other online. Different perspectives were found in the literature regarding the idea of physical interaction versus online interaction in a participatory process. A group of scholars opined that face-to-face debates on decision-making activities or community activities cannot be replaced with any 'high-tech' computer tools (Nuojua et al., 2008; Oksman, Väätänen, & Ylikauppila, 2014; Mueller et al., 2018). Physical presence at the same venue is the key for communicative tools to be successful in in-depth discussions and similar scenarios (Tang, 2019). Another group of scholars was more optimistic about the idea of online participation; claiming that it would enable the citizens to comment and evaluate their suggestions, thus giving them the opportunity to justify and revise their suggestions while discussing them with other participants (Monfaredzadeh & Krueger, 2015). Additionally, online platforms can facilitate the interaction between the community, and their authorities and administrations (Bouzguenda, Alalouch, & Fava, 2019). Healey (1998) favored the online participation method over the conventional method because it allows often silent voices to be heard.

4.1.1.5 Success of the outcome

One of the main evaluation criteria for any process is to have a successful outcome. The stakeholders have listed 'the percentage of ideas that made it into future plans' and 'the satisfaction of the city' as parts of this cluster. It is unclear if the term 'the city' refers to the city council or to the citizens. However, we argue that both are important. Nielsen (1994) stated that in the context of participatory planning, it is crucial to seek citizens' satisfaction. Monfaredzadeh and Krueger (2015, 1115) suggested that "*smart interventions can only become the tools to better satisfy citizens' needs*". Accordingly, the development of these tools should balance technical proficiency with the softness of the features to satisfy a diverse group of people. Testing users' satisfaction level with a certain online service is crucial in terms of proposing more efficient general city services (Monfaredzadeh & Krueger, 2015).

Table.7 Summary of framing the free-listing and pile-sorting outcome

Original Cluster Title	***Suggested Criteria Title***	***Suggested Sub-criteria***	***Impact on the process***	***Literature Relevance***	***Research questions***	***References***
Clarity for the user	**Efficiency**	1. Realistic and adequate comments that are relevant to the project scope 2. Comments responding to the public interest more than private interest	Quality of participatory planning	Several authors claim that citizens find it difficult to understand complex design plans, thus their opinions and ideas might be inefficient	What is the impact of using 3DDPP on the efficiency of the participant's comments?	(Lopez, 2016) (Tang, 2019)
Time	**Feasibility**	1. Duration of the application of the method 2. Costs consumed by the application of the method	Practicality in the application of the method	Additional costs and lengthy time could minimize the positive effect of participation	What is the impact of using 3DDPP on the length and the cost of the project? Will 3DDPP reduce the cost and time barrier?	(Christensen & McQuestin, 2019) (Gordon & Manosevitch, 2011) (Oksman, Väätänen, & Ylikauppila, 2014)
Demographics	**Attractiveness**	1. Spectrum of participants (Age groups, educational level, and gender)	Level of attractiveness	Certain social groups are overrepresented in all forms of citizen participation,	What is the impact of using 3DDPP on the attractiveness level and the spectrum of the	(Michels & De Graaf, 2017) (Fredericks, 2020) (Bouzguenda, 2016)

		2. Number of participants		ringing bells of inequality issues, and non-valuable outcomes	attracted people? Will 3DDPP help attract more participants or other participants from new social groups?	(Anastasiu, 2019)
Discussions	**Interaction**	1. Promoting the initiation of discussions	Dialogue between stakeholders	Online environments could provide a medium of interaction. However, physical interaction is claimed to be more efficient	What is the impact of using 3DDPP on the dialogue between the participants?	(Nuojua et al., 2008) (Oksman, Väätänen, & Ylikauppila, 2014) (Bouzguenda, Alalouch, & Fava, 2019)
		2.Quality of in-depth discussions				
Success of the outcome	**Satisfaction**	1. Levels of satisfaction with the applied method expressed by community	Community and professionals' satisfaction with the participation method	Level of satisfaction with participation method is a vital aspect in community engagement processes	How satisfied are the community and professionals with the application of the 3DDPP method?	(Monfaredzadeh & Krueger, 2015)
		2. Levels of satisfaction with the applied method expressed by the planners				

Table.8 The final list of the evaluation criteria and their sub-criteria

Criteria	***Sub-Criteria***
A. Efficiency	1. Realistic and adequate comments that are relevant to the project scope
	2. Comments responding to the public interest more than private interest
B. Feasibility	1. Duration of the application of the method
	2. Costs consumed by the application of the method
C. Attractiveness	1. Spectrum of participants (Age groups, educational level, and gender)
	2. Number of participants
D. Interaction	1. Promoting the initiation of discussions
	2.Quality of in-depth discussions
E. Satisfaction	1. Levels of satisfaction with the applied method expressed by community
	2. Levels of satisfaction with the applied method expressed by the planners

4.2 Results of the experiment evaluation

The obtained results were integrated as recommended by Morse and Maddox (2014) when conducting a mixed method research. The qualitative results are as shown in Table 9. The

development of the theoretical drive resulted in a list of evaluation criteria (Table 8). These criteria and their sub-criteria were utilized to report the experiment results.

The first criterion is '*Efficiency*', which deals with the quality of participatory planning and clarity for the user. This criterion addresses the following question: What is the effect of introducing 3DDPP on the efficiency of the participant's comments? This question was examined by identifying comments received by the citizens that were relevant to the project scope, such as comments that respond to the public interest versus comments that respond to the private interest as a reflection of anti-NIMBYism phenomenon. Results suggested that 93% of the comments received online by the citizens through the 3DDPP were "on topic". On the other hand, 97% of the comments were found to be responding to the public interest more than to the private interest. For example, only one citizen was concerned about allocating waste containers in front of his door. The majority of the municipality professionals mentioned the benefits of utilizing 3D visualization to facilitate better understanding of the design plans among the participating citizens. With regards to sub-criteria (A.2), several participants stated that people will always be concerned first about their own houses. The comparative analysis, on the other hand, showed minimal differences between the nature of the comments received online versus the comments received during conventional meetings. 90% of the comments received during conventional meetings were found to be realistic and relevant to the project scope. Whereas, 85% were found to be responding to the public interest more than private interest. Three citizens were concerned if the initiation of a new construction project will be causing cracks in their houses or demanding priority to having their private cars in front of their houses.

The second criterion is '*Feasibility*', which deals with the practicality in the application of the method. Through this criterion, the authors were trying to answer the following question: will introducing 3DDPP reduce the cost and time barrier in citizen participation processes? Unexpectedly, the results suggested that municipality professionals have contradicting opinions about the time and cost consumed by online participation compared to conventional participation. Only two of them (20%) stated that when comparing both methods from several aspects, the results will eventually be the same. One (10%) municipality professional thought that 3D-visualized participation required more time to be dedicated to the production of the 3D models. Another municipality professional (10%) commented that online participation requires less time and less money. On the other hand, some citizens have commented that the municipality is wasting money on fancy presentations.

The third criterion is '*Attractiveness*', which deals with the attraction level and the type of attracted participants. The related research question is as follows: will 3DDPP promote social equality by attracting more participants or participants from unusual participating social groups? The results suggested that 60% of the professionals found it interesting that the 3DDPP attracted young educated citizens, unlike the usual participants in conventional participation, who were Dutch males older than 45 years old. With regards to the number of participants, 50% of the professionals stated that the number of participants was low. They further argued that this is the usual number of participants in a neighborhood with a similar social situation like Oost". Unexpectedly, the majority (70%) of the municipality professionals stated that introducing the 3DDPP tool to a project in another neighborhood, with a different social situation, would give a better impact. This is because they claimed that "Oost" is a neighborhood with a majority of immigrants, with low income rates and unsettling situations.

Citizens, who showed an interest in participating online, were asked the reason for their interest. This study tried to explore the following question: Are the added features (e.g., online, 3D) the main reason for attracting the participants? The results suggested that this might not be true. Only one (3%) from the 30 citizens stated that he participated because 3D presentations appeal to him. On the other hand, 40% of the citizens participated because they are living in the area. The rest (57%) participated because they are willing to contribute to the re-design or would like to be informed. On the other hand, the comparative analysis between online and conventional participation (*qual2* vs *qual3*) suggested that the number of conventional participants (13) was higher than the number of online participants (9). Additionally, the number of participants who provided comments that were reported in *qual3* (13) was actually lesser than the actual number of attendees during the conventional meetings (39), since many of the attendees were just listeners and did not participate in the discussions. Additionally, 67% of the online participants were below 40 years old compared to 38.5% of the conventional participants. It is worth mentioning that some of the usual attendees to the conventional meetings were members of the Resident Association Schiedam Oost (BVSO), who are usually volunteering old retired residents, and they usually attend every participation event and would actively participate in the discussions. However, none of these residents participated online.

The fourth criterion is "*Interaction*", which deals with facilitating the interaction among the participating citizens. The research question is as follows: What is the effect of introducing 3DDPP on the level of interaction between the participants? The resulting data suggested that the tool did stimulate discussions between the citizens by giving the advantage of adequate time to respond and modifying the suggested ideas, sketches, and comments by the participants. A total of four discussion points were opened by the citizens, namely, street design, parking spaces, waste containers, and green infrastructure. Only three of them were in in-depth

discussions, where an online conversation was held between several citizens for several days. The in-depth discussions included the street design, parking spaces, and waste containers. However, three out of the nine online participants mentioned that they did not notice the "Review Discussion" feature, and they just saw the sketches created by the other participants. Two of the online participants created sketches, then, after discussing with the other participants, they created an alternative modified sketch that reflected the results of the running online discussions.. On the other hand, although 30% of the municipality professionals believed in the benefits of online participation, they stated that we should not abandon physical interaction in conventional participation in favor of online interaction. Interestingly, one of the professionals favored virtual interaction because it allows the people with lower voices to speak louder. Another one felt that it would be more beneficial to engage some of the municipality professionals in the online discussion with the residents to come to an insightful discussion.
Compared to the online participation, the conventional participation held a bigger number of discussion points in which the participants covered seven discussion points, and two of them were in-depth discussions. The seven discussion points that were covered were waste containers, street design and speed limits, green infrastructure, sewer system, bicycles and cars, flooding problems, and the project budget. The in-depth discussions included street design and speed limits, and green infrastructure.

The fifth criterion is "*satisfaction*", which is concerned with how satisfied are the planners and the community with the introduction of the 3DDPP. Results showed that 55% of the citizens who utilized the 3DDPP agreed that the usability of the tool can be improved, stating that the system was slow or some features were not easy to use or find. Approximately 40% of the municipality professionals were concerned about the difficulty of utilizing such tools, especially among the older generations.

Table.9 Analysis results (QUAL: Core component, *qual1& qual2 & qual3*: Supplemental components)

Criteria	Sub-criteria	Qualifiers, Explanations and Examples
A. Efficiency	A.1. Realistic and adequate comments that are relevant to the project scope	"I do prefer utilizing the 3DDPP since it will give the advantage of explaining the design to the citizens" (QUAL) "create additional parking spaces" (*qual2*) "My preference is for a street with one-way traffic" (*qual2*) "How much money are you putting into this project? Can we have a say on that?" (*qual3*)
	A.2.Comments responding to the public interest more than private interest	"either participating online or conventionally, citizens will always care first about their own house" (QUAL) "apply speed bumps at all intersections for the safety of crossing pedestrians" (*qual2*) "I certainly do not want to put a rubbish dump in front of my door" (*qual2*) "I have cracks in my building, will this project cause more cracks?" (*qual3*)
B. Feasibility	B.1.Duration of the application of the method	"online participation consume less time and less money" (QUAL) "participation is considered as an extra. And the time required to do all the 3D visualization and prepare them will be even more extra" (QUAL)
	B.1. Costs consumed by the application of the method	"visualized digital participation could cost more money" (QUAL) "when we compare the time and cost for both methods, eventually it will be the same. The added cost and time of creating the 3D models are almost equal to the cost and time required for planning the participation evenings" (QUAL) "the municipality is wasting time on fancy presentations" (*qual1*)
C. Attractiveness	C.1. Spectrum of participants	"the good thing about the online participation is that we were able to attract a younger group of people, whereas in similar participation events, the participants were mostly males of 45year old and older" (QUAL) 67% of the online participants were below 40 years old compared to 38.5% of the conventional participants. (*qual2* vs *qual3*)*
	C.2. Number of participants	"the number of participants is low because there is a lot of foreign workers living in the area, renting the houses from big companies" (QUAL) One citizen only stated that he participated online because the 3D presentation appeals to him, while the majority participated because they live in the area. (*qual1*)
D. Interaction	D.1. Promoting the initiation of discussions	"online participation allows people with lower voices to speak their opinions since in a conventional event, such people won't be able to speak in the presence of louder voices" (QUAL) "We cannot depend totally on the online participation because at the beginning of the project, we need to interact physically with the citizens" (QUAL) The number of discussion points initiated during the conventional participation was more than the number of discussion points initiated in the online participation. (*qual2* vs *qual3*)
	D.2. Quality of in-depth discussions	"It would be interesting to have some actual online interactions between the participants and the municipality professionals. A sort of online discussion where they can get instant feedback on their ideas" (QUAL)

		Participants created sketches, then after a discussion with the other participants, they created an alternative modified sketch that reflected the results of the running online discussions. (*qual2*)
E. Satisfaction	E.1. Levels of satisfaction expressed by community	"Usability can be better" (*qual1*) "I have not seen any discussions, but there were many separate sketches per comment" (*qual1*)
	E.2. Levels of satisfaction expressed by municipality professionals	"I think that this kind of digital participation tool is too difficult for old people" (QUAL) "a simplified software or tool is a must" (QUAL)

*Results concluded from the comparative analysis

5. Discussion

Result narratives were discussed by considering for each criterion, the core component and the supplemental components (Table 9). The research question was whether utilizing such technologies within less-advantaged areas could enhance the participatory planning, and accordingly foster community engagement, empowerment, and equality toward a socially sustainable smart city?

5.1. Efficiency

Literature suggests that the quality of the conversation between governmental organizations and the society is crucial to the success of citizen participation in decision-making (Lopez, 2016; Afrooz et al., 2018). In the context of participatory planning, it was claimed that utilizing 3D visualization could create an immersive decision-making medium for non-professional stakeholders and improve the quality of participation (Afrooz et al., 2018; Tang, 2019). In line with this argument, our results suggested that the quality of the participation content was adequate, given that the majority of the comments and ideas were relevant and applicable. However, it was unclear whether this was solely thanks to the 3D visualization, since almost half of the online participants were among the educated younger generation. Thus, their ability to understand the design plans could be higher. On the other hand, most of the municipality professionals confirmed the positive effect that 3D visualization could have on explaining the design proposals for the citizens, given their previous experience in terms of facing challenges

to communicate the plans to some residents. A different perspective was found in the literature, claiming that utilizing 3D visualization could create a 'Bedazzlement' effect (Foth et al., 2018). They argued that the perfect 3D renders made for the project were as "*persuasive fait accompli*" (Foth et al., 2018, 3), which did not leave any room for community discussion, criticism or input. We argue that in order to eliminate this effect, 3DDPP should start by offering 3D illustrations or renders that reflect the actual situation of the project. This could give the residents the ability to visualize, discuss, and criticize the actual situation instead of being bedazzled with pre-fabricated urban futures. Furthermore, the results showed a slight difference between the percentage of comments that were responding to the public interest collected conventionally versus comments collected online (85% conventionally versus 97% online). This difference suggested the effect of the anti-NIMBYism phenomenon. This result is in line with the result reported by Schively (2007), suggesting that full citizen participation and empowerment, as well as a period of prolonged debate might be an effective approach to address NIMBY concerns and promote interaction.

5.2. Feasibility

Public participation is seen as a burden on the planning process by several planning professionals (Christensen & McQuestin, 2019). Nonetheless, there is a growing expectation within society that online participation opportunities would be more feasible. In terms of reducing the reliance on physical resources, the public participation process is not as labor intensive, which would enable the planners and communication professionals to monitor the participation progress online (Fredericks & Foth, 2013). The same observation was confirmed by our results. Municipality professionals thought that substituting the need for their physical attendance at participatory planning meeting with online participation was more feasible. However, our results suggested that authorities might be concerned about the added costs of

utilizing advanced ICT to facilitate the participatory planning. Thus, additional opposition from the society must be faced due to wasting money on such fancy technologies, as mentioned by some residents.

5.3. Attractiveness

Engaging people between 18 and 45 years old is a challenging issue for public participation (Fredericks & Foth, 2013). Agre (2002) questioned the ability of new technologies to widen the network of participants so that new actors are brought into policy discussions. The answer is positive. Our study confirmed that the spectrum of participants was widened as young educated citizens were attracted to participate, which was unusual in similar participatory planning projects in the city. Similarly, Houghton, Miller, and Foth (2014) identified that ICT is able to engage younger, 'tech-savvy' community members in planning issues, which was an advantage for the participatory planning process. The socio-demographic characteristics of the concerned community should be considered when utilizing ICT in participatory planning (Mallan et al., 2010; Afzalan & Muller, 2014; Lopez, 2016). This was supported by our results. Municipality planners tend to agree that utilizing such tools in neighborhoods with better socio-economic situations would have a better impact. Additionally, the low number of participants in the Van Swindenstraat project could be due the socio-economic situation of that area. The neighborhood situation, which is considered a less-advantaged area, and the population demographics might have a significant influence on the effectiveness of this approach. The project area has a high level of unsettled residents, with a high population of immigrants who reside there for few months, seeking low rent rates and then leaving. Thus, these residents might have not cared much about the development of the area and would not be bothered to participate. However, Gurstein (2007) offered another explanation through an attempt to learn from different participatory initiatives to enhance the quality of democratic governance. The

author argued that it is not always a matter of “belonging” and “non-belonging” among members of marginalized communities (Khademian 2008), it could be a matter of a difference in political and cultural climate. In which in home country participation was not an option, unlike the new home where participation is expected and desired. This might explain the higher inclination of younger, educated citizens to participate. On the other hand, the issue of silent participants was discussed by Healey (1998), and James and Lee (2017), by arguing that participants with stronger presence would leave little chance for others to actively participate in face-to-face sessions. Unfortunately, it was a missed opportunity to be able to know if any of the silent attendees during the conventional participation sessions was an active online participant. Identifying such an issue might give an indication about the potential opportunity that online participation could offer to these silent voices. Additionally, Brown and Chin (2013), and Schroeter, Foth, and Satchell (2012) suggested that place component and geographic coordinates (e.g., project and population size) of the planning project could contribute to the number of attracted participants. Another aspect that can be added to the discussion is the interesting result for the reason of participating online through the 3DDPP tool. The results suggested that the added features of the 3DDPP (e.g., online and in 3D) did not add real value in terms of attracting more participants because the main reason for participating was they were living in that area. This would be the main reason why a majority of the citizens in a conventional participation will be interested to participate. Thus, this observation contrasted the claims that 3D online visualization will help attract more citizens (Tang, 2019). The location of the project was the first factor that encourages the citizens to participate online and not the utilized technology. Technology might facilitate the communication, but if the resident is not particularly concerned with the project, he or she will not participate anyway. The technology by itself cannot be an attraction factor. As a conclusion,

another aspect that could be added to the "Attractiveness" criterion is the effect of the type and location of the project on the attractiveness level.

5.4. Interaction

Online environments can provide a variety of participation options (Evans-Cowley & Hollander, 2010). Although numerous initial concerns were voiced that these online environments would destroy any sense of the real place, these concerns have largely been proven to be unfounded (Houghton, Miller, & Foth, 2014). Our results suggested that 3DDPP would be beneficial. However, it should not completely replace the conventional participation. Similarly, Fredericks and Foth (2013) argued that these digital tools are not supposed to replace, but to enhance face-to-face participation and engagement, and thus, reaches out to audiences that would have previously been unable to engage. Additionally, incorporating digital tools to engage people is likely to give community members, who are ordinarily reluctant to contribute in traditional settings, the opportunity of participating in their own environment in their own time, with face-to face encounters being optional, rather than required (Fredericks & Foth, 2013). One of the criticisms against participatory planning methods in Europe is that participation is often dominated by self-selected elites that use the process to further their interest (Kahila-Tani et al., 2016). This might be the case where the members of the BVSO were the usual active attendees in conventional participation sessions, who might dominate the discussion to further their interest. Our results suggested that a minority of municipality professionals favored online participation over the conventional because it allows the often silent voices to be heard (Healey, 1998). A multi-stakeholder society seems to require new forms of participation to be provided by inclusive collaborative multi-party planning approaches (Healey, 1998). One of the additional results that are worth discussing is that the engagement of professionals from various organizations in an online discussion with the

residents would encourage them to participate more and produce insightful discussions. Schroeter and Houghton (2011) mentioned the benefits of more active involvement of the moderators by following up on the online participation and citizens' posts. Additionally, conventional participants have opened a higher number of discussion points, including subjects that were not discussed online, such as the budget that was brought up by a member of the BVSO. This behavior could be linked to the fact that these members are somehow experienced in negotiating such subjects with the government. On the other hand, younger citizens who were the dominant online participants might not be aware of such behavior.

5.5. Satisfaction

Technologies must be inclusive in which they must enable the participation of all community members. The results suggested that there were some difficulties in utilizing the tool, which confirmed the concerns of municipality professionals. Thus, a simplified tool is a must. Technology utilized for participatory planning should be personalized according to the nature of the project and the local socio-demographic situation (Auci & Mundula, 2012; Bria, 2012). Angelidou (2014) has stressed over the advantages of personalized smart city initiatives that could serve a certain community at the local level. However, technology does not need to be sophisticated to be effective. Sometimes, the most effective solutions would involve innovative uses of existing and relatively inexpensive technology (Yigitcanlar et al., 2019). Moreover, building smart city interventions around people's emotional attachment or lack thereof, to share urban issues by addressing issues that move urban residents, and acknowledge these feelings, will nurture citizens' willingness to act (De Lange & De Waal, 2017).

5.6 Study Implications

This study has identified the impact of introducing an advanced technology in participatory planning on citizen participation practices towards creating socially sustainable smart cities. Thus, it was necessary to develop a deep understanding of the status-quo, to identify whether the evolution is consistent with the fundamental notions of the rights to the city, and to extract the best practices in how these mechanisms are used in order to replicate, appropriate, and amplify them. This study fostered the call for learning from good and bad practices, which is a key factor for policymakers to take the appropriate steps toward creating smart sustainable cities. The significance of this study lies behind bringing together the transdisciplinary expertise of researchers and practitioners who are contributing to the development of digital participatory planning. Additionally, this study consulted experts and citizens for their opinion on utilizing digital tools in participatory planning and built their perception according to the real implementation of the tool in which they were personally involved to envisage its impact.

5.7 Study Limitations

Studying an actual participatory planning project has limited the types of methodological instrumentations that can be used. We acknowledged two key limitations with this study. First, due to feasibility and scoping requirements, the sample was limited to the selected local government of Schiedam. We opted to collect data from specific key informants who were directly involved in the experiment and the local residents of the Van Swindenstraat project. Assigning random incentives for participants to contribute to the experiment was not an option since this would be against the aims of this research, in which it was partially concerned with the attractiveness level of digital tools. Instead, participants' interest must be accommodated/reported as found. However, this has limited this study's ability to involve the citizens in other tasks, such as the development of the evaluation criteria, as this would have

overloaded them and might have affected their willingness to participate. Even though this situation posed a limitation to this study, it did open up an opportunity for future research to compare the criteria reported in this study with the criteria that are elicited from citizens. Second, the Oost neighborhood does not represent all less-advantaged areas in Europe. Another useful follow-up study might juxtapose the results of this study with other samples, involving several European cities. Nonetheless, this study has paved the way for further exploration and sets the grounds by introducing new evaluation criteria and assessment methods.

5.8 Future Research

The concept of digital twins is rising alongside the smart city concept. Digital twining, in the context of city planning, has casted a light on the importance of creating 3D virtual reactive models as a twin of the cities where they could predict and steer equitable planning decisions (Batty, 2018)**.** However, the challenge is to merge the social and economic process along with the physical assets. This study can assist future research in terms of identifying the performance of the digital twin application in communities with relatively low socio-economic levels, to indicate the extent that digital twins could add to equitable city planning. Another area of research that could benefit from this study is the current ideological mismatch between the design space that develops digital participatory tools and the institutional space that uses them (Lodato & DiSalvo, 2018; Foth & John Turner, 2019). Experimenting ICT tools within institutional spaces before making them available in the market would increase their usability.

6. Conclusion

This study can contribute to the often-neglected social pillar in the development of a sustainable smart city. This study has evaluated the impact of utilizing 3DDPP on participatory planning practices. It is concluded that utilizing 3DDPP could enhance the quality of the participation content. Utilizing three-dimensional visualization to facilitate the communication between the professionals and the participating community is an advantage. Bear in mind the negative 'Bedazzlement' effect when over-utilizing such presentation, especially as a readymade solution. The feasibility of this technology depends on the utilized tool. However, with the widespread of digital visualization techniques, planning authorities would find it more feasible to communicate via 3D. In the same context, the world is currently experiencing the disappearance of several jobs that could be substituted via ICT applications. This situation could reduce human reliance on physical resources. However, the study results suggested that there is still a need for a moderator to be part of the digital participatory planning process. With regards to the attractiveness of such tools, the significant influence might not be the number of participants, but the spectrum of participants. Being able to engage the often silent voices and younger people is the biggest advantage. To enhance interactions through these tools, it is recommended that experts with social science background are engaged to prepare the method carefully, and to have moderators that can manage and conduct the online discussions. To have higher levels of satisfaction, digital initiatives in less-advantaged areas should be oriented toward the needs of the local residents and move beyond the fascination with technology. Finally, it is worth mentioning that smart cities are not the solution to every problem in this Digital Era. Socio-economic, political, and demographic challenges that could decrease the residents' willingness to actively engage in collaborative decision-making might not be solved completely via technologies.

Competing interests

The authors declare that they have no competing interests.

Funding

Research fund was provided by Schiedam Municipality, Netherlands and is hereby gratefully acknowledged. Schiedam Municipality is not involved in the study design, the collection, analysis resources, in the writing of the article, nor the decision to submit the article for publication.

References

Afrooz, A. E., Lowe, R., Leao, S. Z., & Pettit, C. (2018). 3D and virtual reality for supporting redevelopment assessment. *Real Estate and GIS*, 162-185.
Afzalan, N. (2015). Participatory plan making: Whether and how online participatory tools are useful. *PhD Dissertation*. Denver: University of Colorado.
Afzalan, N., & Muller, B. (2014). The role of social media in green infrastructure planning: A case study of neighborhood participation in park siting. *Journal of Urban Technology , 21*(3), 67-83.
Afzalan, N., Sanchez, T. W., & Evans-Cowley, J. (2017). Creating smarter cities: Considerations for selecting online participatory tools. *Cities, 67*, 21-30.
Agbali, M. 2019. "Developing a framework to promote innovation in socio-economic development in smart cities." PhD diss, University of Salford.
Agre, P. E. (2002). Real-Time Politics: The Internet and the Political Process. *The Information Society, 18*, 311-331.
Ahvenniemi, Hannele, Aapo Huovila, Isabel Pinto-Seppä, and Miimu Airaksinen. 2017. "What are the differences between sustainable and smart cities?" *Cities* 60: 234-245.
Alatalo, T., Koskela, T., Pouke, M., Alavesa, P., & Ojala, T. (2016). VirtualOulu: collaborative, immersive and extensible 3D city model on the web. *Proceedings of the 21st International Conference on Web3D Technology* (pp. 95-103). ACM.
Alatalo, T., Pouke, M., Koskela, T., Hurskainen, T., Florea, C., & Ojala, T. (2017). Two real-world case studies on 3D web applications for participatory urban planning. *Proceedings of the 22nd International Conference on 3D Web Technology* (p. 11). ACM.
Anastasiu, I. (2019). Unpacking the Smart City Through the Lens of the Right to the City: A Taxonomy as a Way Forward in Participatory City-Making. In *The Hackable City* (pp. 239-260). Singapore: Springer.
Angelidou, M. (2014). Smart city policies: A spatial approach. *Cities, 41*, S3-S11.
Arnstein, S. (1969). A Ladder Of Citizen Participation. *Journal of the American Institute of Planners, 35*(4), 216-224.
Auci, S., & Mundula, L. (2012). smart cities and a stochastic frontier analysis: a comparison among European Cities. *SSRN 2150839*.
Batty, M. (2018). Digital Twins. *Environment and Planning B: Urban Analytics and City Science, 45*, 817–820.
Bernard, H. R. (2006). *Research Methods In Anthropology: Qualitative And Quantitative Approaches (4th edn).* Rowman Altamira.
Blake, Christine E., Carole A. Bisogni, Jeffrey Sobal, Carol M. Devine, and Margaret Jastran. 2007. "Classifying foods in contexts: how adults categorize foods for different eating settings." Appetite 49 (2): 500-510.
Bonsón, E., Royo, S., & Ratkai, M. (2015). Citizens' engagement on local governments' Facebook sites. An empirical analysis: The impact of different media and content types in Western Europe. *Government Information Quarterly, 32*(1), 52-62.
Bouzguenda, I., Alalouch, C., & Fava, N. (2019). "Towards Smart Sustainable Cities: A Review of the Role Digital Citizen Participation Could Play in Advancing Social Sustainability. *Sustainable Cities and Society, 50*, 101627.

Bria, F. (2012). *New governance models towards an open Internet ecosystem for smart connected European cities and regions.* Open innovation, directorate general for the information society and media, European commission.
Brown, G., & Chin, S. Y. (2013). Assessing the Effectiveness of Public Participation in Neighbourhood Planning. *Planning Practice & Research, 28*(5), 563–88.
Christensen, H. E., & McQuestin, D. (2019). Community engagement in Australian local governments: a closer look and strategic implications. *Local Government Studies, 45*(4), 453-480.
Colantonio, A. (2009). Social sustainability: a review and critique of traditional versus emerging themes and assessment methods.
De Lange, M., & De Waal, M. (2017). Owning the city: New media and citizen engagement in urban design. *Urban Land Use*, 109-130.
Ensign, J., & Gittelsohn, J. (1998). Health and access to care: Perspectives of homeless youth in Baltimore City, USA. *Social science & medicine, 47*(12), 2087-2099.
Evans-Cowley, Jennifer, and Justin Hollander. 2010. "The new generation of public participation: Internet-based participation tools." *Planning Practice & Research* 25 (3): 397-408.
Falco, Enzo. 2019. "Digital Community Planning: The Open Source Way to the Top of Arnstein's Ladder." In *Smart Cities and Smart Spaces: Concepts, Methodologies, Tools, and Applications*. IGI Global.
Flick, U. e. (2013). *The SAGE handbook of qualitative data analysis.* Sage.
Foth, M., & John Turner, T. (2019). The premise of institutioning for the proliferation of communities and technologies research. *Proceedings of the 9th International Conference on Communities & Technologies-Transforming Communities* (pp. pp. 24-28). ACM.
Foth, M., Brynskov, M., & Ojala, T. (2015). *Citizen's right to the digital city* (Vol. 10). Singapore: Springer.
Foth, M., Caldwell, G. A., Fredericks, J., & Volz, K. (2018). Augmenting cities beyond bedazzlement: Empowering local communities through immersive urban technologies. *Workshop proceedings of Augmenting Cities and Architecture with Immersive Technologies.* Beijing, China: Media Architecture Biennale (MAB).
Fredericks, J. (2020). From Smart City to Smart Engagement: Exploring Digital and Physical Interactions for Playful City-Making. In *Making Smart Cities More Playable* (pp. 107-128). Singapore: Springer.
Fredericks, J., & Foth, M. (2013). Augmenting public participation: enhancing planning outcomes through the use of social media and web 2.0. *Australian planner, 50*(3), 244-256.
Fredericks, Joel, Glenda Amayo Caldwell, Marcus Foth, and Martin Tomitsch. 2019. "The city as perpetual beta: fostering systemic urban acupuncture." In *he Hackable City*, 67-92. Singapore: Springer.
Giffinger, Rudolf, and Haindlmaier Gudrun. 2010. "Smart cities ranking: an effective instrument for the positioning of the cities?" *ACE: architecture, city and environment* 4 (12): 7-26.
Gordon, E., & Manosevitch, E. (2011). Augmented deliberation: Merging physical and virtual interaction to engage communities in urban planning. *New Media & Society, 13*(1), 75-95.
Gurstein, Penelope Cheryl. 2007. *Learning civil societies: shifting contexts for democratic planning and governance.* University of Toronto Press.
Hayek, Ulrike Wissen. 2011. "Which is the appropriate 3D visualization type for participatory landscape planning workshops? A portfolio of their effectiveness." *Environment and Planning B: Planning and Design* 38 (5): 921-939.
Healey, P. (1998). Collaborative planning in a stakeholder society. *Town planning review, 69*(1), 1.
Herbert, Grant, and Xuwei Chen. 2015. "A comparison of usefulness of 2D and 3D representations of urban planning." *Cartography and Geographic Information Science* 42 (1): 22-32.
Houghton, K., Miller, E., & Foth, M. (2014). Integrating ICT into the planning process: impacts, opportunities and challenges. *Australian Planner, 51*(1), 24-33.
Höjer, Mattias, and Josefin Wangel. 2015. "Smart sustainable cities: definition and challenges." *ICT innovations for sustainability* (Springer, Cham) 333-349.
James, Carrie, and Ashley Lee. 2017. *Speaking up online: Civic identity and expression in the digital age in Social Movements and Media (Studies in Media and Communications).* Edited by J. Earl and D.A. Rohlinger. Vol. 14. Emerald Publishing Limited.
Kahila-Tani, M., Broberg, A., Kyttä, M., & Tyger, T. (2016). Let the citizens map—public participation GIS as a planning support system in the Helsinki master plan process. *Planning Practice & Research, 31*(2), 195-214.
Khademian, Anne. 2008. "Learning Civil Societies: Shifting Contexts for Democratic Planning and Governance." *Journal of the American Planning Association* 75 (1): 100-101.
Kusters, Koen, Louise Buck, Maartje, Minang, Peter de Graaf, Cora van Oosten, and Roderick Zagt. 2018. "Participatory planning, monitoring and evaluation of multi-stakeholder platforms in integrated landscape initiatives." *Environmental management* 62 (1): 170-181.
Labor Market service. (n.d.). *labor market information.* Retrieved march 2018, from https://www.uwv.nl/overuwv/pers/dossiers/arbeidsmarktinformatie/detail/werkloosheid

Lake, Robert W. 1993. "Planners' alchemy transforming NIMBY to YIMBY: Rethinking NIMBY." *Journal of the American Planning Association* 59 (1): 87-93.
Levenda, Anthony M., Noel Keough, Melanie Rock, and Byron Miller. 2020. "Rethinking public participation in the smart city." *The Canadian Geographer/Le Géographe canadien.*
Lodato, T., & DiSalvo, C. (2018). Institutional constraints: the forms and limits of participatory design in the public realm. *Proceedings of the 15th Participatory Design Conference: Full Papers-Volume 1* (p. p. 5.). ACM.
Lopez, C. (2016). PhD dissertation . *Modeling sustainability of participatory information systems for urban communities: A mixed-method approach*. University of Pittsburgh.
Mallan, K., Foth, M., Greenaway, R., & Young, G. T. (2010). Serious playground: using Second Life to engage high school students in urban planning. *Learning, Media and Technology, 35*(2), 203-225.
Martin, Chris J., James Evans, and Andrew Karvonen. 2018. "Smart and sustainable? Five tensions in the visions and practices of the smart-sustainable city in Europe and North America." *Technological Forecasting and Social Change* 133: 269-278.
Michels, A., & De Graaf, L. (2017). Examining citizen participation: local participatory policymaking and democracy revisited. *Local Government Studies , 43*(6), 875-881.
Modelo. (2014). Retrieved August 2019, from Modelo Website: https://modelo.io/
Monfaredzadeh, T., & Krueger, R. (2015). Investigating social factors of sustainability in a smart city. *Procedia Engineering 118*, (pp. 1112-1118).
Morse, J. M. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing research, 40*(2), 120-123.
Morse, J. M. (2017). *Essentials of Qualitatively-Driven Mixed-Method Designs* . New York: Routledge .
Morse, J. M., & Maddox, L. J. (2014). Analytic integration in qualitatively driven (QUAL) mixed and multiple methods designs. In *The SAGE handbook of qualitative data analysis* (pp. 524-539). SAGE.
Mueller, J., Lu, H., Chirkin, A., Klein, B., & Schmitt, G. (2018). Citizen Design Science: A strategy for crowd-creative urban design. *Cities, 72*, 181-188.
Mulder, I. (2015). Opening up: Towards a sociable smart city. In *Citizen's right to the digital city* (pp. 161-173). Singapore : Springer.
Neuendorf, K. A. (2016). *The content analysis guidebook.* Sage.
Nielsen, J. (1994). *Usability engineering.* Elsevier.
Niitamo, V.-P., Kulkki, S., Eriksson, M., & Hribernik, K. A. (2006). State-of-the-art and good practice in the field of living labs. *2006 IEEE International Technology Management Conference (ICE)* (pp. 1-8). IEEE.
Nuojua, J., Juustila, A., Räisänen, T., Kuutti, K., & Soudunsaari, L. (2008). Exploring web-based participation methods for urban planning. *Proceedings of the Tenth Anniversary Conference on Participatory Design* (pp. 274-277). Indiana University.
Oksman, V., Väätänen, A., & Ylikauppila, M. (2014). Co-creation of Sustainable Smart Cities Users, Participation and Service Design. *The Eighth International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies* (pp. 189-195). Rome: IARIA.
Panagopoulos, Thomas, Ilze Jankovska, and Inga Straupe. 2012. "Second life 3D city virtual environment as an urban planning tool for community engagement." *Recent researches in environmental science and landscaping* , 13-19.
Paskaleva, Krassimira Antonova. 2011. "The smart city: A nexus for open innovation?" *Intelligent Buildings International* 3 (3): 153-171.
Rapley, T. (2014). Sampling strategies in qualitative research. In *The SAGE handbook of qualitative data analysis* (pp. 49-63). SAGE.
Sager, Tore. 1981. "Evaluation methods in local participatory planning." *The Town Planning Review* 52 (4): 417-432.
Sanford, C., & Rose, J. (2007). Characterizing eparticipation. *International Journal of Information Management, 27*(6), 406-421.
Santinha, G., & De Castro, E. A. (2010). Creating more intelligent cities: the role of ICT in promoting territorial governance. *Journal of Urban Technology, 17*(2), 77-98.
Sarkissian, Wendy, Nancy Hofer, Steph Vajda, and Yollana Shore. 2009. *Kitchen table sustainability: Practical recipes for community engagement with sustainability.* Earthscan.
Schively, Carissa. 2007. "Understanding the NIMBY and LULU phenomena: Reassessing our knowledge base and informing future research." *Journal of planning literature* 21 (3): 255-266.
Schrauf, R. W., & Sanchez, J. (2010). Age effects and sample size in free listing. *Field methods, 22*(1), 70-87.
Schreier, M. (2012). *Qualitative content analysis in practice.* Sage Publications.
Schroeter, R., & Houghton, K. (2011). Neo-planning: Location-based social media to engage Australia's new digital locals. *Australian Planner, 48*(3), 191-202.
Schroeter, R., Foth, M., & Satchell, C. (2012). People, content, location: sweet spotting urban screens for situated engagement. *Proceedings of the Designing Interactive Systems Conference* (pp. 146-155). ACM.

Tang, H. (2019). ShapeUD: A Real-time, Modifiable, Tangible Interactive Tabletop System for Collaborative Urban Design. *PhD diss.* Purdue University Graduate School.
Thomson, D., Kaka, A., Pronk, L., & Alalouch, C. (2012). The use of freelisting to elicit stakeholder understanding of the benefits sought from healthcare buildings. *Construction Management and Economics, 30*(4), 309-323.
United Nations. 2014. "Report of the world urbanization prospects: The 2014 revision, highlights." Department of Economic and Social Affairs, Publication Division, United Nations.
Virtual participation for all. (2018). Retrieved June 2019, from Virtual participation for all: www.vpforall.com
World Economic Forum. (2018). *Global Risks Report.*
Yigitcanlar, T., Kamruzzaman, M., Buys, L., Ioppolo, G., Marques, J. S., Moreira da Costa, E., & Yun, J. J. (2018). Understanding 'smart cities': Intertwining development drivers with desired outcomes in a multidimensional framework. *Cities, 81*, 145-160.
Yigitcanlar, T., Kamruzzaman, M., Foth, M., Sabatini, J., da Costa, E., & Ioppolo, G. (2019). Can cities become smart without being sustainable? A systematic review of the literature. *Sustainable cities and society , 45*, 348-365.
Zhang, L., Geertman, S., Hooimeijer, P., & Lin, Y. (2019). The usefulness of a web-based participatory planning support system in Wuhan, China. *Computers, Environment and Urban Systems, 74*, 208-217.

Chapter 4.

General Discussion

4.1 Technology might be promising

Upon reviewing the literature, this research began to explore **the roles that DCP could play in advancing social sustainability**. First, the relationship between DCP and social sustainability was identified. A hierarchical relationship was found to exist between four main concepts, namely, sustainability, social sustainability, community engagement, and DCP. Social sustainability, as one of the three main pillars of sustainability, is originally tied to community engagement. Community engagement, on the other hand, has been proven to act positively toward the social sustainability of the society. Within the ubiquitous presence of ICT and the rising number of smart sustainable city models, community engagement or citizen participation has become increasingly digitally facilitated. Digitizing citizen participation could potentially overcome some of the challenges associated with actively engaging citizens in decision-making processes or maintaining a certain participation consistency for long periods (Silva, 2020). Engaging citizens could be challenging due to multiple factors, such as busy lifestyles and competing priorities (Fredericks, Tomitsch, & Haeusler, 2020). In some cases, citizens found that they were not sufficiently heard by the government through these participation approaches. In other cases, citizens tend to perceive that only a small proportion of the different interests present in the local community were really considered (Silva, 2020). These factors, together with the inadequacy of the participation approaches and unexperienced facilitators, could explain why in some cases citizens tend to be reluctant to participate. Although DCP could overcome such challenges and pave the way to an enhanced social sustainability, the performance of these digital approaches needs to be critically assessed against their potential outcomes. Thus, the capability of DCP to contribute toward social sustainability could be explored by developing social sustainability indicators. Social sustainability is a vague concept when it comes into practice (Marsal-Llacuna, 2016). Thus, it could be challenging to indicate a city's or a government institution's level of social

sustainability. DCP processes could be utilized to generate indicators that could help measure some of the hard-to-measure soft themes (e.g., empowerment, equity or inclusion) (Colantonio, 2009). Data can be collected and analyzed from online participation processes to provide valuable insight into the social dimensions of such processes. Thus, how much these processes affect the social sustainability of this community can be understood. Despite the positive potentials of digitizing citizen participation processes, which are supposed to enhance equity and social justice (Yigitcanlar, Kamruzzaman, & Foth, 2019), several studies have contradicted these claims. These studies argued about the consequences of creating a digital division in society (Janowski, 2015), the ethical issue of humans as being "digital laborers" (Shaw & Graham, 2017), and issues related to minimized interaction or reciprocity (Caroline W., 2017). They also argued that participation through some of these digital tools tend to exclude the most vulnerable members of the community due to socio-economic reasons and to digital illiteracy as well (Aurigi & Odendaal, 2020; Silva, 2020). From another perspective, the concept of participation itself is criticized, as it is seen as merely another face of the top-down decision-making approach since the decision makers are the facilitators and the controllers of the participation process (Fredericks, Tomitsch, & Haeusler, 2020). Scholars argued for this aspect to be replaced with co-production, co-design, or co-creation. Thus, attention is given to efforts that are investigating online co-production tools, with visualization and immersing technologies (Fredericks & Foth, 2013). These changes in the way cities are developed through increased usage of ICT and the contradicting claims about its real effect on the society require a reliable indicator framework for monitoring and evaluating the maturity of the digital governance practices, their performance, and the multidimensional outcomes of their associated approaches (De Filippi, Coscia, & Guido, 2019). Their potential positive outcomes may be spoiled if the main social sustainability goals are not met.

4.2 City administration should be prepared and the society as well

Schiedam municipality, as represented by its urban development department, is one of the small European cities that are trying to reach a higher rung in the participation ladder (Arnstein, 1969) through increased co-creation approaches, while engaging the citizens in urban planning. According to Arnstein (1969), this ladder is composed of eight degrees of participation, starting with manipulation up to giving the full control to the citizens. Schiedam municipality has adopted a similar ladder that starts with informing and ends with co-creation. The municipality goal was not to put any restrictions on the applied methods, while aiming for the higher rungs of the ladder. However, these efforts face several challenges. The current exponential increase in digital interventions has left little time for critical reflection and effective self-assessment. Hence, the question is **how can small cities prepare to introduce DPP?** A set of factors have been identified, which included planner's attitude, strategic support (IT experts + software), population demographic, level of trust in the concept of citizen participation, technology utilization tendencies, and privacy concerns. These factors could affect the maturity levels of the government organization and the concerned society to introduce DPP, and thus, these two groups were examined against these factors. By examining the representatives from the government organization in Schiedam municipality, the results suggested that maturity level to introduce DPP could be affected by existing good practices of conventional participatory planning and trust levels in the government. However, the last practice is claimed to be unattended consideration in citizen participation efforts (Yang, 2005). This observation is in line with the findings by Falco (2019), who suggested that digital citizen participation in planning is contextually related to the nature of the planning agency, the structure of the organization, and legislation and regulations. These are in addition to democracy, the redistribution of power, and the ability to influence decision-making (Falco, 2019). An equally important aspect is that good practices of conventional participatory planning could be affected

by the planners' attitude. Yang (2005) argued that public administrators' negative attitudes toward citizens have been identified as a major barrier to authentic public participation, while their trust in citizens is a predictor of proactive citizen involvements. The perceptions of several government representatives, who were against participatory planning and whose goal was just to satisfy mandates, were alarming and might affect the maturity of the city to introduce DPP. Christensen and McQuestin (2019) explained that the time required for citizen participation is the biggest challenge faced by government representatives while delivering participatory planning projects, which might cause resistance or depreciation. Hence, in addition to having adequate virtual and physical resources, well-informed civil servants must be carefully selected in order to have positive impacts on citizen engagement in participatory planning and to ensure full maturity to introduce DPP. In the same context, Somarakis and Stratigea (2019) have suggested that planners should be more informed and trained on participatory planning tools, in addition to having increased awareness of the factors affecting the choice of each digital tool. In line with this argument, Silva (2020) suggested that the choice of participation tools should be informed by their impact on the role of the planners since some tools tend to decrease the role of planners as experts and mediators. To gain a comprehensive overview on the strategies that could help small cities be prepared to introduce DPP, the citizens of the city, who are the main actors in the participatory planning process, should be consulted. The analysis results of the maturity levels of the local society in Schiedam City suggested that technology utilization tendencies play a crucial role in the maturity level of the city to introduce DPP. However, technology by itself cannot create smart sustainable cities (Costa & Oliveira, 2017; Almeida, Doneda, & Costa, 2018; Yigitcanlar et al., 2019). Hence, this study will emphasize that participatory planning is a matter of attitude, which must be gradually developed within the community and not imposed due to the availability of technology. This observation has been proven by the significant difference in the level of trust expressed by the citizens in the

participation concept between those who usually participate and those who never did since prior experiences affect trust (Yang, 2005). However, participation attitude should not be influenced solely by digital approaches, it should be coupled with conventional methods that encourage freedom in expressing opinions, in-person discussions, direct feedback on the process, and face-to-face deliberation among community members. Additional results have revealed that trust in the government might affect the trust in the participation process and the belief in the actual influence of citizens' opinions. Previous work in this field suggested that trust in administrative organizations does affect the levels of involvement and conviction for the citizen participation concept and processes (Spyra et al., 2019; Silva, 2020). Corbett and Le Dantec (2018) stressed that trust is vital in citizen participation, especially within the growing area of digital civics, which works to improve or create new modes of citizen participation. Administrative organizations should take this issue seriously if they want to introduce DPP. They should demonstrate to the community that their opinions are being taken into consideration during the planning process and that some of their requests have been implemented (Anthopoulos, 2019). AlWaer and Cooper (2020), and Van de Walle and Migchelbrink (2020) argued that the outcomes of public participation processes matters the most to the community, and they have a significant impact on citizens' trust in public administration. Administrative organizations should also explain the reasons, the practical obstacles, and the administrative limitations in cases where the community's desires could not be met. On the other hand, socio-economic and demographic characteristics of the concerned community seemed to influence the maturity level to introduce DPP. Although some of the government representatives have mentioned that the participation quantity and quality in certain areas of the city are better than the others, the reliability of this result can be impacted by the specific local context. Schiedam, as a Dutch city that is supposed to be hosting a highly "open-minded" and advanced community with high rates of digital literacy, could also host

social groups who are not. This is in line with the claims of Aurigi and Odendaal (2020), who suggested that the local context and the livelihood conditions are vital to the success of digital participation. However, if the society does not practice the outlined social conditions, these conditions could be promoted during the introduction of DPP. DPP could be considered as a tool for public administrations to improve mutual learning. Anthopoulos (2019) suggested that in order to achieve a successful engagement, cities should prioritize the needs of the local population, meet citizens' expectations, and solve community problems over the obsession with technology. Public administrations might consider customizing participation processes according to the sociodemographic characteristics to improve competency and facilitate the participation of certain under-represented social groups (Wood & Landry, 2007; Parra-Agudelo et al., 2018). Additionally, government organizations should initiate awareness campaigns and reach out to wider citizen populations via online and conventional channels to nourish equality (Lee, McQuarrie, & Walker, 2015), reduce digital participation bias, and encourage involvement.

4.3 Social aspect must be emphasized

To investigate the effect of the local context and the livelihood conditions on the success of digital participation, and to evaluate the implications of digital governance practices and their multidimensional outcomes, the third stage of the research was initiated to explore **the implications of utilizing 3DDPP on the participatory planning process in less-advantaged areas.** Upon developing a set of criteria using empirical approaches, i.e., free-listing and pile-sorting to evaluate the impact of utilizing a 3DDPP tool, an actual participatory planning project was assessed in Schiedam city. The evaluation criteria were efficiency, feasibility, attractiveness, interaction, and satisfaction. The results suggested that the utilization of 3DDPP tools could potentially enhance community engagement in decision-making processes. An

immersive decision-making medium for non-professional stakeholders could improve the quality of participation, as participants have stated that the 3D model helped them understand the proposed plans better. This observation is in line with the research by Afrooz et al. (2018) and Tang (2019). Meanwhile, Christensen and McQuestin (2019) claimed that several planning professionals have confided that public participation is a burden on the planning process. Nonetheless, the utilization of 3DDPP could potentially reduce reliance on physical resources and thus, become a more feasible approach. On the other hand, widening the spectrum of participants and the ability to attract younger and more 'tech-savvy' community members were one of the main achievements of this research. However, younger populations are not the only ones who are ordinarily reluctant to participate. As previously mentioned, several reasons could be behind this issue. Although 3DDPP has been proven to attract one group within this population (younger people), it is still unclear whether it will be able to overcome the challenges of engaging a population that does not wish to participate because they have no trust that their voices will be heard (Silva, 2020; Van de Walle & Migchelbrink, 2020). This is, however, a matter best left for the organization because enhancing the mutual trust of the citizens is the first and most crucial step toward successful participation approaches (Corbett & Le Dantec, 2018). Similarly, the socio-demographic characteristics of the concerned community (Brown & Chin, 2013; Schroeter, Foth, & Satchell, 2012) was an aspect that might have a significant influence on the effectiveness of this approach. Aurigi and Odendaal (2020, p. 12) argued that "*smart city-in-the-box solutions that envisage a seamless urban experience assume a particular digital citizen that bears little resemblance to those living at the margins*." This argument is supported by their results of investigating digital participation tool that was utilized across the city of Salvador, Brazil. The results suggested that although the participation tool was implemented to enable the public to report criminals, or "problematic" occurrences, most crimes and problems were reported in well-off areas of the city. This might suggest that

this tool was prevalently appealing to and used by middle class citizens, who are concerned for their safety (Aurigi & Odendaal, 2020), thus confirming the theory that in some cases, popular participation may even reinforce elite power in unexpected ways (Lee, McQuarrie, & Walker, 2015). This observation inherently suggests that respecting the livelihood conditions and the local context are vital factors to consider to ensure the success of digital participation. Apart from socio-economy, livelihood conditions also include people with special needs, immigrants, and people with demographical differences, such as age and gender. These conditions are relevant to the inequality gap, which is recently considered as one of the four most dangerous global risk factors (World Economic Forum, 2018). Botchwey et al. (2019) stated that some less-advantaged population groups require specific approaches. Thus, extensive utilization of technology might not be the ideal approach. It is, however, recommended to stick to approaches that deal with the communities' preferences and needs. A mixture of conventional and online participations could work better. It is recommended that the reliance on fancy technologies is reduced. This is simply because people on the margins or who are less-advantaged might be struggling to survive, or might not possess the technological instruments that could support advanced digital participation methods, such as devices that support virtual reality. They could also lack the required knowledge or familiarity with innovative digital approaches. They might simply be unbothered to participate because they feel that this fancy technology is not for them. They might prefer to attend a meeting where they could express their thoughts and problems, and discuss them with their neighbors. Additionally, the substitution of physical resources with technologies might face an extra opposition from these social groups due to the extra costs that they might think could be utilized more efficiently to solve some of their everyday challenges. Figure 5 summarizes the research outcomes.

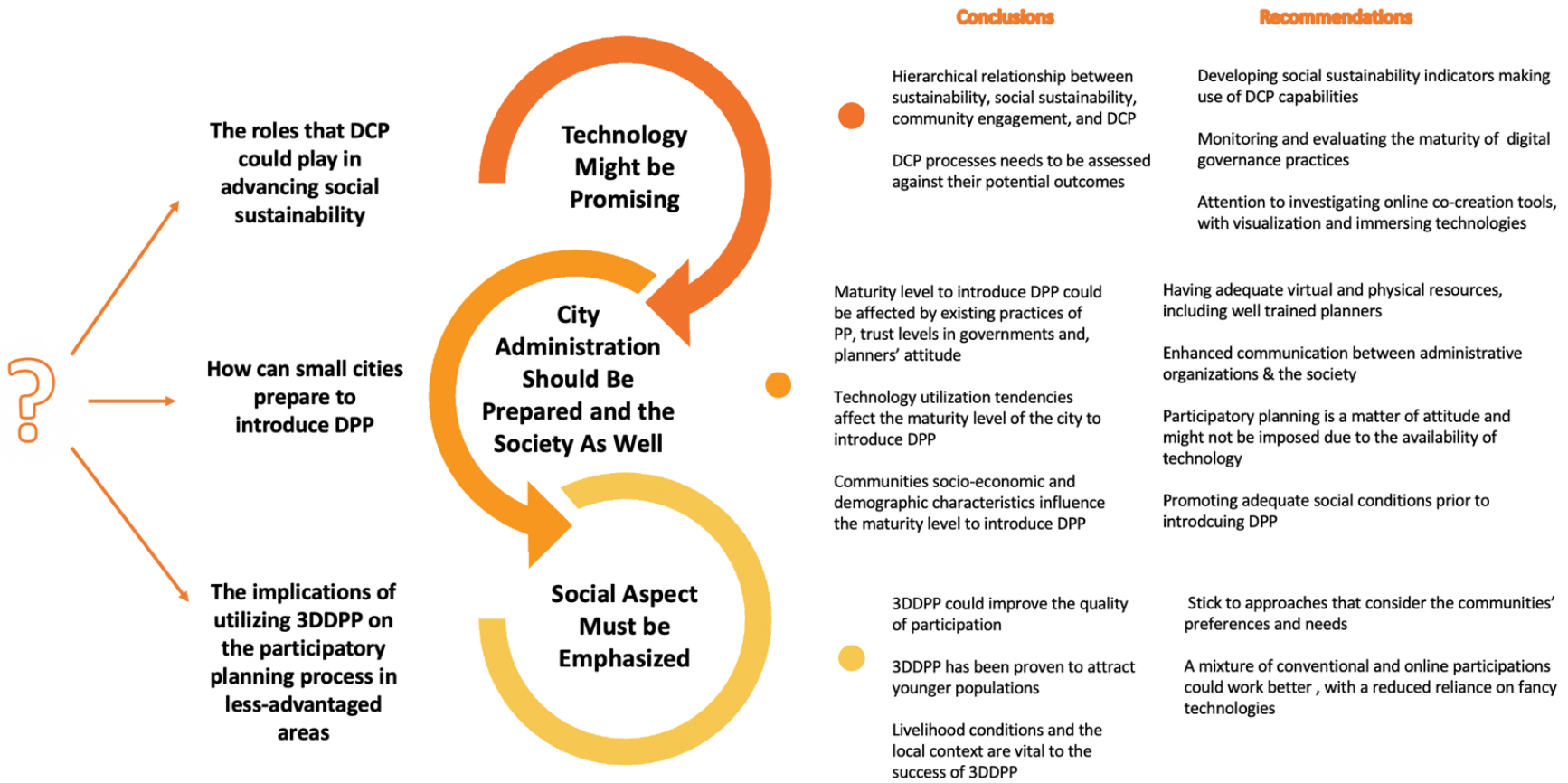


Figure 5 Summary of the research outcomes

4.4 Comparability of research findings

Although this research started with the hypothesis that the utilization of technology might be promising in terms of enhancing citizen participation, which is supposed to enhance equity and social justice (Yigitcanlar, Kamruzzaman, & Foth, 2019), several studies have contradicted these claims. Janowski (2015) argued about the consequences of creating a digital division in society, while Shaw and Graham (2017), and Caroline W. (2017) discussed the ethical issue of humans as "digital laborers" and issues related to minimized interaction or reciprocity. Aurigi and Odendaal (2020), and Silva (2020) argued that participation through digital tools would exclude the most vulnerable members of the community due to socio-economic reasons and to digital illiteracy as well.

Thus, further investigation of these claims was incorporated. The second stage of this research went beyond exploring the maturity of city administrations to introduce DPP (Afzalan et al., 2017; Bherer et al., 2017; Slotterback, 2011), exploring citizens' perspectives and their level of satisfaction with such processes (Michels & De Graaf, 2017), and the level of acceptance to such technologies in terms of their features and functionalities (system quality) (Kimathi et al., 2019). This study extended these efforts by exploring the mutual perspectives between the community and public organization. The results showed that city administration and the society should be equally prepared. This study has also confirmed previous conclusions that emphasized the effect of trust in administrative organizations on the levels of involvement in DCP (Corbett & Le Dantec, 2018; Smith et al., 2013; Spyra et al., 2019; Van de Walle & Migchelbrink, 2020) and not solely on the availability of technology (Almeida et al., 2018; Costa & Oliveira, 2017; Yigitcanlar et al., 2019).

Lastly, this study investigated the previously mentioned social claims (Aurigi & Odendaal, 2020; Silva, 2020) and its relationship to DPP. This study has highlighted the importance of

studying the local context and livelihood conditions when implementing DPP, as opposed to implementing one-size-fits-all solutions, which is what corporate marketing campaigns (Deakin & Al Waer, 2011) are trying to sell: a smart city model in a box (Aurigi & Odendaal, 2020).

4.5 Research limitations

Although this research has shed light into several significant, yet understudied issues related to the effect of the ubiquitous presence of technological interventions on social sustainability, it still has limitations. First, the assessment factors and criteria developed in this research might not be exhaustive. However, this research has introduced and tested a method known as free-listing and pile-sorting, which can be used by organizations to develop their own assessment criteria. By doing so, this work has provided a new method and not just a set of results. The list of assessment criteria developed in this study can be used as the framework under which more detailed sets of criteria can be developed. Second, although the field of inquiry (i.e., the Netherlands) was purposefully selected for this study, it came with some limitations. The transferability of this study might be limited to developed European cities, cities without a digital gap, or cities populated mostly by highly educated people. Results derived from such case studies might not be applicable to cities with extremely different circumstances, such as cities in Africa and the Middle East. Applying the same kind of study in the Middle East or Africa will surely lead to different findings. Third, studying an actual participatory planning project and dealing with the government organization's bureaucracy had set further time restrictions. Additionally, due to feasibility and scoping requirements, the research sample was limited to the selected local government representatives and citizens of Schiedam. Lastly, the relationship between smart cities and social sustainability might be presented differently in other fields. Other research fields might have a different approach to relate these two concepts

according to each specific context. Smart cities represented by smart governance was related to social sustainability in this research. Research in the field of smart economy, for example, might relate job security and access to employment to social sustainability is a different way. Despite these limitations, the findings of this study can still provide valid and comprehensive insights into important and timely phenomena that are seldom addressed in the literature.

Chapter 5.

Conclusions & Future Outlook

During the initial stage, this study aimed to identify the role that DCP could play in advancing social sustainability, in light of smart cities. Based on a systematic review of the literature, a hierarchical relationship was found to exists. It was concluded that a potential advancement to social sustainability through DCP could occur. Overcoming some of the challenges associated with citizen participation, such as reaching a diverse group of citizens, is one of the main achievements. The most important finding was the potential role DCP could play in advancing the development of indicators to assess and measure social sustainability. This finding is particularly crucial since social sustainability is a vague concept when it comes to practice. Government organizations still find it challenging to identify their level of social sustainability. This research proposes that DCP processes could be utilized to generate indicators that could help measure some of the hard-to-measure soft themes, such as empowerment, equity or inclusion. Data can be collected and analyzed from online participation processes to provide valuable insight into the social dimension of such processes. For example, demographic information of participants could indicate the level of equity and inclusion. However, this would require advanced statistical and technological tools. Further research might want to explore the possibility of utilizing smart cities' constitutive technologies (data analytic capabilities, services, and novel applications) to develop detailed indicators associated with numerical limits by referring to the collected data from online participation processes. Optimistic views regarding the utilization of sophisticated immersive tools, and how they would improve the participation quality and quantity, or help the government organizations in small cities overcome some of the challenges associated with citizen participation, were the main endeavors for the next stages of this research. Based on quantitative and qualitative analyses and the implementation of a 3DDPP tool, it was concluded that utilizing technology to engage citizens in urban planning could have positive impact only if some considerations are carefully fulfilled. Utilizing technology to facilitate citizen participatory planning aimed at

achieving a smart city model could not ultimately lead to positive outcomes. The results in this study illustrated that small cities that represent more than 50% of the cities in Europe should be prepared to introduce DPP by fulfilling certain maturity factors. A city that is represented by its government organizations and citizens should pay careful attention to issues related to the attitude of some planners involved in the participation process, as well as the lack of trust in the community's ability to generate feasible ideas, on one hand, and the citizens' uncertainty over the influence that their opinions have on the government organization's decisions, on the other. It was further concluded that participatory planning is a matter of attitude, which has to be developed gradually in a community and not imposed due to the availability of technology. This issue has raised the question about the reasons why some smart cities have failed to meet their social promises despite the high availability of technology. Future research could investigate whether favoring technology over the social dimension while planning smart cities is one of the reasons behind their failure. Additional research could be devoted to analyzing the impact of pandemic situations on the ability of cities and citizens to be prepared to introduce DPP. The current Covid-19 pandemic has forced several government organizations to adopt digitization without careful considerations. It would be interesting to study whether in such situations, the required maturity factors would not be a necessity to the success of digitalizing participatory planning. Finally, by analyzing the impact of utilizing 3DDPP tools on participatory planning practices in less-advantaged areas, this thesis has stressed on the considerations that should be carefully fulfilled to ensure a positive impact. Technology appropriation towards the socioeconomic and demographical characteristics, as well as the positive response to the local context, is vital. It would be faulty to neglect the needs of the local participative community and assume that technology might be able to solve the occurring stresses. No one will line up, pay attention, or celebrate the initiation of another cookie cutter approach, which does not address the needs of the community or provide tangible social

benefits. This is particularly applicable to communities on the margins. Such communities do not care about the improvements the government is trying to do to the digital services, if these improvements do not directly meet their needs. Based on this observation, practitioners should consider that sometimes a simple conventional participation approach could have a more powerful impact than a sophisticated digital tool. However, if digital participation is to be utilized, a simplified and personalized tool is recommended. By doing so, the planning organization would be able to utilize the right approach with the right community. This step could prevent waste in budgets that could occur when utilizing fancy expensive technologies with communities that are not the most effective users. Future research could investigate the possibility of utilizing Artificial Intelligence (AI) to develop a machine learning model that could learn from the previous participatory planning data to provide customized recommendations for future participatory planning projects. In this study, the 3DDPP tool was utilized to explore the potential impact of such advanced technologies. Digital twin, in the context of city planning, is defined as the act of creating 3D virtual reactive models as a replica of the cities (Batty, 2018). Digital twin, which is a rising concept alongside smart city initiatives, has cast a light on the importance of predicting and steering equitable planning decisions. However, the challenge is to merge the social and economic processes along with the physical assets. This thesis can assist future research, in terms of identifying the performance of the digital twin application in communities on the margins, to indicate the extent digital twin could add to equitable city planning. Although the concept of smart cities was the result of the potentials of achieving a sustainable development, these days, it seems that its social, economic, and environmental effects are not considered adequately. Efforts should be combined toward developing an integrated approach for designing future smart and sustainable cities, without neglecting one aspect of sustainability in favor of another.

References

Afrooz, A. E., Lowe, R., Leao, S. Z., & Pettit, C. (2018). 3D and virtual reality for supporting redevelopment assessment. In R. Richard & C. Pettit (Eds.), *Real Estate and GIS* (pp. 162–185). Routledge.

Afzalan, N. (2015). *Participatory plan making: Whether and how online participatory tools are useful* (Publication No. 3739587) [Doctoral dissertation, Design and Planning Program, University of Colorado]. ProQuest Dissertations and Theses Global.

Afzalan, N., & Muller, B. (2014). The role of social media in green infrastructure planning: A case study of neighborhood participation in park siting. *Journal of Urban Technology, 21*(3), 67–83. https://doi.org/10.1080/10630732.2014.940701

Agbali, M. (2019). *Developing a framework to promote innovation in socio-economic development in smart cities* [Doctoral dissertation, University of Salford]. http://usir.salford.ac.uk/id/eprint/49641

Ahvenniemi, H., Huovila, A., Pinto-Seppä, I., & Airaksinen, M. (2017). What are the differences between sustainable and smart cities?. *Cities, 60*, 234–245. https://doi.org/10.1016/j.cities.2016.09.009

Alatalo, T., Pouke, M., Koskela, T., Hurskainen, T., Florea, C., & Ojala, T. (2017, June 5–7). *Two real-world case studies on 3D web applications for participatory urban planning* [Conference session]. Proceedings of the 22nd International Conference on 3D Web Technology, Brisbane, Queensland, Australia.

Alderete, M. V. (2020). Exploring the smart city indexes and the role of macro factors for measuring cities smartness. *Social Indicators Research, 147*(2), 567–589. https://doi.org/10.1007/s11205-019-02168-y

Almeida, V. A., Doneda, D., & da Costa, E. M. (2018). Humane smart cities: The need for governance. *IEEE Internet Computing, 22*(2), 91–95. https://doi/org/10.1109/MIC.2018.022021671

AlWaer, H., & Cooper, I. (2020). Changing the focus: Viewing design-led events within collaborative planning. *Sustainability, 12*(8), 3365. https://doi.org/10.3390/su12083365

Ampatzidou, C., & Gugerell, K. (2019). Mapping game mechanics for learning in a serious game for the energy transition. *International Journal of E-Planning Research (IJEPR), 8*(2), 1–23. https://doi.org/10.4018/IJEPR.2019040101

Anastasiu, I. (2019). Unpacking the smart city through the lens of the right to the city: A taxonomy as a way forward in participatory city-making. In M. de Lange & M. de Waal (Eds.), *The Hackable City* (pp. 239–260). Springer.

Angelidou, M. (2014). Smart city policies: A spatial approach. *Cities, 41*, S3–S11. https://doi.org/10.1016/j.cities.2014.06.007

Anthopoulos, L. (2017). Smart utopia vs. smart reality: Learning by experience from 10 smart city cases. *Cities, 63*, 128–148. https://doi.org/10.1016/j.cities.2016.10.005

Anthopoulos, L. (2019). The smart city of Trikala. In L. Anthopoulos (Ed.), *Smart City Emergence* (pp. 149–171). Elsevier.

Anthopoulos, L. G. (2017). *Understanding smart cities: A tool for smart government or an industrial trick?* (Vol. 22). Cham: Springer International Publishing.

Anthopoulos, L. G., & Tougountzoglou, T. E. (2012). A viability model for digital cities: economic and acceptability factors. In C. G. Reddick & S. K. Aikins (Eds.), *Web 2.0 Technologies and Democratic Governance* (pp. 79–96). Springer.

Appio, F. P., Lima, M., & Paroutis, S. (2019). Understanding smart cities: Innovation ecosystems, technological advancements, and societal challenges. *Technological Forecasting and Social Change, 142*, 1–14. https://doi.org/10.1016/j.techfore.2018.12.018

Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of the American Institute of Planners, 35*(4), 216–224. https://doi.org/10.1080/01944366908977225

Aurigi, A., & Odendaal, N. (2020). From "Smart in the box" to "Smart in the city": rethinking the socially sustainable smart city in context. Journal of Urban Technology, 1–16. https://doi.org/10.1080/10630732.2019.1704203

Batty, M. (2018). Digital twins. *Environment and Planning B: Urban Analytics and City Science, 45*(5), 817–820. https://doi.org/10.1177/2399808318796416

Bernard, H. R. (2006). *Research methods in anthropology: Qualitative and quantitative approaches* (4th ed.). Rowman Altamira.

Bibri, S. E., & Krogstie, J. (2017). Smart sustainable cities of the future: An extensive interdisciplinary literature review. *Sustainable Cities and Society, 31*, 183–212. https://doi.org/10.1016/j.scs.2017.02.016

Blake, C. E., Bisogni, C. A., Sobal, J., Devine, C. M., & Jastran, M. (2007). Classifying foods in contexts: How adults categorize foods for different eating settings. *Appetite, 49*(2), 500–510. https://doi.org/10.1016/j.appet.2007.03.009

Botchwey, N. D., Johnson, N., O'Connell, L. K., & Kim, A. J. (2019). Including youth in the ladder of citizen participation: Adding rungs of consent, Advocacy, and Incorporation. *Journal of the American Planning Association, 85*(3), 255–270. https://doi.org/10.1080/01944363.2019.1616319

Brocke, J. V., Simons, A., Niehaves, B., Niehaves, B., Reimer, K., Plattfaut, R., & Cleven, A. (2009). *Reconstructing the giant: On the importance of rigour in documenting the literature search process.* AIS Electronic Library (AISeL).

Brown, G., & Chin, S. Y. W. (2013). Assessing the effectiveness of public participation in neighbourhood planning. *Planning Practice and Research, 28*(5), 563–588. https://doi.org/10.1080/02697459.2013.820037

Bruyninckx, H., Happaerts, S., Van den Brande, K., & van den Brande, K. (Eds.). (2012). *Sustainable development and subnational governments: Policy-making and multi-level interactions.* Springer.

Christensen, H. E., & McQuestin, D. (2019). Community engagement in Australian local governments: A closer look and strategic implications. *Local Government Studies, 45*(4), 453–480. https://doi.org/10.1080/03003930.2018.1541794

Colantonio, A. (2009, April 22–24). *Social sustainability: A review and critique of traditional versus emerging themes and assessment methods* [Conference session]. Sue-Mot Conference 2009: Second International Conference on Whole Life Urban Sustainability and Its Assessment, Loughborough, UK.

Corbett, E., & Le Dantec, C. A. (2018, April 21–26). *Going the distance: Trust work for citizen participation* [Conference session]. Proceedings of the 2018 CHI conference on human factors in computing systems, Motreal, QC, Canada.

Costa, E. M., & Á. D. Oliveira. (2017). Humane smart cities. In R Frodeman, J. T. Klien R. C. S. Pacheco (Eds.), *The Oxford handbook of interdisciplinarity*, 228–240. Oxford University Press

Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research process.* SAGE.

De Filippi, F., Coscia, C., & Guido, R. (2019). From smart-cities to smart-communities: How can we evaluate the impacts of innovation and inclusive processes in urban context?. *International Journal of E-Planning Research (IJEPR), 8*(2), 24–44. https://doi.org/10.4018/IJEPR.2019040102

Deakin, M., & Al Waer, H. (2011). From intelligent to smart cities. *Intelligent Buildings International, 3*(3), 140–152. https://doi.org/10.1080/17508975.2011.586671

Deakin, M., & Allwinkle, S. (2007). Urban regeneration and sustainable communities: The role of networks, innovation, and creativity in building successful partnerships. *Journal of Urban Technology, 14*(1), 77–91. https://doi.org/10.1080/10630730701260118

Dembski, F., Yamu, C., & Wössner, U. (2019, July 8–13). *Digital twin, virtual reality and space syntax: Civic engagement and decision support for smart, sustainable cities* [Conference session]. Proceedings of the 12th International Space Syntax Symposium, Beijing.

Dezuanni, M., Foth, M., Mallan, K., & Hughes, H. (Eds.). (2017). *Digital participation through social living labs: Valuing local knowledge, enhancing engagement.* Chandos Publishing.

Dijkstra, L., & Poelman, H. (2012). Cities in Europe: the new OECD-EC definition. *Regional Focus, 1*, 1–13.

Ensign, J., & Gittelsohn, J. (1998). Health and access to care: Perspectives of homeless youth in Baltimore City, USA. *Social Science & Medicine, 47*(12), 2087–2099. https://doi.org/10.1016/S0277-9536(98)00273-1

Falco, E. (2019). Digital community planning: The open source way to the top of Arnstein's ladder. In Management Association & Information Resources (Eds.), *Smart cities and smart Spaces: Concepts, methodologies, tools, and applications* (pp. 1490–1514). IGI Global.

Foth, M., Brynskov, M., & Ojala, T. (2015). *Citizen's right to the digital city.* Springer.

Fredericks, J. (2020). From smart city to smart engagement: Exploring digital and physical interactions for playful city-making. In A. Nijholt (Ed.), *Making smart cities more playable: Exploring playable cities* (pp. 107–128). Springer.

Fredericks, J., & Foth, M. (2013). Augmenting public participation: enhancing planning outcomes through the use of social media and web 2.0. *Australian Planner, 50*(3), 244–256. https://doi.org/10.1080/07293682.2012.748083

Fredericks, J., Tomitsch, M., & Haeusler, M. H. (2020). Redefining community engagement in smart cities: Design patterns for a smart engagement ecosystem. In C. N. Silva (Ed.), *Citizen-responsive urban e-planning: Recent developments and critical perspectives* (pp. 13–53). IGI Global.

Goldsmith, S., & Crawford, S. (2014). *The responsive city: Engaging communities through data-smart governance.* John Wiley & Sons.

Granier, B., & Kudo, H. (2016). How are citizens involved in smart cities? Analysing citizen participation in Japanese "Smart Communities". *Information Polity, 21*(1), 61–76. https:// doi.org/10.3233/IP-150367

Healey, P. (1998). Collaborative planning in a stakeholder society. *The Town Planning Review, 69*(1), 1–21.

Höjer, M., & Wangel, J. (2015). Smart sustainable cities: definition and challenges. In L. M. Hilty & B. Aebischer (Eds.), *ICT innovations for sustainability (*pp. 333–349). Springer.

Hollands, R. G. (2008). Will the real smart city please stand up? Intelligent, progressive or entrepreneurial?. *City, 12*(3), 303–320. https://doi.org/10.1080/13604810802479126

Hollands, R. G. (2015). Critical interventions into the corporate smart city. *Cambridge Journal of Regions, Economy and Society, 8*(1), 61–77. https://doi.org/10.1093/cjres/rsu011

Houghton, K., Miller, E., & Foth, M. (2014). Integrating ICT into the planning process: Impacts, opportunities and challenges. *Australian Planner, 51*(1), 24–33. https://doi.org/10.1080/07293682.2013.770771

Hughes, H., Foth, M., Dezuanni, M., Mallan, K., & Allan, C. (2018). Fostering digital participation and communication through social living labs: A qualitative case study from regional Australia. *Communication research and Practice, 4*(2), 183–206. https://doi.org/10.1080/22041451.2017.1287032

Janowski, T. (2015). Digital government evolution: From transformation to contextualization. *Governemnt Information Quartely, 32*(3), 221–236. https://doi.org/10.1016/j.giq.2015.07.001

Khansari, N., Mostashari, A., & Mansouri, M. (2014). Impacting sustainable behavior and planning in smart city. *International Journal of Sustainable Land Use and Urban Planning, 1*(2), 46–61. https://www.sciencetarget.com/Journal/index.php/IJSLUP/article/view/365/104

Kim, J. I. (2014). Making cities global: The new city development of Songdo, Yujiapu and Lingang. *Planning Perspectives, 29*(3), 329–356. https://doi.org/10.1080/02665433.2013.824370

Kimathi, F. A., Zhang, Y., & Hu, L. (2019). Citizens' acceptance of e-government service: Examining e-tax filing and payment system (ETFPS) in Tanzania. *African Journal of Library, Archives & Information Science, 29*(1), 45–62.

Komito, L. (2005). e-participation and governance: Widening the net. *Electronic Journal of E-government, 3*(1), 39–48.

Lee, C. W. (2017). Public participation professionals in the US: Confronting challenges of equity and empowerment. In L. Bherer, M. Gauthier & L. Simard (Eds.), *The professionalization of public participation* (pp. 75–96). Taylor & Francis.

Lee, C. W., McQuarrie, M., and Walker, E. T. (2015). *Democratizing inequalities: dilemmas of the new public participation*. NYU Press.

Levenda, A. M., Keough, N., Rock, M., & Miller, B. (2020). *Rethinking public participation in the smart city.* The Canadian Geographer/Le Géographe Canadien.

Lombardi, P., Cooper, I., Paskaleva-Shapira, K., & Deakin, M. (2010). The challenge of designing user-centric e-services: European dimensions. In Management Association & Information Resources (Eds.), *Electronic services: Concepts, methodologies, tools and applications* (pp. 259–275). IGI Global.

Lombardi, P., Giordano, S., Farouh, H., & Yousef, W. (2012). Modelling the smart city performance. *Innovation: The European Journal of Social Science Research, 25*(2), 137–149. https://doi.org/10.1080/13511610.2012.660325

Lopez, C. (2016). *Modeling sustainability of participatory information systems for urban communities: A mixed-method approach* [Doctoral dissertation, University of Pittsburgh]. http://d-scholarship.pitt.edu/id/eprint/26741

Mallan, K., Foth, M., Greenaway, R., & Young, G. T. (2010). Serious playground: Using Second Life to engage high school students in urban planning. *Learning, Media and Technology, 35*(2), 203–225. https://doi.org/10.1080/17439884.2010.494432

Marsal-Llacuna, M. L. (2016). City indicators on social sustainability as standardization technologies for smarter (citizen-centered) governance of cities. *Social Indicators Research, 128*(3), 1193–1216. https://doi.org/10.1007/s11205-015-1075-6

Martini, S., & Quaranta, M. (2020). Changes and political Ssupport: What is the role of context?. In S. Martini & M. Quaranta, *Citizens and democracy in Europe* (pp. 221–232). Palgrave Macmillan.

Meijer, A., & Bolívar, M. P. R. (2016). Governing the smart city: a review of the literature on smart urban governance. *International Review of Administrative Sciences, 82*(2), 392–408. https://doi.org/10.1177/0020852314564308

Michels, A., & De Graaf, L. (2010). Examining citizen participation: Local participatory policy making and democracy. *Local Government Studies, 36*(4), 477–491. https://doi.org/10.1080/03003930.2010.494101

Modelo. 2014. Accessed August 2019. https://modelo.io/.

Morse, J. M. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing Research, 40*(2), 120–123.

Morse, J. M. (2017). *Essentials of qualitatively-driven mixed-method designs* (1st ed.). Routledge.

Mulder, I. (2015). Opening up: Towards a sociable smart city. In M. Foth, M. Brynskov & T. Ojala (Eds.), *Citizen's right to the digital city* (pp. 161–173). Springer.

Parra-Agudelo, L., Choi, J. H. J., Foth, M., & Estrada, C. (2018). Creativity and design to articulate difference in the conflicted city: collective intelligence in Bogota's grassroots organisations. AI & SOCIETY, 33(1), 147–158. https://doi.org/10.1007/s00146-017-0716-5

Peattie, L. R. (1968). Reflections on advocacy planning. *Journal of the American Institute of Planners, 34*(2), 80–88. https://doi.org/10.1080/01944366808977531

Sanford, C., & Rose, J. (2007). Characterizing eparticipation. *International Journal of Information Management, 27*(6), 406–421. https://doi.org/10.1016/j.ijinfomgt.2007.08.002

Santinha, G., & Anselmo de Castro, E. (2010). Creating more intelligent cities: The role of ICT in promoting territorial governance. *Journal of Urban Technology, 17*(2), 77–98. https://doi.org/10.1080/10630732.2010.515088

Schrauf, R. W., & Sanchez, J. (2010). Age effects and sample size in free listing. *Field Methods, 22*(1), 70–87. https://doi.org/10.1177/1525822X09359747

Schroeter, R., & Houghton, K. (2011). Neo-planning: Location-based social media to engage Australia's new digital locals. *Australian Planner, 48*(3), 191–202. https://doi.org/10.1080/07293682.2011.595059

Schroeter, R., Foth, M., & Satchell, C. (2012, June). *People, content, location: sweet spotting urban screens for situated engagement* [Conference session]. Proceedings of the Designing Interactive Systems Conference.

Shaw, J., & Mark, G. (2017). *Our digital rights to the city.* Meatspace Press.

Silva, C. N. (2020). Introduction: Smart digital technologies and the 'ladder' of citizen-responsive urban e-planning. In C. N. Silva (Ed.), *Citizen-responsive urban e-planning: Recent developments and critical perspectives* (pp. 1–12). IGI Global.

Soegiono, A. N., & Asmorowati, S. (2018, March 22–23). *Revitalising democratic local governance: Enhancing citizen access and participation through smart city* [Conference session]. 2018 Annual Conference of Asian Association for Public Administration: "Reinventing Public Administration in a Globalized World: A Non-Western Perspective" (AAPA 2018). Atlantis Press.

Solow, Robert. 1950. "Labor productivity functions in meat packing." MIT Press 270-272.

Somarakis, G., & Stratigea, A. (2019). Guiding informed choices on participation tools in spatial planning: An e-decision support system. *International Journal of E-Planning Research (IJEPR), 8*(3), 38–61. https://doi.org/10.4018/IJEPR.2019070103

Spyra, M., Kleemann, J., Cetin, N. I., Navarrete, C. J. V., Albert, C., Palacios-Agundez, I., ... & Picchi, P. (2019). The ecosystem services concept: a new Esperanto to facilitate participatory planning processes?. *Landscape Ecology, 34*(7), 1715–1735. https://doi.org/10.1007/s10980-018-0745-6

Tait, E. J. (2010). *An analysis of eParticipation in Scottish local authorities* [Doctoral dissertation, Robert Gordon University].

Tang, H. (2019). *ShapeUD: A real-time, modifiable, tangible interactive tabletop system for collaborative urban design* [Doctoral dissertation, Purdue University Graduate School].

United Nations. (2014). *Report of the world urbanization prospects: The 2014 revision, highlights.* Department of Economic and Social Affairs, Publication Division, United Nations.

Van de Walle, S., & Migchelbrink, K. (2020). Institutional quality, corruption, and impartiality: the role of process and outcome for citizen trust in public administration in 173 European regions. *Journal of Economic Policy Reform*, 1–19. https://doi.org/10.1080/17487870.2020.1719103

Varela-Álvares, E. J., Mahou-Lago, X. M., & Viso, M. L. (2019). Do smart cities really provide opportunities for citizen participation? A case study of the RECI cities in Spain. In M. P. R. Bolivar & L. A. Munoz (Eds.), *E-participation in Smart Cities: Technologies and Models of Governance for Citizen Engagement* (pp. 37–58). Springer.

Wallin, S., Horelli, L., & Saad-Sulonen, J. (2010). *Digital tools in participatory planning*. Centre for Urban and Regional Studies Publications.

Wood, P., & Landry, C. (2007). The Intercultural City: Planning to make the most of diversity. Earthscan.

World Economic Forum. (2018). *Global Risks Report.*

Yang, K. (2005). Public administrators' trust in citizens: A missing link in citizen involvement efforts. *Public Administration Review, 65*(3), 273–285. https://doi.org/10.1111/j.1540-6210.2005.00453.x

Yigitcanlar, T., Kamruzzaman, M., Buys, L., Ioppolo, G., Sabatini-Marques, J., da Costa, E. M., & Yun, J. J. (2018). Understanding 'smart cities': Intertwining development drivers with desired outcomes in a multidimensional framework. *Cities, 81*, 145–160. https://doi.org/10.1016/j.cities.2018.04.003

Yigitcanlar, T., Kamruzzaman, M., Foth, M., Sabatini-Marques, J., da Costa, E., & Ioppolo, G. (2019). Can cities become smart without being sustainable? A systematic review of the literature. *Sustainable Cities and Society, 45*, 348–365. https://doi.org/10.1016/j.scs.2018.11.033

Zhang, L., Geertman, S., Hooimeijer, P., & Lin, Y. (2019). The usefulness of a web-based participatory planning support system in Wuhan, China. *Computers, Environment and Urban Systems, 74*, 208–217. https://doi.org/10.1016/j.compenvurbsys.2018.11.006