Eberhard Karls Universität Tübingen,
Forschungsbereich Geographie

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The new role of citizens as co-creators of socio-digital innovations and urban development:
A case-study of participation and co-creation in the smart city development of Barcelona.

Felix Fabian Stroh

Matrikelnummer 3901724

Betreuer: Prof. Dr. Dr. Olaf Kühne (Universität Tübingen)

Zweitgutachter: Univ.-Prof. Dr.-Ing. Dr.-Ing. E.h. Dr. h.c. Dieter Spath (Fraunhofer IAO und IAT Universität Stuttgart)

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Zusammenfassung

Die vorliegende Masterarbeit untersucht aktuelle Trends in der Stadtplanung und Design, um zu analysieren, wie Bürger an der Mitgestaltung von Smart Cities beteiligt werden können. Ziel ist es, ein ganzheitliches Verständnis der neueren Konzepte und Methoden von Co-Design und Co-creation zu entwickeln und diese mit den etablierteren Forschungsfeldern der Bürgerbeteiligung und Koproduktion zu vergleichen. Koproduktion und Co-Creation können als verbesserte Partizipation oder Partnerschaft in Bezug auf die Partizipationsleiter verstanden werden, da beide Konzepte Beziehungen auf Augenhöhe zwischen Bürger und Stadtverwaltung voraussetzen. In ähnlicher Weise gesteht Co-Design, Designern und Usern die gleichen Rechte und Möglichkeiten im Gestaltungsprozess zu.

Es wird eine ganzheitliche Definition des Co-Creation-Prozesses dargelegt, die Erkenntnisse aus Co-Design, Co-Produktion und Partizipation beinhaltet und Co-Creation als einen Prozess versteht, der aus Initiation, Design und Produktion besteht. Die Smart City als sich rasch entwickelndes Forschungsfeld, Definitionen und Charakteristika sowie populäre imaginäre und dominante Diskurse werden vorgestellt. Um die Rolle des Bürgers zur Smart City zu verstehen, werden die unterschiedlichen Verständnisse von Smart Governance erläutert und Aspekte von Open Data, Big Data und Big Data Analytics sowie die Rolle von Bürgern und Gefahren der Smart City diskutiert.

In der Fallstudie zur Bürgerbeteiligung werden Methoden und Werkzeuge zur Förderung der Mitgestaltung einer Smart City anhand Partizipationsleiter von (Arnstein 1969) diskutiert und analysiert. Die Smart City Entwicklung in Barcelona wird vor dem Hintergrund der gemeinschaftlichen Entwicklung sozialer Innovationen in Smart Cities analysiert. Die Fallstudie verweist auf Mängel im Hinblick auf Bürgerbeteiligung an der Entscheidungsfindung und an der Verlagerung von Machtverhältnissen in der Entwicklung der Smart City Barcelona, die dafür aber mit neuen Werkzeugen und Technologien für partizipative Stadtentwicklung experimentiert und sich zu einem alternativen Smart City Modell entwickelt. Die wichtigsten Ergebnisse sind abschließend im Methodenkatalog zusammengefasst, der Methoden und Tools aus Theorie und Fallstudie aufgreift um zu dem Verständnis beizutragen, wie Smart Cities gemeinsam gestaltet werden können.

Abstract

This thesis studies current trends in planning and design studies to analyse how citizens can participate in the co-creation of smart cities. It aims at developing a holistic understanding of the new concepts and methods of co-creation, and co-design and compares those with the more established research fields of citizen participation and co-production. Co-production and co-creation can be understood as instances of enhanced participation or as a partnership in participation, as both concepts require equal relationships among citizens and the city administration. Similarly, co-design requires designers and users to share the same rights and possibilities in the design process. A holistic definition of the co-creation process is provided that incorporates insights from co-design, co-production and participation and defines co-creation as a process consisting of initiation, design and production.

The smart city as emerging research field, definitions and characteristics, as well as popular imaginary and dominant discourses, are presented. To grasp the role of the citizen in the smart city, the different understandings of smart governance are explained and aspects of to open data, big data and big data analytics, as well as the role of citizens and perils of the smart city are discussed.

In the case-study of citizen participation methods and tools fostering the co-creation of a smart city are discussed and analysed with the introduced participation framework, which is based on the ladder of participation (Arnstein 1969). The smart city development in Barcelona is analysed against the backdrop of co-creating social innovations in smart cities. There might be a lack of citizen participation in decision-making and shifting power relations in the city, which experiments nonetheless with new tools and technologies for the participatory environment experiments with new formats and technologies for economic and urban development and evolves to become an alternative model of the smart city. The main findings are included in the toolbox based on methods and tools from theory and the case-study contributing to the knowledge of how to co-create of smart cities.

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1 Introduction

The ongoing shift from a rural to urban population creates new kinds of technical, physical and material problems in cities and megacities (Chourabi et al. 2014). Due to problematically inadequate infrastructures and their bad poor environmental performance in general, it is estimated that cities consume more than 75% of the global energy resources while generating 80% of the total greenhouse gas emissions (Lazaroiu & Roscia 2012). Inevitably, problems like air pollution relate to human health concerns. The warming global climate and the prevailing economic instability coupled with demographic pressure has led to a range of new city concepts accompanied by policy prescriptions that place cities at the centre of the solutions of those wicked problems (Shelton et al. 2015). Cities are increasingly held responsibly to protect the environment from pollution and energy consumption (Dameri & Rosenthal-Sabroux 2014).

Urbanisation is expected to increase in terms of both, the level of the urban population relative to the overall population, and the rate at which cities are growing. Most cities believe in leveraging information and communication technologies (ICT) for economic growth, competitiveness, and increasing the quality of life of its citizens (Caragliu et al. 2011). Cities began to shift their traditional image towards a new image, in which the city becomes a centre of excellence that not only optimises the quality of life but also emphasises its role in the development of knowledge and information (Mechant et al. 2012). This comes at a time when citizens increasingly engage in solving urban problems. Cities recently can profit from citizens' participation in engaging to solve urban problems in new forms of ICT-enabled collaboration peer-to-peer production, sharing economies, or maker movement. Although these new technologies seem to have an empowering quality, the democratic quality of smart cities still must be proven, as there are many open questions related to, e.g., data ownership & privacy, surveillance, exclusion and citizen participation.

Cities that have embraced Information and communication technologies (ICT) for urban development for their entrepreneurial and regulatory effect have been labelled as wired cities, cyber cities, digital cities, intelligent cities, smart cities or sentient cities (Kitchin 2014b). As people and machines increasingly are interconnected through mobile devices and sensors, cities around the world need to adapt to the ICT-infused environment. Thus, unsurprisingly the smart city received a peak of attention in the last years and was heavily promoted by researchers and by a powerful political and economic lobby promoting 'smart city initiatives that will lead to more efficient, effective, sustainable, resilient, safe and secure cities' (Kitchin et al. 2015).

Cities are key sites of social experimentation and problem solving in the 21st century (Shelton et al. 2015; Albino et al. 2015), which can be conceptualized as open, complex ecosystems where different stakeholders with different and contrary interests are forced to collaborate to ensure an adequate quality of life and a sustainable urban development (Capdevila & Zarlenga 2015). Thus, cities are facing a set of problems concerning the difficulty to balance multiple and diverse stakeholders with competing values and goals contributing to their social and political complexity. Or to put it with Jane Jacobs: 'Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody' (1961).

Citizen participation and engagement are recognised a key success factor in the development of sustainable solutions and business models (European Commission 2016). Co-creation is considered a promising concept to explore new approaches to wicked societal challenges in the context of financial austerity, ageing populations and decreasing trust in public institutions (Voorberg et al. 2014). Evidence suggests that operationalising co-creation can help to make urban management 'smarter' (Dawe & Sankar 2016) and helps creating human smart cities (Rizzo et al. 2015) by harnessing the benefits of a participatory innovation model (Fu & Lin 2014) and IT-enabled collaborative planning (Goodspeed 2014).

1.1 Relevance

Smart cities are an emerging megatrend worldwide that is expected to drive and shape urban development significantly the next years and will bring huge business opportunities (Castelnovo 2016). The smart city implies 'a somewhat nebulous idea which seeks to apply the massive amounts of digital data collected about society as a means to rationalise the planning and management of cities' (Shelton et al. 2015: 1). The diffusion and the success of the smart city idea are connected to the latest developments of affordable state-of-the-art technology working on a real-time basis, wireless, with increased performance, safety and reliability (Angelidou 2015). Although 'smart' is not reducible to a single meaning, in the most rudimentary sense, 'smart' is related to the pervasive use of ICT to make better use of the city's resources (cf. Neirotti et al. 2014).

However, the diffusion of smart cities is echoed in the work of urban planners, architects, infrastructure operators, real-estate developers, transportation officials, mayors and entire industries, altogether contributing to the making of smart cities. The smart city is far from being merely a technological issue. 'Smart city' is a utopian idea and a debated construct which turns into reality when applied in existing cities which then impacts on urban planning and design, governance, economic development, democracy and politics, citizen participation, urban data and discussions about privacy, among others.

Some sort of interaction and communication between citizens and government is considered a requirement of the democratic process (Berntzen & Johannessen 2016). Decisions made through civic participation not only lead to better results, they tend also to be better accepted. Furthermore, participation improves individuals' well-being through a feeling of being socially integrated and accepted and by strengthening their belief in being beneficial to themselves and society (Mannarini et al. 2010). But, although citizen participation is considered as positive for both, people and institutions, as well as for society at large (Mannarini et al. 2010), community engagement in urban or architectural projects proves often as useless and frustrating for all involved parties, due to insufficient information, or lacking a suitable framework or transparency, or the ideas resulting from participation are not translated into policy (Ellin 2013).

An issue that interests most people is the role humans are going to play in the digitalised city of tomorrow. We are witnessing a new mindset of collaboration and participation in smart city development (Snow et al. 2016) and wider trends in economy and society suggest a transformation of the role of people, from passive consumers and users to becoming 'activists'[1] (Marg et al. 2013), 'co-creators' (Ind & Coates 2012) or 'prosumers' (Ritzer & Jurgenson 2010), and co-creators in the making of collaborative cities (Foth 2017).

In the information society, citizens must be enabled to learn to make useful contributions by using their imagination and creativity in making use of the knowledge of their habitat and their personal context to co-create the systems, products and services that best suit their lives, providing inputs to the 'design decision-making process that reflect the diversity and richness of their own experience' (Olphert & Damodaran 2007: 503). For forward-looking cities, co-creation as an innovative tool is considered as a key issue (Duvernet & Knieling 2013). This is anchored by the increasing interest in how approaches to participatory design like co-creation can be used in smart city projects (Hudson et al. 2016).

Proponents of the open innovation paradigm emphasize the role of citizens, businesses and communities in service design and product innovation (European Commission 2016). Open innovation and co-creative methods can enable every organisation to become successful in the future by institutionalising co-creative culture and thinking (Ramaswamy & Gouillart 2010). The necessity of renewal of public participation is broadly acknowledged in discussions about urban planning, as well as the role of the internet plays in this renewal (Duvernet & Knieling 2013). Participation is regarded as beneficial, as more citizens engage actively in urban development, more different perspectives can be included in planning enriched with a diverse set of experiences and personalities, all contributing to a more balanced urban development, which considers a greater spectrum of different interests.

[1] Referring to the new power of citizen activists

1.2 Research objective

The idea that citizen engagement is critical in the development and implementation of smart cities is regarded by many as self-evident truth (European Commission 2016). But, despite the importance given in the literature to collaboration and ICT-enabled collaboration, there is still a gap in knowing how ICT can enable collaborative governance in smart cities (Pereira et al. 2017). Although there is evidence of user involvement in creating future smart cities through living labs (Schaffers et al. 2011), there is a lack of methodologies supporting the call for smart cities to be based on citizen-led co-creation (cf. Deakin 2014). Case studies of co-creation and collaborative solutions are hard to find evidence (European Commission 2016). *The European Innovation Partnership on Innovation* calls for cities to change the game of innovation to design solutions 'with the people' and not 'for the people' (Correia et al. 2016).

This thesis seeks to address the gap between rhetorical and actual participation in smart city undertakings, as many 'best practices' claim to be highly participatory, but actually, display only peace-meal approaches to involving the citizens (European Commission 2016). Although participation is stressed as a crucial element in various smart city definitions, little research exists about the issue (Chourabi et al. 2012; Meijer & Bolivar 2016; Granier & Kudo 2016). There is a gap between theory and practice, as in many smart city proposals 'computational technologies are meant to synchronize urban processes and infrastructures to improve resource efficiency, distribution of services, and urban participation' (Gabrys 2014: 4).

Or, as Chourabi et al. (2012) put it: 'addressing the topic of people and communities as part of smart cities is critical, and has been traditionally neglected on the expense of understanding the technological and policy aspects of smart cities' (p. 2293); although a meaning of a city's smartness is to better know what citizens want and need, as well as to know their opinions (Alawadhi et al. 2012).

Thus, this thesis addresses current trends in planning and design studies to citizens participating in the co-creation of smart cities. The following four research questions will be addressed:

- What are benefits of citizen participation, co-production and co-design? What are differences and underlying concepts and methodologies?
- What is a real-existing smart city?
- What roles play the citizens in smart city theory and development?
- What methods and tools can support co-creation and participation on the urban scale?

Smart city plans and proposals often promote citizen-sensing and participatory platforms as enabling urban dwellers to monitor environmental events in real-time through mobile and sensing technologies. This raises questions towards material-political arrangements and

issues of the smart city. The objective is to understand public participation in the making of the smart/self-sufficient city of Barcelona by focussing on new methodologies and their repercussions in wider socio-economic issues of urban development. The thesis seeks to contribute to the understanding of how citizens and communities can contribute to smart cities by studying co-creation methodologies in the practices of urban development of the smart city in Barcelona.

1.3 Methodology

The underlying methodology is a case-study of co-creation and participation in the smart city development in Barcelona. Both, 'co-creation' and 'smart city' are quite new research fields, whereas the public administration and political sciences literature regarding participation contain an established body of work. The motive of this research effort was an extensive literature research to grasp how future cities can be built with the help and participation of citizens. Secondary data was analysed in monographs, conference papers, grey literature and most, peer-reviewed Journals (Appendix 2).

Various disciplines contribute to the broad research field of digitalisation and urban development and planning. Multidisciplinary research fields like co-creation, or smart city are themselves co-created in many books, conferences, research papers, corporate and third sector publications. To see the main thematic influences of this research effort, the 81 cited scientific journals were clustered according to the Journals' thematic focus and disciplinary background into five groups (Appendix 1). The following list represents the body of knowledge consulted in this research effort:

- Geography, Urban Planning, Policy & Design
- Information and Communication Technology
- Economy, Business and Management
- Policy & Government and Public Sector
- Miscellaneous: Design, Psychology, Environment

Based extensive literature review, this research aims to develop a holistic understanding of the 'new' concepts and methods of co-creation, and co-design and compares those with the more established research fields of citizen participation and co-production. Although 'participation' is generally considered to be a desirable virtue, it remains controversial how to best design and carry out a public engagement process. Therefore, this chapter introduces prominent terminologies and compares different engagement theories and streams of research on citizen participation, co-production of public services, co-creation and participatory design. This chapter aims to delineate these concepts from each other by pointing out similarities and differences and to outline and clarify their meanings. After discussing the interrelated concepts,

a unifying definition of the co-creation process is provided in the last subsection. The research questions addressed are the issues and benefits of citizen participation, co-production and co-design, as well as the differences and underlying concepts, methods and tools.

The next part of the theoretical framework introduces the smart city, a complex and heterogeneous research field. To draw a holistic picture of a multi-faceted concept, the smart city is introduced in theory, application and practice, in other words, as emerging research field, definitions and characteristics, as well as popular imaginary and dominant discourses.

Then, the smart city concept is discussed in relation to open data, big data and big data analytics. The different understandings of smart governance are explained and then the quadruple helix as an innovative governance model for smart cities is introduced. The next subsection analysis the role citizens play in real smart city projects and discusses four roles citizens play when interacting with smart cities.

Chapter 3 provides a case study of citizens involvement in smart city development in Barcelona. The 'ladder of participation' is introduced as a heuristic tool for the case-study of citizen participation and co-creation of the smart city development in Barcelona. Then, participative projects for regarding the different steps of the ladder are identified and discussed in respect of co-creation and citizen participation. Specific focus was placed on the innovation and knowledge district in Poblenou, which transformed from a run-down area into a prototype for a fab-city.

The co-creative smart city is constituted by living labs, citizen innovation in open data initiatives such as hackathons where citizens become co-creators of innovations in Makerspaces and fab labs. Methods supporting co-creation are discussed in the case of crowdsourcing and citizen science, illustrated by a paradigmatic case of citizens participation in sensing the environmental quality in Barcelona. Another way to participate in urban planning is through participatory platforms: Barcelona's participation platform was host to the co-creation of a programme enabling citizens to live increasingly in car-free zones by reorganising the city blocks (3.3.9). The final subsection discusses socio-economic factors of citizen participation in Barcelona.

The fourth chapter provides a toolbox of methodologies addressing the co-creation of smart cities. The toolbox is a catalogue for co-creation of smart cities complemented by the methods found in case-study and a set of innovative methodologies for smart urban planning found in the literature. The final discussion discusses the addressed research questions and sums up the results.

2 Theoretical Framework

2.1 From Participation to Co-creation

Generally, public engagement is the basis of processes that improve the environmental, social and economic conditions of a community, therefore enhancing the quality of life of its members (Mannarini et al. 2010). Participation has different facets, from voluntarily forms like an informal consultation, complaining and community-based decision-making, to formal public participation processes like voting or petitioning. It is applied in policy-setting, planning, and decision-making in domains such as healthcare, environmental, city planning or elections.

Nowadays, participation is not only accepted but more and more desired and requested from members of the public to be involved in urban planning. People want to have their voices heard, and non-existent opportunities to participate in big infrastructure projects in the past years have led to frustration, rebellion and a loss of trust in public authorities. Not involving the public upfront can lead not only to a lack of legitimacy and a feeling of injustice but also to a higher economic cost of participation (cf. Wang & Bryer 2012). This increasing demand for public participation in policy-setting, which is reproduced and increasingly considered as standard across the 'OECD world' (Bishop & Davis 2002) has produced a growing number of processes, techniques and instruments that can be subsumed as 'mechanisms' for enabling involvement (Rowe & Frewer 2005).

People have very different beliefs about what participation should accomplish (Webler & Tuler 2002), and similarly, what defines participation (Davis & Bishop 2011). The term addresses everything, from the wide field of direct democracy with a more continuous and active role for citizens, to unsteady or infrequent informing or consultation processes. One can view participation as a continuum from non-existent participation, at the bottom of the ladder to tokenistic processes up to citizen control, at the top of the ladder (cf. Figure 1) with a rising amount of shared power and more equal relationships between government and citizens climbing the ladder (Arnstein 1969). Participation expectations and outcomes also differ in relation to the underlying model of democracy (Berntzen & Johanessen 2016). The same holds true for the respective model of e-democracy (Päivärinta & Sæbø 2006).

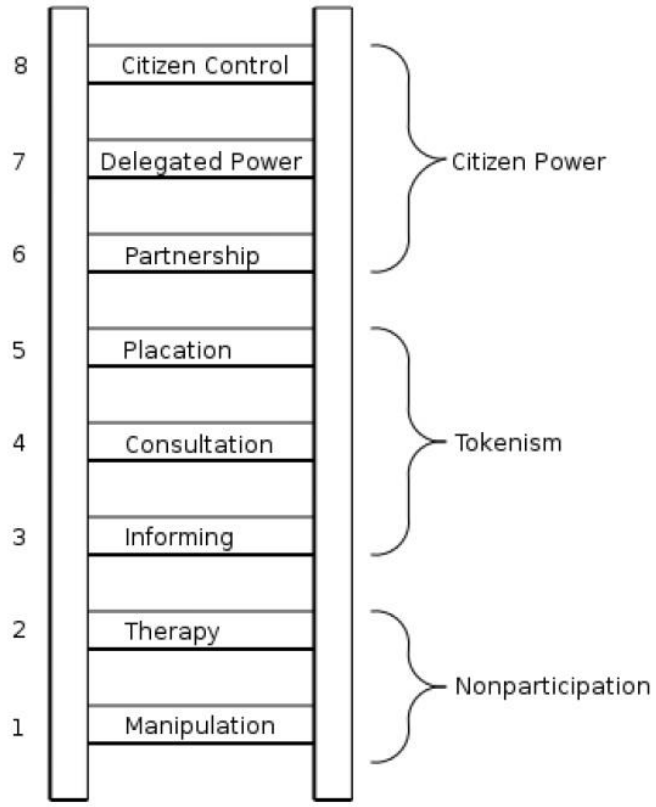

Figure 1: Ladder of Participation (Arnstein 1969)

2.1.1 Citizen Participation

Public participation refers to the 'whole public' including citizens and citizen-initiatives, organised actors from civil society such as lobbies, NGO's and local organisations, as well as, experts from academia and consultants from professional associations. Planning law of most countries requires formal consultations in the concluding stage of planning when formal consultations must be run with affected residents (individual formal participation). However, the recent evolution of urban planning has sparked the extended interest of the local community and civil society to take part in planning decisions for the defence of collective rights such as quality of air, soil and water, culture, architecture or business-friendly environments (Marsh et al. 2013). Innes & Booher (2004) explored benefits from political participation in decision-making from the public organisation's viewpoint.

Involving citizens in meaningful ways is a complex endeavour as the format of interaction depends on the context of the problem. However, different mechanisms such as roundtables, town hall meetings, citizen juries, scenario workshops, digital or analogue, almost all aiming at bringing people together so that they can talk about a specific issue, become informed about it, and arrive at a strategy of what to do (Webler & Tuler 2002). Through the growing interest in the subject and the digital era, there are increasing numbers of participation mechanisms and channels available to public managers. One sole paper summarizing some participation mechanisms lists more than 100 different tools and methods (cf. Rowe & Frewer 2005) with

each mechanism varying in terms of production and participation costs, as well as in terms of associated benefits (Wang and Bryer 2012), as some are related to higher quality or inclusion and others to higher participation quantity that is different to quality (Quick & Feldman 2011).

As outlined above for individuals to become involved depends on a complex interplay of personal factors and processual factors on the organisational side. On the psychological side, the perceived self-efficacy, which means the degree to which individuals believe in their capabilities to master a task, the sense of community that describes the relationship between an individual and the social structure, as well as the causal importance that reflects individual's beliefs about the relationship between their actions and outcomes, are all factors considered important to empower individuals to civic participation (Goncalves et al. 2013). Mannarini et al. (2010) found for people to get involved depends on the perceptions of costs and benefits, on the opportunity for a satisfactory experience, and on the openness to new information (Mannarini et al. 2010). Also, the motivation behind their interest to participate are very different, as some people might be more motivated by environmental or sustainability causes, others might be more interested in community or political outcomes, while others are not interested in one or another. In practice, participation has its limits, due to high complexity and a high number of heterogeneous stakeholders with different interests and limited resources, and ultimately, it is rather illusory to achieve a consensus among all the participants (Schraml & Kleinszig 2014).

The most advantaged find themselves often in a better position than others to voice their interests because they tend to have higher incomes and education and tend to have more time at their disposal (John 2009). This is called the representational bias of political participation and has negative repercussions on the making of a democratic society, as participation leads to more democratic decisions about resources, and a redistribution of existing power relations from the government to citizens (Arnstein 1969). As outlined above, citizen participation can differ from no participation at all to citizens being informed about decisions and plans and citizens being consulted in a dialogue, to ultimately citizens being in control and self-government of the people (Arnstein 1969) which is certainly an outdated idea as today no single actor has all the knowledge, expertise, and resources required to govern alone and the capacity to govern depends more on a mutual exchange of resources (Torfing et al. 2017).

2.1.2 Co-Production

> We argue that the movement toward co-production can be conceptualized as the shift from 'public services for the public' towards 'public services by the public' (Bovaird & Loeffler 2013).

The concept of co-production was originally developed by Elinor Ostrom during 1970s to describe and delimit the involvement of ordinary citizens in the production of public services when she realized that in contrast to goods, services are difficult to produce without the active

participation of those persons receiving the service (Pestoff 2011). Co-production relates to both, 'soft services' which require participation of citizens to achieve their goals of transforming (education, health care, crisis intervention) or 'hard' services such as police, fire, waste recycling or water. Common examples include students doing their homework, or neighbourhood watches or citizens taking part in recycling, fire prevention, etc.

Co-production challenges traditional public service delivery model in which municipalities provide goods and services to largely passive, demanding and consuming citizenry (Brudney & England 1983). It also challenges the idea that service delivery can be separated from service design since users play key roles in both, design and delivery of public services (Pestoff 2011). Additionally, service users and professionals increasingly develop a mutual and independent relationship in which both parties take a risk and need to trust each other (Bovaird 2007). The implications of co-production (Bovaird & Loeffler 2013) are that user involvement leads to better outcomes, as the 'right' services are more likely to be delivered and by emphasizing the users' in all stages their evaluation criteria, such as their journey becomes important, as they evaluate not just the outcome but also the interaction and the process of a service.

When considered as partners in service delivery, users and communities offer resources, skills and capabilities, while in the professional providers share power and control with them. Through aligning both parties' perspectives in a shared solution, services can be improved and increased productivity can be achieved requiring close interaction and participation. This can have a positive impact on the quality of the service, improve citizen satisfaction and morale while ensuring public value and the acceptance and usage of the service by the users. Literature suggests a win-win outcome situation, if co-production is enabled in public service provision there are benefits for users, citizens, frontline, staff and politicians at the same time (Bovaird & Loeffler 2013). But it is also recognised that 'powerful and systemic barriers' exist preventing co-production / co-creation from entering the mainstream and a wider adoption in public sector (NESTA 2011; Bovaird & Loeffler 2012; Wiewiora et al. 2015; Voorberg et al. 2015).

As it is more and more becoming mainstream that the public sector aims to create conditions for enabling collaboration, peer production of value and co-production to achieve community outcomes, public managers and the public employees must increasingly exhibit new behaviours and play new roles (cf. Sancino 2016). Underlining its paradigmatic nature, co-production implies rethinking the roles of the State, the relationship between the State and civil society and the roles of public managers (OECD 2011; Thomas 2013). Although expectations are high and while it is often assumed that co-production is beneficial to citizens and society, there is little empirical evidence proving it (Brandsen & Honingh 2016). Co-production is not

only found in countries with generous welfare states (Pestoff 2011), it is also found in the context of developing states and poor countries especially in environments where a public authority is weak and often it would be otherwise difficult to deliver the service effectively (Joshi & Moore 2004).

2.1.3 Co-Creation

> …[C]o-creation can be a force for participation and democratisation that does create meaning for all, rather than simply an alternative research technique or a way of creating value through co-opting the skills and creativity of individuals (Ind & Coates 2012: 10).

Co-creation has different meanings and backgrounds and can be viewed from different perspectives, but generally, it can be understood as a process of joint creation with a mutually valued outcome. Similarly, co-creation refers to any act of collective creativity that is shared by two or more people (Correia et al. 2016; Opromolla et al. 2015). There is great research activity related to co-creation from various fields, but no clear and established definition of it (Tokoro 2015).

In practice, it is understood as a creative process where new solutions are designed 'with' the people, not 'for' them (Sanders & Stappers 2008; Bason 2010). Additionally, it describes a shift in thinking about organizations as the sole definer of value to a more participative process in which people and organizations together generate and develop meaning (Ind & Coates 2013), thus it improves 'organizational knowledge' processes by involving stakeholders in the creation of meaning and value (Correia et al. 2016).

Although the recent obsession with co-creation has come with its announcement in business management literature (Prahalad & Ramaswamy 2002; 2004a; 2004b), it emerged through the mainstream adaption adoption of internet technologies, the orientation towards services and experiences, a more open approach to innovation and the growth of social, collaboration and customisation technologies (Ind & Coates 2013). It is also related to the concept of open innovation introduced by Chesbrough (2003) in contrast to closed innovation. Open innovation refers to conscious efforts by firms to incorporate ideas created outside the firm in innovation processes within the firm, thus making use of inflows and outflows of knowledge for internal innovations.

In the business management, co-creation is understood as active involvement of end-users in various stages of the production process, and is considered as a source of product and service innovation resulting not only in customer satisfaction and loyalty but also helps firms to achieve competitive advantage (Voorberg et al 2015).

Additionally, co-creation is considered a new paradigm for public administration, as it involves new thinking about public service delivery and policy development (OECD 2011; Torfing et al.

2017). It is also considered crucial to innovations in the public sector and a source of social innovation, which is defined as:

> 'the creation of long-lasting outcomes that aim to address societal needs by fundamentally changing the relationships, positions and rules between the involved stakeholders through an open process of participation, exchange and collaboration with relevant stakeholders, including end-users thereby crossing organisational boundaries and jurisdictions' (Voorberg et al. 2015; cf. Bason 2010).

In this sense, co-creation is related to other, similar concepts like social or open innovation, public participation, collaborative or interactive governance, community involvement and co-production (Voorberg et al. 2015; Torfing et al. 2017). Torfing and colleagues outlined the differences of 'co-creation' to similar concepts like 'social innovation' and 'collaborative governance' (2017): The focus of 'social innovation' is on civil society attempts to correct and supplement the public sector, which is given a rather passive role, except for its occasional role as sponsor for social enterprises and local initiatives. Contrastingly 'co-creation' refers to common efforts of a plethora of public and private actors to solve public problems and the emerging innovative potential when different actors engage in mutual and transformative learning. The collaborative governance concept refers also to private and public actors engaging in informal, consensus-oriented, collective decision-making, but 'collaboration' is considered more related to governing, than as a lever for innovation like 'co-creation'.

Furthermore, co-creation is connected to design concepts like 'participatory design', 'co-design and 'design thinking' that have been considered as 'absolutely central to innovation' in the public sector (Bason 2010). Also, the recognition of the need to apply these concepts has become 'fairly commonplace' in the public sector (Mulgan 2014). However, others stress that the introduction of design culture in the public sector is still in its initial phase, as design methods and tools are still unknown to public institutions and design knowledge is far from a large-scale uptake that could affect daily processes and underlying culture public organisations (Deserti & Rizzo 2014). Additionally, supranational organisations like the OECD (2011) have taken up the topic - the European Commission has launched several calls for co-creation proposals in the *Horizon2020* research funding programme in the two main areas: 'Co-creation for growth and inclusion', as well as 'ICT' (Correia et al. 2016).

In service management, importance is placed on that very moment of the interaction of expectation on one side and actual customer experience on the other side, which is when the value is co-created through co-production (Prahalad & Ramaswamy 2004; Grönroos & Voima 2012; Osborne et al. 2016; Payne et al. 2008). During this interaction value co-creation is not the only possible outcome, side effects and negative externalities may happen which possibly lead to interactional value co-destruction (Plé & Chumpitaz 2010). Prahalad & Ramaswamy

recognized that interconnected and informed costumers are increasingly valuable to companies (2004a):

> The meaning of value and the process of value creation are rapidly shifting from a product- and firm-centric view to personalized consumer experiences. Informed, networked, empowered and active consumers are increasingly co-creating value with the firm.

Since that there had been an explosion in the interest of co-creation of value by service users, as for companies adopting a co-creation strategy to create meaningful experiences with consumers means a source of innovation, competitive advantage, future success and loyalty (Prahalad & Ramaswamy 2002; Ramaswamy & Gouillart 2010; Chatoth et al. 2013; Alves et al. 2016).

Interaction as the basis for value co-creation is key to the service-dominant logic, within which goods function solely as vehicles for services and all economies become service economies and all economic actors become integrators of resources (Vargo & Lusch 2004). A company, therefore, cannot provide value alone, but only value proposals with which the customer interacts as co-creator of value. Due to this logic, the value of buying a car is therefore contingent upon the resources the customer can integrate with like driving skills or driver's license and upon the context of using the car (as a commuter vehicle, a family car or for driving to holidays). Thus, 'value' depends rather on the context (value-in-context) and use (value-in-use) and not on the exchange of units of output like goods (value-in-exchange). This distinction between use-value and exchange-value can be traced back to the work of Adam Smith and Karl Marx who already found out that a high exchange-value does not necessarily imply a high use-value (Jacob et al. 2013).

This matters also for public services, as the public sector must not deal solely with private value like the private sector (to name the 'corporate social responsibility' phenomenon as an exception), because governments have two beneficiary types, citizens and clients, with the former receiving public or social value and determining what should be done through the electoral process, while the latter gain individual or private value (Alves 2013). Often private value as 'purely selfish motivation' on part of the clients or the users may explain their willingness to co-produce to ensure to gain high private value (Bovaird & Loeffler 2012). How to reconcile these private and public values (cf. Table 1) shows the 'Arts and Craft School Project of Santana do Parnaíba' that sought to regenerate and revitalize the historical centre of Santana de Parnaíba and its suburbs (cf. Alves 2013). Young people have trained in restoration that in turn generated employment and better labour qualifications that are an individual value (value-in-use), while in the meantime, it changed the behaviour of the young who stopped vandalizing the historical centre from now on, and thus it produced public value for the entire community (value-in-exchange).

Table 1: Dimension of Private and Public Value (cf. Bovaird & Loeffler 2012)

Dimension of 'value-added'	Meaning	Type:
Individual value	Public service costumers, clients or users gain value	private
Value to wider groups	Family, friends, or individuals indirectly affected	private
Social value	Creation of social cohesion or support for social interaction	public
Environmental value	Ensuring environmental sustainability	public
Political value	Supporting democratic process, e.g. through co-creation.	public

Wikipedia, for instance, is considered to be a well-known example of autonomous co-creation, where individuals or communities produce (public) value in voluntary activities conducted independently of any established organization (Zwass 2010). It has challenged the traditional encyclopaedia with its commitment to involving people it has become the 'dominant form knowledge dissemination' (Ind & Coates 2012). Other famous examples are open source software (OSS) like Linux, or Mozilla, which have changed the competitive landscape of software and knowledge industries in an unforeseeable way.

While those examples relate to more autonomous forms of co-creation, it is not always the user or citizen that initiate co-creation activities, co-creation can be initiated top-down or sponsored co-creation in the form of idea-jams or innovation contests where users are invited to contribute their ideas regarding improving an existing product or a service. Similarly, in the public sector, there is a long tradition in Scandinavia of citizens, civil society organisations, and public authorities joining forces and co-creation solutions to common problems (Torfing et al. 2017).

Alves argues that the co-creation of value may effectively foster and enhance public-sector innovation and drive radical innovations (2013). Co-production leads to co-creation of value that emerges through the user's satisfaction with the service, the impact of the service experience upon their well-being and the extent to which it meets their social, health or economic needs (Strokosch et al. 2016). By integrating citizen capabilities and knowledge governments can restructure and relaunch public services, design and implement new processes and methods of service delivery that result in gains in efficiency, effectiveness and quality (Alves 2013).

> When actors with different resources and competences, and ideas are brought together in processes of creative problem solving, they are likely to produce a better understanding of the problem at hand, and engage in processes of mutual learning through which they can develop and test new and bold solutions while building a joint sense of ownership for their project (Sørensen & Torfing 2016).

The key to co-creation is the idea that everybody can be creative (Bason 2010), although this belief is not very common, especially in the business community, whose primary approaches to co-creation assumed that solely 'lead' users are creative enough, to become co-designers (Sanders & Stappers 2008). Co-creation today means involving people inside and outside the organisation through the process of creation, including people from other public agencies and institutions, private actors, social innovators, and end-users such as communities, families and individual citizens and businesses (cf. Agusti et al. 2014). In this understanding co-creation is a process where different stakeholders can actively influence and drive the formulation of policies, design alternatives and management decisions in concrete projects (Prahalad and Ramaswamy 2002).

Research suggests that public innovation is rarely the output of a single actor, but that of a plethora of private and public actors (Sørensen & Torfing 2016). Recently, also the role of academic institutions in urban development is subject to change (Trencher et al. 2013). While earlier they were criticised for disregarding place-based and real-world problem solving and as too theoretical, universities now play a more active role and collaborate across sectors with other actors to create societal transformations in pursuit of sustainable development. Multi-actor-university alliances are considered capable of advancing transformation and innovation the built environment, mobility sector, government policy and political priorities (Trencher et al. 2013).

There is a paradigmatic shift happening in urban planning and design, which are considered as a participatory process involving many actors, such as citizens, planners, architects, managers, architects, etc. regardless of their professional background. This shift is called (urban) co-creation[2] (Dörk & Monteyne 2011; Iaconesi & Persico 2013). It is terminologically a better fit than 'urban design', as it follows not a master plan envisioned by urban planners and leaves room for the experimental requiring a loss of control and shifting power. This notion of co-creating the city as participative placemaking is thematically connected to other ideas in urban planning such as DIY-Urbanism, urban guerrilla movements and 'the right to the city' (Foth 2016: 16).

[2] The equivalent in German is ‚Mitgestaltung', as the term 'co-creation' is used in marketing or economic development and is not explicitly referring to urban development in German literature and expert discussions (Duvernet & Knieling 2013).

Similarly, the idea of ‘tactical urbanism’ describes the voluntary nature of citizen participation in the local habitat, as citizens tend to care about the place where they live. Citizens may use tactical urbanism as a tool to draw attention to perceived shortcomings in policy and physical design (Lydon & Garcia 2012). It aims to leverage social ties of the citizens with the city and represents a low-cost method used for realistic, neighbourhood-based planning based on the self-responsibility and voluntary actions of citizens. Some cities already enable citizens to participate in the active design of places through tactical urbanism (Robra-Bissantz et al. 2016). They seem the right persons to ask, as Iaconesi & Persico (2013: 13) notice that:

> Individuals and social groups of many kinds live in a constant state of re-invention of the spaces around them, transforming, re-programming, repurposing, re-combining places, and creating new layers of meaning, knowledge, information and practices during the course of their daily routines.

The way how people perceive their surroundings and personalize them can provide endless amounts of insights. The wide and ubiquitous accessibility of technologies is changing our experience of place, e.g. a park bench transforms into an office when an important business call is made on it (Iaconesi & Persico 2013). As this information of how people re-interpret space is becoming increasingly accessible to ‘read the city’ in real-time and in different ways bearing different meanings and narratives, it is envisioned that this might give people more information and yield benefits for their own actions (Iaconesi & Persico 2013). This is generally known as crowdsourcing, as input from a large number of people can be gathered without much effort, thus digital technologies stimulate communication and enable to tap into collective intelligence (Stembert & Mulder 2013).

Heading in the same direction of reading, understanding and interpreting the city, Dörk & Monteyne define urban co-creation as the synthesis of three interrelated forms of participation (2011):

- Understanding the urban reality, which involves discussing urban issues implying some sort of transformation of perception.
- Improving the urban conditions, e.g. by demanding change from authorities.
- Subverting underlying principles, questioning fundamental principles and experimenting with new ways to relate to one another in the urban environment.

This understanding implicitly assumes that citizens take different roles such as the observer, volunteer, and activist, as these roles vary with respect to different activities carried out to change perception and reality of urban relations.

2.1.4 Co-Design

> Rather than treating participants as research subjects, we understood them to be partners in a research process in line with recent thinking about moving beyond “designing for” and towards “designing with” (Forlano & Mathew 2014).

Throughout the past decades, designers have moved closer to an understanding what people need (Sanders & Stappers 2008). Whereas, traditional user-centered design follows an ‘expert perspective’ similar to the classical R&D approach, in which the researcher studies the user as merely passive subject, who might be asked to give an opinion about product concepts that were generated by others and to perform instructed tasks, the participatory design approach empowers the user to generate active input to the design process (Ind & Coates 2012). The ‘user as a partner’ is given more room in roles where they provide expertise and participate in informing, ideating and conceptualising activities in the early design phases (Sanders & Stappers 2008).

Participatory Design is rooted in a Scandinavian cooperative design tradition with a strong emphasis on the political aspects of technology design. The object of the design process is not only the new artefact, it is also the design process in which participants (through processes of mutual learning) gain insights about design processes and the impact of technology on human practice. The difference to co-design is participatory design is top-down initiated and only invites the users to participate, while in co-creation and co-design practices wider groups than strictly the user can participate. Therefore, co-design should not be expected as a smooth, or easy process for collaborations – tensions and frictions are likely to rise when diverse must cooperate, which in turn may be one of the most valuable learnings from this methodology (Forlano & Mathew 2014).

Within this landscape of participatory design, the notions of co-design and co-creation have been growing (Sanders & Stappers 2008). In this respect co-creation is a broader term that refers to acts of shared creativity by two or more people, while co-design is referring to the act of collective creativity across the whole design process/cycle, thus co-design is a specific instance of co-creation in the design process, where designers and people not trained in design work together (Sanders & Stappers 2008). Although everybody can be creative with the right tools and techniques, it seems difficult for many people to believe that they are creative and to behave accordingly (Sanders & Stappers 2008). Creative confidence is the belief that everybody is creative, while creativity is more a way of understanding the world than an artistic quality. It is the belief humans have and will come up with big solutions and have the ability to act on them (IDEO 2015).

The level of creativity that people can achieve depends on the amount of expertise, interest, passion and effort they put in, at every level need more of those inputs. Thus, not everybody

can become a designer, but people with a high level of passion and knowledge in a certain domain who are invited to participate directly in the design process can certainly become co-designers (Sanders & Stappers 2008). There are different levels of creativity with 'doing' the lowest level, which is, e.g., buying a pre-packaged microwave dish and prepare it in the microwave, while the highest level of creativity would be to invent a new dish (cf. Table 2).

Table 2: Four levels of creativity in people's lives (adapted from Sanders 2005; Sanders & Stappers 2008)

Level	Type	Motivated by	Purpose	Requirements
1	Doing	Productivity	'getting something done'	Minimal interest, minimal domain expertise
2	Adapting	Appropriation	'Make things my own'	Some interest, some domain expertise
3	Making	Using ability or skill	'Make with my own hands'	Genuine interest, domain expertise
4	Creating	Inspiration	'Express my creativity'	Passion, domain expertise

Although still early in its phase concepts such as design thinking, service design, co-design human-centred-design and strategic design - which all signify more collaborative approaches to design - are gaining currency in the public sector across many countries and across all levels of the public sector (European Commission 2016). A distinction between service design and participatory design can be found in (Holmlid 2012).

The following table summons tools and methods being used to facilitate co-designing (cf. Hribernik et al. 2011; IDEO.org 2015):

Table 3: Co-design Methods

Method	Description
Role-playing	A quick and tangible way to test an idea or experience is to get into character and act it out. Actors in the design process (users and/or designers) play through a potential use of an imagined service or process.

Storytelling	Use of a product or a service is described in simple words as a story, allowing for the communication of ideas and the development of storyboards.
Group sketching	A group of participants develops ideas, services or products by sketching together on a piece of paper or equivalent. GroupSketch is a tool which supports simultaneous drawing virtual paper.
Card sorting	It is a useful approach for designing information architecture, workflows, menu structure, or website navigation paths. The process involves sorting a series of cards, each labelled with a piece of content or functionality, into groups that make sense to users or participants. By putting a deck of cards, each with a word or single image, in someone's hands and then asking them to rank them in order of preference, you'll gain huge insight into what really counts.
Rough/Rapid Prototyping	Rough prototyping is a method of quickly prototyping product or service components using any available materials in order to better explain ideas to the team.
Experience Prototyping	Allows for the active engagement of team members, users and clients with a product or service. It emphasizes 'the experiential aspect of whatever representations are needed to successfully (re)live or convey an experience with a product, space or system.' (Buchenau & Suri 2000)
Storyboard	A quick, low-resolution prototype and a narrative representation of use cases through a series of drawings of pictures to illustrate the use of a product or service and the users' points of contact with it.
Persona development	Persona development is often used in co-design and co-creation approaches. A persona is a fictitious user described grounded in data, using the everyday experiences of the users and their needs as a starting point when developing new products. 'The persona method does not include real users but instead representations of the users. This leads to inclusion of the users' perspective in all aspects of the design process.' (Nielsen 2010: n.p.).

User Journey	The customer journey map is an oriented graph that describes the journey of a user by representing the different points of contact that characterize his interaction with the service.
Poster	The Poster simulates a future advert for the product or service. By elaborating it, the designers imagine how the new offering could be launched and perceived by the consumers.
Interaction Table	This is an expansion of the storyboard methods which describes step-by-step interaction with the product or service.
Moodboard	A mood board is a visual composition of pictures and materials that propose an atmosphere by giving the generic perception of it.
Actor Hierarchies	Actor hierarchies use graphs to show an overview of the people who will interact with the product or service.
Lead Users	The 'lead user' method represents a forecasting of users as their needs and interest will supposedly become general in the future marketplace (cf. von Hippel 2005).
Consumer Partnerships	At the very least, consumers are involved in a design process as providers of information. In more intensive consumer partnerships, an organisation will ask consumers to identify goals and objectives and provide the support and advice to accomplish outcomes
Idea Competitions	Users are asked to propose innovative ideas within a given timeframe. The ideas are then commented and discussed by all participants. Finally, the submissions are evaluated by an expert panel and a winner selected. This method is often used in an online context, e.g. IBM Innovation Jams.

2.1.5 Participation, Co-production or Co-creation?

While citizen participation refers to the broad spectrum of participation including passive participation, e.g. when the public is manipulated or only informed, co-creation refers to an active process of citizen involvement in the initiation, design, or production of a public service or policy. In this understanding, co-creation is rather like public participation understood as a form of partnership with equal rights and responsibilities, or 'enhanced participation' (Voorberg

et al 2015). The following definition of the co-creation process integrates the definitions in (Correia et al. 2016) and (Voorberg et al. 2015; Torfing et al. 2017):

Co-creation = co-initiation + co-design + co-production

The definition is useful because it integrates a bottom-up aspect of citizen initiatives to the top-down character of co-creation as initiated by organisations or industries. This is a holistic understanding of the co-creation process (cf. Table 4), which includes the service delivery lifecycle: Initiation, planning (design), and co-production, which constitutes the delivery and execution phase that covers day-to-day operations and monitoring. When citizens initiate a process regarding the quality of their neighbourhood in the fields of liveability, public safety and social cohesion, it is usually self-organised and is in its core independent of the government and professional organisations. Municipalities have various managerial instruments to foster citizens initiatives (cf. Bakker et al. 2012). Co-initiation is portrayed as the missing part in co-created public innovation processes and has traditionally been neglected in research on co-creation (Sørensen & Torfing 2016).

Table 4: The Co-Creation Process (own research based on Correia et al. 2016)

Co-creation process					
CITIZEN AS CO-INITIATOR	CITIZEN AS CO-DESIGNER				CITIZEN ACTIVE IN CO-PRODUCTION
Initiate	Definition	Engage the citizen	Clarify roles and responsibilities	Think things through together	Realise, Implement
Sometimes citizens initiate an initiative and government acts as supporting or frustrating actor.	What do we seek to create together? How are we going to proceed?	If the government wants to initiate co-creation, then it must ask how to engage the citizens?	Who will contribute and how? How is civil society engaged? Who are the stakeholders?	What options do we have beyond easy answers? Do our decisions match our purpose?	Bring the words, visions and requirements to reality.

To demarcate co-production and co-creation entirely is challenging, as most scholars define the terms very similarly and empirically the concepts are used interchangeably (Voorberg et al. 2015), and usually ‘co-creation’ is simply another word for ‘co-production’ and vice versa

(Torfing et al. 2017). However, the services management literature puts more emphasis on value co-creation and thus public value in a broader sense, while the public administration literature traditionally applies the term ‘co-production’ to public services. Also, co-creation aims at innovation defined as the development of disruptive ideas (Torfing et al. 2017). Anyway, both literature streams consider the citizen as a valuable partner in public service delivery. However, recent efforts are shown to unite the perspectives of co-creation and co-production to benefit of the synergy from two different knowledge bodies (Osborne & Strokosch 2013; Osborne et al. 2016).

Throughout the literature, co-creation is seen as virtue itself like participation, democracy or transparency and the co-creation process is considered as a goal in itself and does not need to be legitimized by external goals (Voorberg et al. 2015). However, when a goal-oriented or functional approach is used, the outcomes of co-creation can be somewhat disappointing and its beneficial effects are difficult to conclude (Voorberg et al. 2015).

2.2 Smart City

> ‘Rising from empirical application, the concrete smart city is especially a collection of several projects, initiatives and actions, carried out both by public and by private organisations’ (Dameri & Rosenthal-Sabroux 2014: 3).

Smart cities are what today has become ‘the symbol of ICT-driven urban innovation and development’ (Mora et al. 2017: 2) since its beginnings in 1992 when the ‘smart city’ term appeared first in a book. In 2009 the ‘smart city’ was fully established as new research area with an exponential increase in publications since then (Cocchia 2014). Although the smart city movement began to manifest itself in the physical world with the *digital agenda* of the city of Amsterdam in 1994, and the creation of Geneva’s *metropolitan area network* (MAN) in 1998 (Anthopoulos 2017), its intellectual history can be traced back to previous centuries’ visions about urban futures (Angelidou 2015), and back to the long-lasting metaphor of the ‘city-as-machine’ for rational management (Mattern 2013).

A bibliometric analysis of the first decades of smart city research (1992-2012) shows the limited exchange and lack of cohesion of the intellectual structure of the research field (Mora et al. 2017). The most publications produced are separate knowledge entities divided along two main development paths of the smart city research: On the one hand, peer-reviewed publications by European universities that developed a holistic interpretation of smart cities, on the other hand, a strand of grey literature produced by North American business world and its consultancy firms promoting a techno-centric understanding of smart cities. These rather isolated geographies of knowledge production are considered the source of this division leading to a ‘cacophony of definitions’ (Chourabi et al. 2012: 2290) while the process of conceptualization is still underway (cf. Fernandez-Anez 2016).

As there is no such a thing as ‘the smart city’, there is neither a commonly agreed definition (Albino et al. 2015) nor a common evolution path for smart cities independent of local factors (Neirotti et al. 2014). Some argue that separating the ‘smart’ from ‘sustainable’ implies that a city can be smart without being sustainable, therefore a better definition would be ‘smart sustainable cities’ (Bibri & Krogstie 2017; Hudson et al. 2016).

Global institutions such as the *World Bank, World Economic Forum, OECD*, and the *EU* bet on the digitisation of the whole urban landscape as a means for securing environmental sustainability and economic growth (Viitanen & Kingston 2014). The concept of urban smartness became very popular recently after the smart city became institutionalized in the complex mechanism of EU research funding (Vanolo 2014; Dameri & Cocchia 2013). Without going into many details, the EU provides funding for research in the fields of energy efficiency of buildings, energy distribution networks, transport and mobility systems and ICT, in order to cut greenhouse gas emissions by 40% in 2020.

Another factor that contributed to the diffusion of the smart city originated in urban planning. Seeking to limit suburbanisation and to curb urban sprawl, a movement called ‘New Urbanism’ emerged during the 1980s in urban planning across the United States. A major intellectual offspring from this movement is the idea of Smart Growth, a planning strategy aiming at developing compact, less greedy and less soil consuming cities (Vanolo 2014).

2.2.1 Definition and Characteristics

Smart cities find themselves inevitably in tensions between attracting the global and highly mobile capital characteristic for the corporate world with its elitist workforce and top-down development, and on the other side, serving its stationary citizens adopting a bottom-up and grassroots perspective (Kitchin 2014b). These two contrasting development paths are reflected as well in the first 20 years of smart city research (Mora et al. 2017) and in new tensions arising from (smart) city transformations (Almirall et al. 2016). Earlier conceptions have been criticised for being too technocratic only focus on the importance of ‘hard factors’, such as infrastructure and transport (and ignore human or ‘soft’ factors), as the following smart city definition exemplifies:

> A city that monitors and integrates conditions of all its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens (Hall et al. 2000).

This definition solely stresses the role of technologies and is in line with the early corporate visions of smart city equipped with sensors and real-time data, interconnected and conceived as an intelligent system of systems (Nam & Pardo 2011). Contrasting the technocratic view, there has been developing an increasing body of critical research - since Hollands asked the

‘real smart city to stand up’ (2008) - which is concerned to add human and social dimensions to the technology-fuelled visions of the smart city, so-called soft-factors associated with communities and local culture, which has led to the alternative conceptualizations of the human-centred Smart City:

> A community that systemically promotes the overall well-being for all of its members, and flexible enough to proactively and sustainably become an increasingly better place to live, work and play (Lara et al. 2016).

However, in the European academic context the following definition of a smart city is frequently adopted:

> We believe a city to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance (Caragliu et al. 2011).

This definition offers a progressive and holistic view of smart cities (Lara et al. 2016) and is among the most cited definition in the smart city research (cf. Cocchia 2014). The definition is based on an often-cited project by the Centre of Regional Science at the Vienna University of Technology that identifies six main axes, so-called dimensions along which 70 European middle-sized cities were ranked (Giffinger et al. 2007):

- Smart Economy
- Smart Mobility
- Smart Environment
- Smart People
- Smart Living
- Smart Governance

There is no dominant model but two different development patterns of smart cities (cf. Figure 2). The first development model concentrates on ‘hard’ domains: Natural Resources and Energy, Transport and Mobility, Buildings, while the second model focuses on the ‘soft’ domains: Living, Government, Economy and People. ‘Many municipalities and their technology vendors focus mainly on technology, and not on people’ (Neirotti et al. 2014: 34). Which is concurrent to evidence that smart city is strongly supported by extensive marketing and partnerships between cities and corresponding vendors (Anthopoulos 2017).

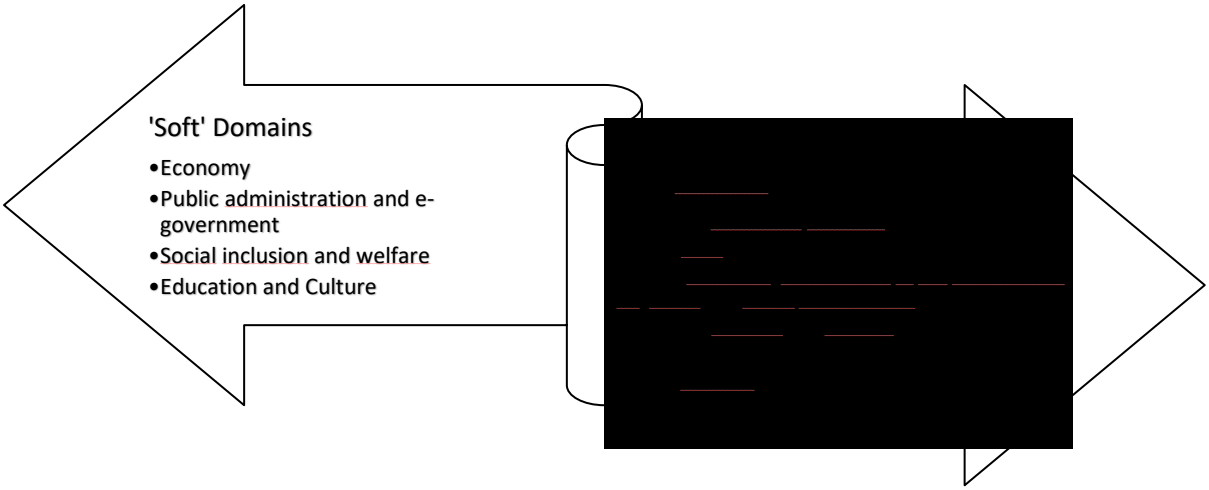

Figure 2: Prevalence of investments in soft and hard domains

In the so-called hard domains, enhancing sustainability relies on the deployment and application of ICT through sensor networks and wireless technologies, whereas the role of ICT is more limited in soft domains, which are rather characterized by public interventions aimed to create beneficial social and institutional conditions through investing in education and culture. Public Safety and Healthcare could be positioned in the middle between hard and soft factors, as initiatives in those fields focus on campaigns parallelly seek to enhance social values and sensor network roll-out (Neirotti et al. 2014). In practice, smart city projects are rolled out place across various sectors, the different areas in which smart city initiatives have been applied can be found in (Neirotti et al. 2014).

2.2.2 Urban Imaginaries and discourses

The confusion about the meaning of the smart city definitions and labels is related to similar concepts and urban imaginaries that paved the way for the smart city label (cf. Table 5), which can be largely categorized into four dimensions: Infrastructure & ICT, creative economy, sustainability or human infrastructure (Nam & Pardo 2011; Lara et al.2016; Kitchin 2013). A lot of the present confusion about the Smart City stems from its conceptual similarity with other terms, such as the digital, intelligent, virtual or ubiquitous city (Albino et al. 2015).

Table 5: Conceptual relatives of the Smart City associated with four key dimensions

Infrastructure & ICT	Creative/Knowledge-based Economy	Human Infrastructure	Sustainability
Digital City Wired City Ubiquitous City Sentient City Hybrid City Information City	Intelligent City Creative City Innovative City Knowledge City	Human Smart City Humane City Learning City	Sustainable City Eco-City Zero-carbon City Green City

Originally, those urban planning and development concepts from the table had been used in a particular way to describe the relation of ICT and people with contemporary urbanism (Kitchin 2013), but today, they ultimately find themselves largely merged and subsumed under the smart city label, in spite of some differences. The slight differences between 'digital' and 'smart' city concepts have been outlined (Dameri & Cocchia 2013; Cocchia 2014). The connection between the sustainable city and the smart city concept is examined by (Tregua et al. 2015; Bibri & Krogstie 2017).

The smart city discourse is separated into three dimensions, of which the first understanding has a strong technological component. In this sense, 'smart' is indebted to the concept of 'intelligent cities', which are portrayed as innovation environment with an integration of the physical and virtual level (Komninos 2002). The birth of intelligent cities had been influenced by the advent of internet and web technologies and the successful rise of the knowledge/innovation economy in urban development and planning. Both trajectories were linked together to constitute the intelligent cities paradigm (Komninos 2013). Some commentators question the terminological distinction between the smart and the intelligent city, as most scholars use both terms synonymously (Allwinkle & Cruickshank 2011; Komninos 2013).

The first discourse stresses the need for city-wide planning and control, as well as the central function of ICT and portrays smart cities as digital systems where real-time data is gathered, processed and integrated to increase productivity and foster better decision-making. For instance, the right mixture of data and policy interventions can optimise morning traffic or evening out high energy peak during certain hours. In this sense, urban smartness refers to the city being informed with data from physical and virtual sensors, using a computing platform that integrates data and shares information and uses analytics to make better operational

decisions (Pereira et al. 2017). This view is of a city that ‘senses and acts’ is concurrent with the technological focus that most of the publications in business and grey literate by North American scholars and firms have adopted (Mora et al. 2017). In these publications, ICT is central to the operation of future cities and signifies a starting point for rethinking all other issues (Meijer & Bolivar 2016).

Another influential discourse, the creative city (Landry 2012) - linking cultural policies and economic development at the city level – developed through the merging of regional innovation theory and the management of knowledge and information society. Urban economic development is contingent upon the presence of the ‘Three T’s - Technology, Talent and Tolerance‘ (Florida 2002), which are considered as crucial factors to build a creative economy that, in turn, is considered as a competitive advantage over other cities. The citizens in the creative city consist of a high level of the ‘creative class’ characterized by a spirit of autonomy and flexibility in the process of creativity, expression of individuality and openness to the different (Florida 2002). These scientists, artists, businessmen holding high-ranking and well-paid positions choose to stay in a city, not because of high wages, but because of the place-specific quality of life, modernism, and other factors that make a place more attractive than others (Vlachopoulou & Deffner 2011).

The third dominant discourse locates citizens right at the centre of planning (Paulin 2016). Human smart cities (Oliveira et al. 2015; Marsh & Oliveira 2014; Lara et al. 2016) might sound promising in theory, but practical examples going beyond rhetoric are still rare and consists of a very small number of case studies and research projects. Smart cities must possess the ability to identify, learn and do what is needed to ensure a better and sustainable future for its residents (Lara et al. 2016). This discourse is in line with others who advocate improving a city’s smartness through the participation of local stakeholders in the process of co-creating the city and community (Marsh & Oliveira 2014). Urban intelligence is derived from the city promoting economic development with social justice and environmental sustainability, developing and adapting technologies for its local reality, helping to build a community associated with the cultural values and lifestyles that its residents engage or disengage with (Lara et al. 2016). This view is based on the perspective that maximising well-being and happiness of the residents is the ‘kind of smartness’ that matter most, and, although and because these are highly subjective concepts dependant on local circumstances and culture, urban planning should pay attention to them and help local communities finding their own local way of becoming a better place

2.2.3 Urban data

The promised feature of the smart city is to create a more precise control and understanding of the urban condition through big data enhancing the evidence-based decision-making.

Different to government statistics, sensor data from sensor networks embedded in the environment measure some aspects of the city in real-time (Kitchin 2014b). The supposed sophistication of urban information through big data is based on the characteristics and features of big data, which are (Kitchin 2014a):

- Huge in volume (consisting of terabytes or petabytes of data)
- High in velocity (being created in or almost in real-time)
- Diverse in variety (unstructured, structured and often temporally and spatially referenced)
- Exhaustive in scope (depicting large populations, n=all)
- Fine-grained in resolution (very detailed, indexically identifiable)
- Relational in nature (containing common fields allowing conjoining with other datasets)
- Flexible and extendable (adding of new fields is possible while scalable in size).

City operations centres and city dashboards represent typical use-cases for big data in smart cities[3]. For instance, in the Centre of Operations Rio de Janeiro (COR), 30 agencies monitor 24/7 visualisations of urban processes and control where and when necessary (Jaekel 2015) to provide better crisis management in case of heavy rains and storms, landslides and traffic accidents (Perreira et al. 2016). 'Big data analytics' is helping managers in Rio de Janeiro to identify problems and guide the way they should act (Pereira et al. 2017). Also, decision-making and definition of preventive measures are also driven using big data analytics. Preventive measures relate, for instance to the mapping of flood points and the possible prevention of future floods, if data of the past years can indicate frequent flooding of a certain point.

In Rio de Janeiro, citizens also act as data sources when they report traffic accidents, e.g. through reporting an accident in the application *Waze*, this information can be used in turn by the COR to acquire knowledge where people are affected most by traffic accidents (based on the reports the citizens make in the application). Thus, the COR combines its own data traffic accidents with those reported by users to see where most people are affected in order to improve road safety for the people who receive better public services and public value in turn (Mainka et al. 2015).

To extract value from the data, stakeholders need to be empowered with more useful, relevant, and complete set of information from the government (Mellouli et al. 2014). This information is called open data, which can be freely used and modified without discrimination and is readable by humans and machines. Citizens increasingly will ask for the publication of public data in

[3] The data is visualised in a city dashboard as a tool for urban managers and even for citizens. Barcelona's new city dashboard http://bigov.bismart.com/Indicators/IndicatorMasterGroups/4, accessed on February 19, 2018.

open formats that they can reuse to track the progress of their city performance (Garriga-Portolà & López-Ventura 2014). Open data gives citizens the possibility to contribute to government initiatives and to interact with the public sector, thereby collaborative governance can profit from open (government) data in terms of overcoming knowledge asymmetries by giving access to information and knowledge, second, it might facilitate joint fact-finding by offering shared knowledge bases, and third, it could enable trust building (Bartenberger & Grubmüller-Régent 2014). Making government data open requires combating several challenges related to legal, cultural, political, governance, human resources, infrastructural and fiscal issues (cf. Mainka et al. 2015).

2.2.4 Smart governance

The fragmentation of the discourse has also been reproduced in the literature on smart governance where opinions range from conservative ideas suggesting that existing institutional arrangements will deliver smart cities, to more radical concepts suggesting that city governments itself must change in order to enable a smart city (Meijer & Bolivar 2016). Nijkamp & Cohen-Blankshtain studied the perceptions and opinions of experts on the effects of ICT on urban governance and found that 'smart' and e-government initiatives are likely to take place in cities led by those who strongly believe in the abilities of ICT to affect their city in a positive and visible manner (2013).

Meijer & Bolivar (2016) identified four ideal-typical types of conceptualizations of smart city governance containing different foci and varying transformation-levels of city governments in order to make cities smarter (Figure 3). They argue that a higher level of transformation not necessarily leads to a smarter city as more collaboration complicates decision-making and that the question of which type of governance is most effective and legitimate must still be answered through empirical research.

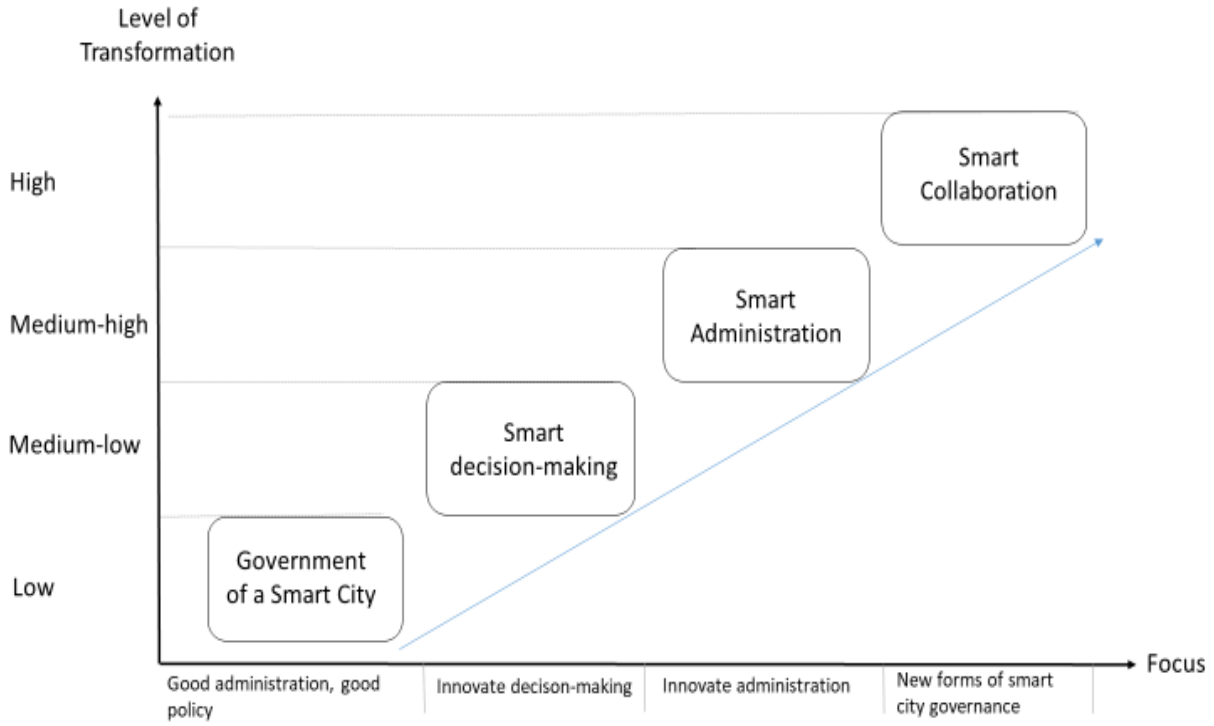

Figure 3: Perspectives on smart governance (adapted from Meijer & Bolivar 2016; Jaekel 2015)

The first perspective highlights no need for transformation and governance is just about making the right policy choices and implementing them in an effective and efficient way without changing the existing structures. Some argue that smart governance is just an attribute which self-promoting smart city give themselves (Batty et al. 2012).

The second type of conceptualizations emphasizes the need to innovate on decision-making without restructuring government institutions. This perspective understands smart governance as a process of collecting all kinds of information concerning public management enhanced by sensors and sensor networks.

The third perspective refers to a smart administration that uses sophisticated ICT to interconnect and integrate information, processes, institutions and physical infrastructure to better serve citizens and communities requiring an internal transformation of government. Administrations need to become smart to deal with many components that comprise a smart city, therefore they need to transform them internally and integrate across city departments.

The fourth notion relates to a high level of transformation as it reconceptualises the position of government in the urban system, not only requiring internal transformation, but also external reorientation. Government is understood as enabler and facilitator collaborative governance – promoting the involvement of all relevant stakeholders to create a co-creative, participatory and information based urban environment. This body of research is in line with community-based urbanism and making services and operations truly citizen-centric.

Smart government developments have been related to the trajectory of earlier e-government initiatives at many places (Meijer & Bolivar 2016; Nam & Pardo 2011; Salvoldelli et al. 2014). Like e-government initiatives, smart city government suffer from various barriers to adoption, which had been outlined from to an extensive literature study by (Salvodelli et al. 2014). Ignoring political and juridical implications can have serious adverse effects on the 'sustainability of technical artefacts' such as early project failure, vendor lock-in situations and the violation of democratic principles (Paulin 2016).

The smart city is increasingly interpreted as meeting place for the triple or quadruple helix (private sector, government, university and citizens) as the delivery of public services in such reciprocal relationships between all stakeholders, is very appealing and promising for developing truly smart cities (Walravens 2016). This view is in line with the widely-stated 'city as a platform approach' which paints a picture of cities with smooth information process, facilitation of creativity and innovativeness, and smart and sustainable solutions promoted through service platforms (Anttiroiko et al. 2014).

2.2.5 Smart citizens

Smart city development witnessed a discursive shift from smart cities to smart citizens with a strong emphasizes on citizens participating in city making fuelled by a governmental push for a participatory society (Niederer & Priester 2016). Although there had been a reorientation towards 'smart citizens' there had been little critical conceptual research on citizen participation in smart cities with some exceptions like (Cardullo & Kitchin 2018; Gabrys 2014; de Lange & de Waal 2013; Cowley et al. 2017). Cowley and colleagues who studied public participation in six smart cities in the UK worked out four modalities of how smart different smart technologies imagine and engage citizens (2017):

First, the service-user refers to the rather passive consumption of everyday urban services such as public transport, water, electricity or broadband infrastructure, intelligent street lights, etc. Mostly an improved efficiency is highlighted as a goal, e.g. in reworking traffic flows, recalibrating energy distribution. This modality is unsurprisingly common, as local authorities are seen by default as service providers. The notion of citizenship is moving away from civic responsibilities and engagements to classifying citizens as consumers who purchase services from providers (cf. Powell 2014).

Second, citizen as entrepreneurs refers to more active role citizens play in co-creating and innovating in the smart arena. The citizens are expected to participate in creating services and economic value through hackathon events, laboratories and test-beds, often through on the premise of open government data. This fits well with claims that people are put at the centre of smart city development, as it explicitly invites the public to contribute to its products and

services. However, like the service-user modality, little is being said about the more democratic dimensions of publicness.

Third, politically active citizens engage in deliberation through institutional channels or novel extensions of these, e.g. online platforms, or apps. However, this mode of involvement is highly underrepresented in smart city activities, although frequently claimed by strategy documents, the smart city not only often operates at the margins of the normal institutional process, but might even be critically interpreted as seeking to bypass them.

Fourth, civic engagement considers activities taking place in spaces beyond state institutions, but which are not directed towards markets, such as activities more immediately associated with leisure activities, volunteering and playfulness located in the broader public sphere. One type of relevant activities is often constituted by the goal of manifesting the virtual/digital in traditional (physical) space such as interactive infrastructure, creative and arty installations, digital screens or talkative bus stops. The second type of civic publicness attempts to reclaim the digital sphere from the public sector aiming to empower citizens to use and to experiment with digital urban technologies through living lab programmes, training courses or fab labs emphasizing its grassroots character.

While cities increasingly recognize the need to involve their inhabitants, citizens, in turn, are seldom aware of smart city concepts and often completely unaware of ongoing smart city projects in their city (Hudson et al. 2016). More specifically, only one in five adults recognises the term smart city in the UK (IET 2016). To build better knowledge about smart cities, ‘massive open online courses’ can represent a useful method for engaging citizens in learning about smart city concepts and how they can co-create a smart cities project in their community (Hudson et al. 2016).

Another factor for becoming smart is the adaption of a sustainable lifestyle. Thus, changing citizens’ lifestyle is considered as one of the enabling conditions for the environmental sustainability of smart cities. Thus, citizens must be willing to change their lifestyle towards green consumption, ecological tourism and lifelong (technological) learning. Manipulation of lifestyles and intriguing in privacy seem to become quite normal in the future smart city and will be further institutionalized through the increasing roll-out of smart meters, which monitor and record energy consumption and share the data with the energy providers and third parties raising further concerns to privacy, security and the protection of personal data (Galdon-Clavell 2013).

The many smart cities in India lack local participation even in urban areas with the presence of high internet coverage and high-skilled workers, since the online-participation platform is managed by the central government targeting the wider national Indian community, underlining the importance of local governments’ key role to spur imagination and interest of the residents

(Praharaj et al. 2017; cf. Nam 2012). 2017). Similarly, in the Smart City program of Amsterdam, localized and less technology-intensive projects with open partnerships and ex-post defined rules are characterized by a more intense participation of citizens, whereas complex interactions among large numbers of stakeholders appear closely linked to formal rules and limited experimentation in terms of partners involved, therefore reducing the possibility for non-expert citizens to take an active role (Capra 2016). Thus, pointing to the facts that different governance models of smart city programmes can result in more or less participatory approaches and an increased policy attention towards underlying governance models can balance technocratic approaches (ibid.).

In a smart city participation case in Japan, citizens were urged to become co-producers of public energy services in the restrained meaning of co-implementation, as they were steered to become prosumers in a smart grid energy network in which they shifted their consumption behaviour from peak to off-peak period, rather than engaging in deliberative and decision-making processes or deepening democracy (Granier & Kudo 2016).

The problem of the digital divide between the ICT 'haves' and the 'have-nots' has been analysed from a socio-economic perspective relating it to primary factors contributing to the divide such as income, employment and education. However, the socio-economic perspective excludes psychological, cultural and social factors explaining why individuals don't embrace technology into their lives (Partridge 2004). This is a valuable perspective for studying the socio-digital divide in a smart city, as hyper-connected cities create various socio-technical misalignments (Calzada & Cobo 2015) and new forms of inequalities. Furthermore, it is not just enough to analyse who is connected but the key question is how can we generalise and democratise the opportunities that come with the high-tech urban revolution (cf. Graham & Marvin 2002).

Although smart citizens are considered as one of the characteristics of a smart city, they represent the fundamental enabling conditions for smart cities, as there can be no smart city without smart citizens. Whereas, in turn, citizens even can contribute to making any city smarter without that the city explicitly states being a smart city (Castelnovo 2016). Through their behaviour, citizens can contribute to achieving targets in emissions reduction and energy (and other resources savings). The city can use 'nudging' as a technique to create better conditions for citizens to use bikes or public transport, or applications reminding them to optimize their energy consumption (European Commission 2016). Nudge theory argues that indirect suggestions can achieve non-forced compliance rather than direct instruction, legislation or enforcement (ibid).

But it is not only through their appropriate (smart) behaviour and by using a city's infrastructure or services that citizens take part, they also must be enabled to participate in a smart city's

governance as demanded by (Chourabi et al. 2012; European Commission 2016). Furthermore, in the dominant discourse citizens are held responsible to adapt to smart environments, leaving little room for the technologically illiterate, the poor and those marginalized by the smart city discourse (Vanolo 2014). Thus, citizens are urged to adopt a 'smart mentality' that is the right frame of mind to accept and cope the inevitability of urban technological change (Hollands 2015).

2.2.6 Critique and risks

> 'Because of the specific needs and interest of the corporate and local governance worlds (profit and dynamism, respectively), issues related to the legal, social and ethical impact of smart environments are being overlooked, and technology solutions are incorporated in a seemingly uncritical way. In this situation, not only are empowerment, participation and bottom-up approaches being neglected but so are basic concerns related to the social, ethical and human-rights implications and risks of smart solutions' (Galdon-Clavell 2013: 722).

The 'smart urbanism' which can be summarized as interwoven set of approaches and visions from national and local governments, international organisations and from the corporate sector is applied to provide solutions addressing problems related to urban growth and renewal, climate change and the building of a more socially inclusive society (Luque-Ayala & Marvin 2015). Technocratic modes of urban government presume that all aspects of cities can be measured, monitored and framed as technical problems which can be addressed through technical solutions (Kitchin 2014b). Technocratic views portray cities as something we can fully understand if we just had enough data, like the engine of a car or a nuclear power station (Hill 2016). This is what Morozov has called 'technological solutionism' (framing complex social situations as neatly defined problems with computable solutions) – and what is the privileged way to tackle problems in this era (2013). Moreover, it gives the public managers the possibility to justify decisions that raise ethical and accountability concerns by enabling them to say: 'It's not me, it's the data' (Haque 2012).

The critique of the data-and-algorithm-based approach is three-fold: the first one is that the highly functionalist and reductionist approach fails to recognise the wider effects of culture, politics, policy, governance and capital in shaping city life and urban systems (Kitchin et al. 2015). Second, this 'reification of data' leads to obscure the real nature of problems in order to find immediate and easy solutions: 'if we can simply automate the depersonalized dispensation of social welfare', we might avoid following up with 'root problems like poverty, unequal access to healthcare and information services, and socioeconomic disparity in school performance' (Mattern 2013: n.p.). Thus, it is more a management of the manifestations of problems rather than really fixing them. Third, technocratic approaches have a centralising effect rather than distributing power and forms of top-down governance (Kitchin 2014b).

One stance of critical literature understands the smart city as an expression of neoliberal and market-led restructuring process of the urban space (Hollands 2008; Vanolo 2014), labelling the smart city as 'corporate smart city' (Hollands 2015) and as 'an abstract utopia, a sterile and decontextualized narrative that preserves existing relations of power, rather than challenging them' (Grossi & Pianezzi 2017: 84). As some technology and consulting companies like *IBM, Cisco, Intel, Microsoft, Siemens, Philips, Capita, General Electric, Schneider, SAP* and *Arup*, etc., are active players in the smart city roll-out and management, they are the main producers of the discourse about the benefits of smart cities. Both, to describe their actions in the domain and to portray themselves as central actors of this urban management model and to persuade municipalities to think of the company as an 'obligatory passage point' for efficient and sustainable urban development (Söderström et al. 2014). Smart solutions are then promoted by urban managers and economic elites to support specific development policies demonstrating the manifold links between neoliberal urban development and the smart city imaginary of a green, clean and intelligent city image portrayed as useful to attract investments, workers and tourists (Hollands 2008; Vanolo 2014).

Through the digitalization of cities, their vulnerability and resilience could be put at risk, as their digital systems could be hacked or become prone to bugs (Neirotti et al. 2014). Technology is run with software which is sold in full knowledge of being inherently partial, provisional, porous and open to failure, as well as needing patches and continuous updates to cope with new contingencies (Kitchin et al. 2015). Smart systems with city-scale size come with their own problems, as they constitute the 'most complex structures humankind has ever created' and 'interweaving them with equally complex information can only multiply the opportunities for bugs and unanticipated interactions', thus they will be so complex that so-called normal accidents will be inevitable (Townsend 2013). Usually smart systems are not entirely coded by one company, instead, it is a collection of modules plugged together into one another, thus a 'programmer on one side can only hope that the programmer on the other side has gotten it right' (Ullman 2012). Technology infrastructures like cellular networks are threatened by breakdowns due to population density, as they are typically only build to connect a fraction of their customers in a place at the same time. Equally, GPS and cloud-computing outages pose a risk to smart cities, e.g. in terms of non-functioning of biometric authentication (Townsend 2013).

Another point is a cyber war on city infrastructure - the Israeli government acknowledges that its essential services such as water, electricity, banking, rail and road infrastructure are the target of numerous cyber-attacks (Kitchin 2014b). Also, devices like printers, refrigerators, or smart home devices, etc. making up the Internet of Things (IoT) have proven to be highly vulnerable to attacks in the past. Consider a breakdown of the city-scale system – who will take the blame, the city, the military, homeland security, or the technology firms that build it?

(Townsend 2013). The fearsome researchers have is that smart cities are going to be highly vulnerable and costly urban systems, instead of robust, efficient and resilient ones (Kitchin et al. 2015).

Cities with a broad portfolio of smart initiatives are not necessarily to be considered better or more liveable cities, as they could turn into panoptical environments in which citizens are persistently observed and scrutinized, e.g. the Operation Centre Rio de Janeiro. (Neirotti et al. 2014). Cities are threatened to become 'quasi-military' zones with ubiquitous surveillance cameras running face-, voice, odour, or walk recognition software (de Lange & de Waal 2012). Defence, military and surveillance industries offer ambient technologies like RFID tags, algorithmic video cameras, data mining and biometrics to track and trace the movements and actions of humans and non-humans recalling the disturbing trends towards the 'militarisation and surveillance of spaces through ubiquitous computing.' (Crang & Graham 2007). This underlines what has been termed the creation of panoptic surveillance (all-seeing vantage point) and wide-scale dataveillance (searching interconnecting datasets) and anxieties towards predictive profiling, social sorting and anticipatory governance that use data and algorithms to influence human behaviour (Kitchin 2014b; Kitchin et al. 2015). In the terms of data privacy and surveillance, data open for public use is handled often as impersonal and anonymous as possible (de Lange 2013), although there are concerns about what smart cities mean for people's privacy and what privacy and predictive harms might arise from generating, storing, sharing, and processing of big data (Kitchin 2016).

A significant point of rhetoric is that digitally informed cities will lead to more efficient, sustainable, cleaner, safer, productive cities (Kitchin 2014a) and like the cities themselves the data and algorithms on which they rely are portrayed as being neutral, non-ideological and grounded in scientific objectivity, political benign and commonsensical (Kitchin et al. 2015). The argument that data can portray the city as it actually is (realist epistemology) is underlying urban indicators, city-benchmarking and real-time dashboards as they enable managers and citizens to assess how a city is performing vis-à-vis targets and translate factual information into actionable knowledge. Some scholars expose the politics and technical issues of these systems and demonstrate the difficulty to reduce the complexity, independencies and chaos of cities to a set of statistics and indicators, which means that they cannot be simply dissembled into a collection of facts (Kitchin et al. 2015; Vanolo 2014). Thus, urban indicators consist of data which production is a not a neutral, technical process, but a normative, political and ethical one (Kitchin et al. 2015).

City benchmarks are highly normative in their outcome as being used to shape city governance, modify institutional behaviour, influence decision making and shape spending patterns. Through rankings and benchmarking cities are framed as single, collective and

homogeneous units striving to win the race of becoming smart, while other prevalent urban problems like poverty are swept under the carpet. For instance, Italian cities - while being subjected to marketing campaigns of private firms and desperate for European funding - are moving to a new uniform urban identity which acts as 'disciplinary mechanism' leaving little room for alternative development paths (Vanolo 2014). Cities are held responsible for their achievement of smartness, in other words, to become technologically advanced, green and economically attractive, and cities not following this path are reframed as 'smart-deviant' (Vanolo 2014: 9).

Giving cities a higher score in benchmark systems creates a favourable urban climate for private investments (Giffinger et al. 2007), these urban indicators serve as a discipline mechanism obscuring the fact that attracting capital is not always a good thing because it depends on how the capital will be fixed in space (Vanolo 2014). This 'good-or-bad' scheme fosters a narrow and simplistic view of the urban condition, which is favoured by politicians who appreciate the seeming objectivity of urban charts to justify their agendas (Kitchin et al. 2015; Vanolo 2014). If decision-making moves away from policy-based decisions to insights gained from 'neutral' data as it is portrayed in company's visions, then effectively IBM's software will eventually become our digital mayor (Galdon-Clavell 2013).

3 Case study: The citizen in the Smart City of Barcelona

Barcelona is considered as Europe's leading metropolis when it comes to urban planning and regeneration policies (Komninos et al. 2013) and as a forerunner of becoming a smart city. It congratulated itself as the smartest city in Spain and was considered the tenth smartest city on the planet (Cohen 2012). The smart city strategy was part of a wider re-imaging of the city with different brandings and strategies, e.g. the 'Barcelona as a people's city' project (Capdevila & Zarlenga 2015) and Barcelona as the 'Self-sufficient-city' (March & Ribera-Fumaz 2016). Barcelona's smart city strategy is built around 'international promotion', 'international collaboration' and 'local projects' aiming to establish collaboration channels among government, industry, academia and citizens (Angelidou 2017b; Bakici et al. 2013). Furthermore, it aims to involve citizens in the co-creation process of products and services through fostering clusters, open data and living labs (Bakıcı et al. 2013). One of the central challenges was the intergovernmental collaboration, coordination and the integration of the city departments due to the difficulty to clearly define the roles and responsibilities of each person and authority (Angelidou 2017b; Bakıcı et al. 2013; Jaekel 2015).

An in-depth analysis of the development process of the Barcelona smart city strategy can be found in (Mora & Bolici 2016), which is generally considered as soft-factor oriented strategy (Angelidou 2014) and has been termed successful in terms of creating a public-private

ecosystem of innovation and of having benefitted from citizen-grassroots effort (Mora & Bolici 2016). Ambitious goals of the smart city strategy such as digital inclusion, enhanced public services, social innovation, transparency, democracy (Angelidou 2017b) had been emphasized, but for digital-social cohesion & accessibility dimension, it was not possible to identify how this could be achieved through the smart city strategy (Angelidou 2016). Similarly, while the city promises to foster inclusiveness and citizen empowerment, it was unclear how the interests of citizens are to be made compatible with the interests of private capital and urban political elites (March & Ribera-Fumaz 2016).

The smart city strategy was translated into a series of projects managed by various executive units of the city administration, thus over 100 projects are considered to be part of the smart city strategy (Angelidou 2014). The *Urban Habitat department*, which is also informally known as 'Smart City department' was created after an organizational reform to coordinate services previously provisioned by isolated City Departments regarding infrastructure, ICT, public services, planning, environment, housing, architecture, energy and water, etc. working towards common goals under its new umbrella (Angelidou 2016). Vicente Guallart – writer and chief architect and leader of the Urban Habitat for 15 months - conceived the city as systems of systems, with self-sufficient and productive neighbourhoods in a hyper-connected, zero emissions city, in other words: 'many slow cities within a smart city' (March & Ribera-Fumaz 2016).

After the 1992 Olympic Games and in the eye of post-industrial decline, Barcelona decided to modernize its economic structure towards the new (service) economy what is considered a foundation stone for the future Barcelona smart city (Jaekel 2015). The deep urban transformation began with the City Council deciding to raise efficiency and to facilitate a public-private partnership in planning policies (Marti-Costa & Miguel 2011). Also, the creative class hypothesis formulated by urban theorist Richard Florida in the early 2000s, which contents that attracting and retaining highly educated professionals leads to urban growth, urban regeneration and life-satisfaction, has been influential for Barcelona's strategy of how to become a smart city (March & Ribera-Fumaz 2016). Confidence in ICT as a tool for urban development 'was extremely widespread within the municipality' (Mora & Bolici 2016) and some people argue that improving the city's competitiveness was the most important driver for smart city development in Barcelona under Mayor Xavier Trias (Bakıcı et al. 2013).

According to some authors, Barcelona has transformed successfully into a smart city (Bakıcı et al. 2013) and has found the right balance between technological and human factors in its city strategy (Mora & Bolici 2016), as well as the right mix between top-down planning and bottom-up approaches (Capdevila & Zarlenga 2015). Or, that the city still finds itself transitioning from a more top-down to a more bottom-up strategy (Calzada 2017). However,

others stress that the citizens had mostly been kept outside from the smart city development that occurred primarily between government and technology vendors (Tomás & Cegarra 2016), although the engagement of the citizens has been a primary concern of the city's strategy (Angelidou 2014). Yet, other critical voices evaluate these smart interventions as rather exclusive than socially inclusive at their outcome, as they tend to neglect the social and local trajectories of different neighbourhoods and raised opposition from specific neighbourhood associations), suggesting that Barcelona's residents are not really being put 'at the centre of urban debate' and that the city needs 'to repoliticise the debates on the Smart City' (March & Ribera-Fumaz 2016: 816)

Due to these somewhat contradictory statements, it might be interesting to study the citizens' role in the development of the smart city in Barcelona in more detail. Thus, the focus is placed on people and community aspects from a social science perspective highlighting socio-technological factors. The first period of smart city development started in 2011 with the presidency of the mayor *Xavier Trias* and ended in May 2015, when the newly elected mayor *Ada Colau* declared to realign the city's technological and social agenda paying more attention to socio-political and ethical challenges and to conceive citizens as decision-makers rather than as data providers (Calzada 2017). This ongoing transformation of the smart city strategy has moved from the hegemonic position of the private sector's universal and global solutions towards open source, co-production and more place-specific smart city solutions (Calzada 2017).

3.1 Participation Framework

While participation is not only beneficial for democracy as a whole, it is seen as equally important in the development of smart cities (Berntzen & Johanessen 2016). Thus, to understand participation in smart cities, Jerry Arnstein's participation's ladder – which might be open to critique, it proved to be a popular heuristic utility to analyse the extent to which citizens are involved in formulating, conceiving and delivering services, by analysing the roles of all involved actors (Cardullo & Kitchin 2018). By considering how power is possibly redistributed in different levels of participation, the classification helps to uncover 'empty rhetoric' that can be found easily in marketing materials and technophilic discourses about citizens' participation (Castelnovo 2016). The Smart Participation framework is based on the research of (Cardullo & Kitchin 2018) and was feed with own examples from the case-study (cf. Table 6).

Table 6: Smart Participation Framework (own research based on Cardullo & Kitchin 2018)

Form and Level of Participation		Role	Citizen Involvement	Political discourse/ framing	Modality	Case-study in Barcelona
Citizen Power	Citizen Control	Leader/ Member	Ideas, Vision, Leadership, Ownership, Create	Rights, Social/Political Citizenship, Deliberative Democracy, Commons	Inclusive, Bottom-up, Collective, Autonomy, Experimental	*Decidim; Barcelona en Comú; Fab labs*
	Delegated Power	Decision-maker, Maker				*Pla Buits*
	Partnership	Co-creator	Negotiate, Produce	Participation, Co-creation		
Tokenism	Placation	Proposer	Suggest		Top-down, Civic Paternalism, Stewardship.	IRIS
	Consultation	Participant, Tester	Feedback	Civic Engagement		Arreglamicalle
	Information	Recipient	Browse, Consume, Act			
Consumerism	Choice	Resident		Capitalism, Market, Neoliberalism		*Bicing*
		Consumer				*22@*
		Data-Product				
Non-participation	Therapy	Patient, Learner, User, Data-point	Steered, Nudged, Controlled	Stewardship, Technocracy, Paternalism		Smart Lighting
	Manipulation					-

Additional to the form and level of participation, the framework includes additional columns, starting with the roles citizens adopt in a smart city, ranging from passive to active and responsible co-creators and decision-makers. The next column relates to the nature of citizen participation varying from being controlled to negotiating, giving feedback and providing visions and ideas. The fourth column considers the 'political discourse' used to justify and drive the different levels, forms, roles and natures of citizen involvement. The 'Modality' column classifies roughly the citizens' position towards the smart city, from top-down initiatives launched by city administrations or corporations underpinned by stewardship for the citizens and civic paternalism (deciding what is best for the citizens), whereas bottom-up projects are in part or wholly constituted by citizens and often more experimental in nature, thus it is understood that they might fail to provide long-term and sustainable outcomes (Cardullo & Kitchin 2018: 7)

'Therapy' and 'manipulation' are considered as forms of 'non-participation' and citizens are steered or nudged rather than engaged in a dialogue or any other active form of involvement. Their real objective is not to enable people to participate in planning or conducting programs, but to enable powerholders to 'educate' or 'cure' the participants (Arnstein 1969: 217). In the smart city context, little input from citizens is expected when algorithmic governance utilises

big data to control and shape citizen behaviour, e.g. navigating in a smart traffic network controlled by an intelligent transport system, or walking down a street with smart lighting (Cardullo & Kitchin 2018: 8).

'Consumerism' significates an update to the original scheme, as states have gradually embraced neoliberalism since the almost 50 years when Arnstein was writing, 'with public services and infrastructures being increasingly marketized (treating citizens as costumers) and privatised (corporations own key assets and performing many key roles)' (Cardullo & Kitchin 2018: 5). Therefore, consumption is an essential way of interacting with the smart city, as consumers purchase services from a marketplace of smart products and lifestyles. Another way is to exchange personal data in return for free-to-use applications designed and operated with limited involvement by citizens (Castelnovo 2016; Löw & Rothmann 2016). When they are residents, people can afford to live in smart buildings or smart districts which often function as exclusive, gated communities (Cardullo & Kitchin 2018). The third role constitutes citizens as 'data-products', as they create data using smart city technologies from which companies then can extract value from by mining them for the purposes of marketing and trading with data brokers (ibid.).

'Tokenistic' forms of participation allow citizens to hear (being informed), to have a voice (consultation) and to hand in suggestions (placation), but nonetheless, powerholders stay in control of decision-making and there is no mechanism to change the status quo (Arnstein 1969). Through informing, citizens receive useful information from the government or access open data to know what is happening in the city. However, although informing might be highly useful, it is one-directional with limited or no channel for the feedback provided, or even occurs after key planning and decisions have been made, leaving little or no room for change (Cardullo & Kitchin 2018). In 'consultation' practices citizens are asked to express their opinions increasingly supported by social media and online tools that establish a two-directional channel with the objective of collecting public feedback (Tambouris et al. 2007). Some citizens may even have the important competence that the city does not possess, by listening to citizens potential problems can be identified early thereby reducing the risk of failure (Berntzen & Johannessen).

'Placation' refers to the possibility to suggest alternatives for centrally formulated plans or alternative work programmes for the city workers. Mobile web applications such as 'FixMyStreet.com' or the Spanish pendant 'Arreglamicalle' in Barcelona allows citizens to report problems with roads, graffiti and burned out streetlights while tracking their resolution by the government, thereby suggesting alternative work programmes for city personnel. However, in 'tokenism' citizens are asked to contribute to a set of predetermined initiatives, thus citizens are wanted to participate and governments can claim having involved them, but

decision-making power is not shared and it remains open how suggested change is going to be implemented (Cardullo & Kitchin 2018).

At the top of the ladder are more rewarding and representative forms of civic participation in which citizens have more power in decision-making (Arnstein 1969). Entering a 'partnership' with the authorities involves negotiations, trade-offs and power-redistributions from the city administration and corporations to citizens, thus sharing planning and decision-making competences. Through 'delegated power' citizens obtain the majority in decision-making, while in 'citizen control' they are fully in charge of policy and managerial aspects of a programme or institution (Arnstein 1969).

3.2 Smart citizen participation in Barcelona

Barcelona engages actively with its citizens through various mechanisms, e.g. the Municipal Action Plan (PAM), the smart citizen platform, it hosts hackathons and application development contests as a way of boosting innovation and the creation of new ideas. Social networks are used together with Barcelona City's official webpage to inform and teach citizens about any possible services. In addition, an educational facility called the *Cibernàrium* was created in the Media-Tic building in the 'smart district' to provide technical training for all citizens to use the new services and training for professionals and companies.

The Catalan tradition of '*Associacionisme'*, for example, greatly informs and influences the role of citizens in the decision-making process in Barcelona: 'Barcelona has historically applied co-creation techniques while others have a long history of functional separation between public administration, academia, the private sector and the pub[l]ic' (Agusti et al. 2014: 2). This social collaboration and association movements have created spaces for meeting, socialising and sharing (Capdevila & Zarlenga 2015). Neighbourhood associations, one of many types of organizations that emerged from the '*Associacionisme* movement' in the 19th century, were traditionally formed by citizens looking for solutions and change and subsequently became one of the most important methods of channelling citizen participation into active involvement in policy decision-making in all phases: diagnostic, design, implementation, and evaluation (Agusti et al. 2014).

However, as neighbourhood association memberships have fallen, Barcelona officials and citizens increasingly use co-creation methods to supplement the associations' involvement and integrate more stakeholders and citizens into the policymaking process. Co-creation techniques in Barcelona, therefore, are viewed by many as a tool for increasing social capital. Platforms to engage citizens like online idea banks increasingly emerge as a tool to engage and activate citizens and communities to help with designing solutions to local issues (European Commission 2016).

3.3 Towards the co-creation of smart cities

The following chapter analyses methodologies and tools found in the co-creation process of the Smart City in Barcelona.

3.3.1 Innovation district

Around the year 2000, the Barcelona City Council started an urban regeneration programme in Poblenou, in a former manufacturing and industrial district in the east of Barcelona (the blue area marked in Figure 4). Poplenou[4] was historic but rundown after manufacturing went overseas. The area known as 'the Catalan Manchester' was set to be transformed into an innovation and knowledge-district (Charnock et al. 2017). The area received a new name: the *22@Barcelona District* consisting of 200ha of formerly brownfield land and is the most representative case of large-scale urban renewal projects (Angelidou 2014), which is considered to be well-known among the many projects of the smart city project portfolio (Bakıcı et al. 2013).

While creating a private company for the design and management of infrastructure and public places was seen as effective for regeneration it is problematic due to top-down urban design with an entrepreneurial focus, which did neither involve elected politicians, nor any representatives of the citizens in the decision-making process. While the benefits of urban regeneration programmes generally seen in Barcelona as a means for granting the quality and international visibility, it implied transforming a declining middle-lower class area into an attractive mixed-use pole for high-tech and creative industries (Ponzini 2018). Citizens were included in 'fixed participation procedures related to each project, sometimes including public presentations and hearings in order to have feedback on the projects' (Ponzini 2018: n.p.) The project's successful development in the beginning - which could be seen in the area of diagonal where some pre-existing industrial settlements had been converted – did slow down because of the stagnation of real-estate market after the start of the financial crisis and because design of pre-existing blocks is generally was practically more difficult than brownfield development after the area had been already regenerated approximately 60% of the land in 2008 (Ponzini 2018).

[4] Which fittingly stands for 'new town' in Catalan

Figure 4: The project area of the innovation district (22@Barcelona 2012)

While the area was imagined as incubator for the start-up scene, in line with the city's strategic focus to raise its knowledge-based competitiveness by attracting the international creative-class of workers, the district became the preferred office-space location for larger and well-established companies in the tourism sector looking to profit from cost and location benefits instead (Charnock et al. 2017). The area was planned as a smart district to support the smart city transformation through creating an innovative cluster where companies and research institutes collaborate to enhance research and innovation of urban management (Jaekel 2015). It is also considered as a demonstrator of how innovation ecosystems can be deployed in real life (Angelidou 2017b).

Although the project was not unsuccessful in terms of creating jobs in the retail, leisure, and the construction industry, it did not fully transform into a smart district as it has been planned. In absence of the hoped-for local entrepreneurship and large firms choosing Madrid over Barcelona, scarce venture-capital resources and little international connectivity towards Europe and Latin America, the hoped-for jobs in the knowledge economy could not have been created (Charnock & Ribera-Fumaz 2014). The newly built Around 4000 newly built residential buildings rented out 25% lower than the average city price (Jaekel 2015). But ironically, instead of the young university-educated cosmopolitan 'creative class', some of the district's abandoned warehouses had been partly occupied by another class of creative young people, serving as provisional and temporary houses to migrants who predominantly work precariously in the informal recycling sector of scrap metals which they carried around in shopping carts (Charnock et al. 2017). In total, there were over 700 migrants - mostly with no documents from Rumania and Sub-Saharan Africa - living in squatter settlements in the city and many of them

in *Poblenou*, from where they had been forcefully evicted in July 2013 (Charnock & Ribera-Fumaz 2014).

The urban development in the 'innovative district' was not integrated into the district's social life and interaction with the citizens was absent. Thus, it is no surprise that the 22@ initiative encountered considerable opposition from local actors that have accused the municipality of taking a top-down approach and neglecting the concerns of the citizens, which was illustrated by the disappearance of most the local artist workshops signifying a collapse of the local artistic and social identity of the district (Marti-Costa & Miguel 2011; Zarlenga et al. 2016). Although there had also been initiatives like artist's workshops and open workshops opposing and surviving the gentrification effect through negotiation with the city council (Capdevila & Zarlenga 2015).

3.3.2 Living Labs

> 'Urban Living Labs are the most appropriate instruments for cities to develop their smartness in a way that is not focused on the technological solutions, but rather driven by collectively shared problems, although Living Labs are not often identified as drivers or producers of a city's smartness' (Concilio & Molinari 2015: 102).

The concept of Living Laboratories (Labs) evolved in the early at the Media Lab at MIT, Boston to study users in real-life contexts, e.g. the first living labs consisted of real people living a couple of days in the setting of a real smart/future home in order to observe their use of technology (Eriksson et al. 2005). It is a research methodology for 'sensing, validating and refining complex solutions in multiple and evolving real-life contexts', thus innovations can be validated in empirical environments within specific regional contexts (Schumacher & Feierstein 2007). Since 2006 there exists a European Network of Living Labs (ENoLL) functioning as a basis for knowledge exchange and collaboration (Carter 2013).

Living labs are driven by two main ideas: first, involving users as co-creators on equal grounds with the rest of participants and second, experimentation in real-world settings (Almirall et al. 2012). The traditional trial-and-error process of product development is transformed to a co-creation/co-design process in which user and developer create solutions together with the benefit to recognize unexpected user behaviour, or problems in very early stages of the product or service development (Eriksson et al. 2005), which then can be fixed together with user. It only qualifies as co-creation, if users have decision-making power in the various phases development (Steen & Van Bueren 2017).

Today, living labs represent research and design environments serving as a playground for co-creation, exploration, experimentation and evaluation through multi-stakeholder collaboration, user-centred and open innovation (von Hippel 2005), and urban transformation (Veeckman & van der Graaf 2015). Often such labs operate in spatial contexts like cities,

neighbourhoods or regions where they integrate research and innovation processes (Nevens et al. 2013). Their application domain shifted from a purely technological - especially ICT-pervasive - field of experimentation towards broader socio-economic, environmental and governance related fields including the co-creation of open data, open government and innovation policies (Marsh et al. 2013). Living labs can promote a more proactive and co-creative role of users in the research and innovation process of smart city solutions (European Commission 2016).

Throughout the literature there are similar (urban living lab) concepts subsumed under different names, e.g. Urban Transition Labs (Nevens et al. 2013), City Labs (Capdevila 2015), testbeds, hubs, making spaces (Steen & van Bueren 2017), and Territorial Living Labs (Marsh et al. 2013). Although, compared to the 'traditional' living lab which evolved in a commercial context, urban living labs concentrate more on public value generation than on economic value (Veeckman & van der Graaf 2015). Another distinction is the urban living labs' explicit focus on finding solutions that can increase urban sustainability, although their definition remains unclear, both in practice and in theory (Steen & Van Bueren 2017).

There are three different functions living labs can cover (Marsh et al. 2013; Veeckman & van der Graaf 2015):

- As vertical tools for research, development innovation in a specific domain such as health, media, smart grids, e-participation, etc.;
- As intermediaries between public, agencies, universities, institutes and citizens of the public-private-people-partnerships (4Ps) supervising the whole experiment;
- As behavioural and improvement guideline for public administration officials who want to increase available knowledge for development and use local intellectual capital.

Citizens can play multiple roles in urban living labs from informant to tester as well as contributor and co-creator in the development process, while the city has an enabling, or mediating function, firms and local service providers are utilizers and educational institutions act as providers (cf. Figure 5). It is commonly stated that citizens usually don't possess the necessary technical skills for e.g. coding or programming mobile applications on their own (Veeckman & van der Graaf 2015), therefore ICT-based methodologies such as toolkits for user-innovation (Schumacher & Feuerstein 2007; Schuurman et al. 2012) and internet-toolkits enable citizens to create their own applications.

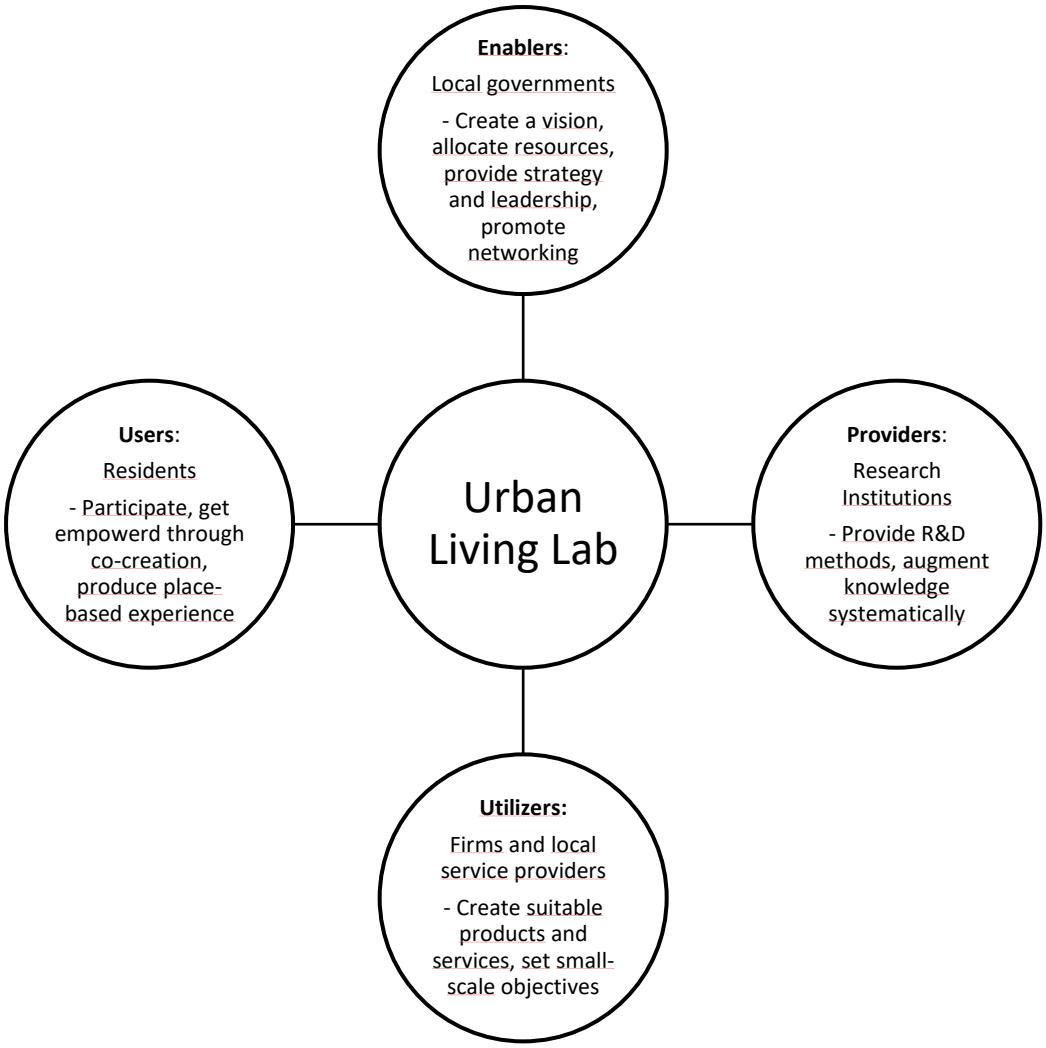

Figure 5: Actor Roles in Urban Living Labs (adapted from Veeckman & van de Graaf 2015)

It is important to mention, that the partnerships of the actors in the living lab are conceptualized towards openness, creating a fluid, dynamic networking in which trust and ethical value assume a contractual power among participants (Concilio & Molinari 2015). Equally, all actors involved have decision-making power (Steen & van Bueren 2017).

As the quote at the beginning of this chapter illustrates, the potential of urban living labs to contribute to a city's smartness is increasingly acknowledged, by aligning technological solutions with urban issues and needs of the local stakeholders, 'while taking into account the local and institutional contexts, cultures, and creativity potentials' (Steen & van Beuren 2017: 21) Especially the citizens are more and more recognised as key actors in the innovation process (De Bonis 2013). Although, there are still open questions related to methods and tools within Living Lab research domain and identifying appropriate concepts for supporting user co-creation (Pallot et al. 2010). In practice, co-creation and innovation are often absent in 90 urban projects in Amsterdam, which are labelled as living labs but differ sometimes not much from traditional top-down development processes (Steen & van Beuren 2017).

The 22@ is home to the *22@Urban Lab* seeking to establish the area as a living lab for developing new infrastructure and services. Companies were inspired to test and develop innovative solutions for products or services in the fields: sensors, urban planning, mobility, education (Bakıcı et al. 2013). It has been used as a tool to bring the latest products and services closer to the city hall services and served as a testing ground for companies at the pre-commercial stage of product development. The urban space serves as experimentation sandbox and field for urban research with firms profiting from having first-hand access to real-life testbeds (Capdevila & Zarlenga 2015). Living Labs have recently appeared increasingly all over Europe, alone in Barcelona there exist numerous living labs such as *LIVE, BDigital Cluster, TIC Living Lab, i2Cat Living Lab, Hangar, Citilab-Cornella, Fab Lab Barcelona, BCNLAB, Guifi.net and Barcelona Laboratori* (Capdevila & Zarlenga 2015).

The *Citilab-Cornella* (formerly known as *Citilab167*) is a centre for socio-digital innovation in *Cornellá de Llobregat,* Barcelona (Eskelinen et al. 2015). It is a mix between a training and research centre and an incubator for business and social initiatives. It sees itself as a centre for civic innovation, using the Internet as a way of innovating in a more collaborative manner, integrating citizens in the core process. The lab has the ambition to introduce innovation culture in the everyday life of citizens with the facilitating help of 'local innovation agents' who bring together academic contributions, knowledge of new technologies, and a special insight to help extract innovation requirements from citizens. Public authorities and companies provide resources but are equally invited to participate in discovering their own needs and setting up their own projects in their own organizations.

Since its opening in November 2007, the lab counts 25 employees and has a budget of 1.2 Mio. Euro. It launched two major projects: *SeniorLab* (helping the elderly to develop their own innovations using IT) and *Edutec* (helping the young to approach computational thinking: Scratch, Arduino, etc.). Over time, the model has been extended to other social groups, such as the Social Media Lab: *Musiclab* with local musicians, *Sportic*, with young football teams and *GameAcademy* with dropouts or the *LaborLab*, a laboratory for inventing new forms of work using ICT. Over the years, *Citilab* has strengthened and extended its laboratory model, cited as best practice in the EU's Guide to Social Innovation and the World Bank's guide to citizen-driven innovation (Eskelinen et al. 2015). Its biggest impact is the idea that everybody can develop their own innovation project. The *Citilab* experience has been instrumental in introducing the citizen-driven innovation methodology in the City of Barcelona, that in 2012 launched the *Barcelona Laboratori* project, exploring how an entire city can become a city lab.

Barcelona Laboratori (BCNLab) is based on a Quadruple Helix which includes citizens, public administrations, research institutions and Universities and Companies (Micro, SME and big companies). It was created in early 2012 and hosted by the Institute of Culture of Barcelona

(ICUB). BCNLab aims at being at the centre of the urban innovation ecosystem helping the creation of an open space for co-creation combining traditional arts, science and technology. It acts at the city level and impacts the whole city maximizing the use of different cultural equipment and culture festivals of the city, as well as city data, infrastructures and information systems (Openlivinglabs.eu, n.d.).

3.3.3 Open Data

Like many cities Barcelona became involved in the Open Data movement and opened up its data, although the politicians in Barcelona were sceptical in the beginning and opening government data was not very popular topic, but then even established new jobs which are responsible for open government in the city (Mainka et al. 2015) The opened data is about the city's territory, population, management and procedure indicators, urban environment and documental data (Bakıcı et al. 2013). More specific, in 2018, the 459 publicly accessible datasets with creative commons license include (with the number of datasets available in parenthesis; OpenDataBCN):

- Administration: Public sector (65), Legislation and justice (7), Human Resource (6), Procurement (5).
- Economy and Business: Trade (8), Employment (5), Science and technology (2).
- Population: Demography (130), Society and Welfare (9), Education (1).
- Territory: Housing (59), Town planning & Infrastructure (43)
- Urban environment: Culture & Leisure (52), Transport (41), Environment (14), Security (6), Tourism (3), Sport (2), Participation (1).

Smart cities aim to create an open data ecosystem and aiming at the active participation of residents, the different city authorities, software developers and SMEs in providing, curating and consuming the datasets (Ojo et al. 2015). The datasets are also used in temporary events like hackathons - which are also named app competition, app contests or barcamps – and long-term projects. The city sponsors open data initiatives to encourage start-ups to create new functionalities for its citizens. Resulting in an application, which shows where bikes are available in Barcelona's bike share program (*Bicing*), and an app helping the user to find free parking spots in the city. This is an example of how open data initiatives can lead to new applications from local start-ups. While the start-up scene could profit from open data initiatives, there is reason to doubt that ordinary citizens don't possess the needed 'data literacy' to engage with the smart city, which means that although citizens have so much data at their disposal, they lack the necessary skills and resources to filter out useful information and understand the application of these data (Fivaz & Schwarz 2016).

iCity is a European smart city project aiming to offset public services cuts, as governments are forced to do more with less and reduce increasingly their spending on public services which they are not forced to deliver by law (Garriga-Portolà & López-Ventura 2014). Thus, this project aims to close this gap and to empower third parties like private companies, NGOs and neighbourhood associations, etc. to deliver public services of interest by opening public IT infrastructures and data at street level. In Barcelona, examples of this open infrastructures include sensor data, such as temperature, noise, humidity, air quality, wind, weather, as well as pedestrian flows and parking information. There had been various hackathons pricing the most innovative applications made by citizens out this data. This project constitutes a mix of openness, technology, economic boost and co-creation in order to provide more public interested services made by the citizens themselves and third-party developers such as businesses (Garriga-Portolà & López-Ventura 2014; Ojo et al. 2015).

3.3.4 Hackathons

The first hackathon was held in the USA in 2011. The word 'hack' refers to smart programmes or programmers and not criminal hack attacks and 'marathon' hints at the temporal construction of those events. The idea behind hackathons is bringing people from different backgrounds together and see whether they can create value-added products and to build a bridge between government, citizens and economy (Mainka et al. 2015).

In Barcelona, several hackathons such as the *Hackathon for Social good*, *Journalism Hackathon*, or *A Smart Cities Hackathon*, as well as a bottom-up hacking community is present, although there is no hackathon especially dedicated to urban government data (Mainka et al. 2015). According to Mainka et al. there had been 49 open urban government mobile apps developed out of the urban data in Barcelona of which 44 had been developed by governmental agencies themselves (2015).

3.3.5 Fab labs and Makerspaces

Inspired by open source and free culture movements, different grassroots ICT-based forms of production have emerged in the DIY-Movement through new formats such as Makerspaces, Hackerspaces and fab labs (Diez 2012; March 2016). Equipped with machines such as 3D printers, laser cutters, vacuum formers and open-source and web-based design tools, etc., fab labs offer citizens learning and using design and manufacturing technologies able to create 'almost everything' (Gershenfeld 2012). 'Emerging from the free culture and autonomist movements, community workshops have moved into hardware hacking, using tools that allow their members to modify, personalize, and manufacture anything from toys and vehicles to wind turbines and home energy systems. For instance, FabLab Barcelona even made a prefabricated eco-house (Smith 2015).

Originated in MIT's interdisciplinary *Center for Bits and Atoms*, fab labs are laboratories or workshops where people can make almost everything with the help of computer-controlled machines producing integrated circuit boards and even houses (Diez 2012). Members share ideas, design, code and instructions online, what is designed in one workshop can theoretically be replicated in any other part of the world (Smith 2015).

These collaborative, open-source, peer-to-peer forms of value creation are praised to bring about radical new possibilities in material production (and consumption) and to transform innovation in society and to improve social inclusiveness, democracy, sustainability and creativity, although, some commentators do warn against the speculative nature of these optimistic claims (March 2016). The idea behind Fab labs is that they produce the tools to reproduce themselves and point the way towards a zero-waste city (Diez 2012) and expose the 'inability of the current political-economic system to address the demands for new convivial, sustainable, citizen-centric and democratic forms of production and consumption' (March 2016: 7).

Barcelona opened its first FabLab at the Institute of Advanced Architecture Catalunya (IAAC) in 2006 and planned to open an *Ateneu de Fabricació Digital* (an A*teneu* is a Catalan civic space) in every district (Smith 2015). Barcelona labels itself as a Fab City, due to the aim of developing a fab lab in every district. The idea of the digitally empowered citizen was appealing to civic leaders, thus each *ateneu* received public funds to run local innovation programs, events, school visits and training days (Smith 2015). Interestingly, the second Fab Lab in Barcelona in Ciutat Meridiana, a working-class neighbourhood that had been hit hard by the economic recession was forced to stop operations, as it had been occupied in summer 2013 and was turned into an improvised foodbank. Because the residents considered it more urgent for the city to solve the social needs in the neighbourhood, rather than to invest in technological innovation (Tomás & Cegarra 2016; March & Ribera-Fumaz 2013). But after negotiations ensued an agreement was achieved: the food bank was re-opened, albeit elsewhere in the neighbourhood; and the FabLab would emphasise training and work for young people (Smith 2015).

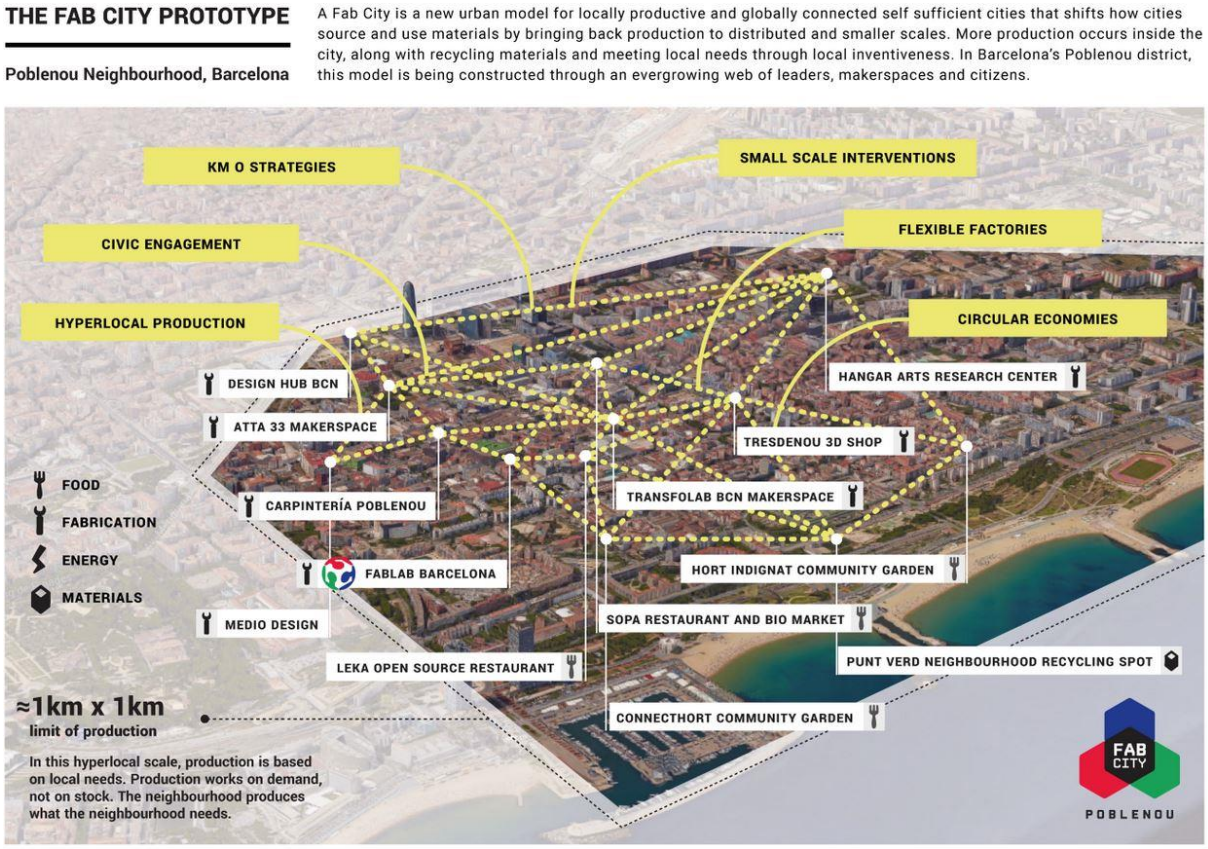

Figure 6: Poblenou envisioned as maker district (Diez 2017)

The former industrial district of Poblenou - which was recently termed as the 'mini silicon-valley for sustainable industry' by a Catalan newspaper - has become a testbed for urban renewal. It is now envisioned as sustainable circular maker district, where everything is made locally and all resources flow in a closed-loop system within the city, without the need to import things and export waste (Diez 2017). This idea led to the largest Fab City prototype (cf. Figure 6) – a one-square-kilometre testbed to explore how to rethink and re-engineer the urban production system. Poblenou strives to produce at least half of its whole consumption locally in 2054 by re-using materials from waste. Not only the city government has declared to support the district's transformation, also other cities, including Amsterdam, Boston, Bhutan, Detroit, Georgia, Paris, Shenzhen, and Toulouse promised their support of fab cities and to become self-sufficient by 2054 (Diez 2017).

3.3.6 Crowdsourcing and Citizen sensing

> In our complex and highly connected world it is rare that a single person has all of the information, skills and insights needed to characterize a problem accurately or generate the most promising solutions (Johnston & Hansen 2011: 8-9).

The term 'crowdsourcing' is related to a series of articles written by Jeffrey Howe in *Wired* magazine and his subsequent book on the topic but continues to be debated in relation to other concepts like co-creation and user innovation (Seltzer & Mahmoudi 2013). Like open

innovation and co-creation, crowdsourcing is increasingly applied in non-business contexts. Similarly, ‘citizen-sourcing’ describes a new trend in a citizen-government relationship where sourcing refers to governments basing policymaking and service production on inputs from citizens (Nam 2011). Thus, citizens can improve government’s situational awareness, responsiveness and effectivity (Linders 2012).

However, crowdsourcing technologies are used by municipalities in the formation of public opinion (Hosio et al. 2015), for idea-generation (ideation) and selection and evaluation of ideas (Mechant et al. 2012; Seltzer & Mahmoudi 2013), and as useful and effective tool in the context of smart city innovation (Schuurman et al. 2012) and smart city planning (Gooch et al. 2015). A prominent example is the smartphone application Street Bump which automatically collects the vibration data in the car to identify road holes and sends it to the road management.

The research field ‘urban emotions’ advocates crowdsourcing (crowdsensing) human’s physiological and subjective emotions with the help of a technological or human sensor and integrating them into a spatial data infrastructure leading to, e.g., bio-mapping of a digital map with geo-referenced emotion data, which, in turn, is expected to enrich urban design and issues in traffic safety planning (Resch et al. 2015). Other research investigates the application of service design theory and crowd-sourcing technology to improve public services (Zimmerman et al. 2011).

Crowdsourcing is based on the earlier work of Surowiecki (2005) and what he called the ‘wisdom of the crowd’. His research shows that under the right circumstances, a group can be smarter than the smartest person in the group. It requires the presence of non-experts or a large body of amateur contributors (Nam 2011). This means that innovative solutions to problems can be found within diverse, decentralised and independent crowds and the best solutions were not the product of consensus and compromise, but of disagreement and context (Seltzer & Mahmoudi 2013). Social interaction lowers the collective wisdom by groups, as answers can become biased in group thinking process (cf. Seltzer & Mahmoudi 2013). This is somewhat contrary to the logic of ‘collective intelligence’ (Lévy 1997), which signifies an aggregation of individual knowledge which is shared, corrected, opened, enriched and evaluated through social interaction (Schuurman et al. 2012). It is argued that the internet and web 2.0 applications allow us to think through a global brain, e.g., Wikipedia as an illustration of this process (Schuurman et al. 2012).

The term ‘crowdsourcing’ combines ‘outsourcing (subcontracting another firm to complete a task) with the ‘wisdom of crowds’ and the ‘collective intelligence’ approach and refers to the phenomenon of everyday people using their free time helping to solve problems. This is an important aspect, as participation is a leisure-time activity for citizens and signifies time not spent with family, on hobbies or simply hanging out.

Thus, it is suggested that crowdsourcing via electronic devices can boost participation in general, as it is less time consuming (Setzer & Mahmoudi 2013).

To define a project, an engagement plan or a business model as crowdsourcing is not straightforward, but there are some necessary characteristics defining crowdsourcing (Setzer & Mahmoudi 2013):

1. A diverse, heterogenous crowd composed of non-experts and experts;
2. A clear and well-defined task or problem statement;
3. Idea Generation: Crowds must submit innovations or ideas that other crowd members can see them;
4. The process should utilize an easily accessible and broadly understood internet platform;
5. The selection of winning ideas is clearly outlined, either by the crowd itself through voting, or evaluation and selection by the sponsoring organisation.

The Obama administration is not the only political institution that used crowdsourcing to collect ideas from the public through the website *change.gov* (Nam 2011), also The Barcelona ruling political platform *Barcelona en Comú* (it considers itself not as a traditional political party) crowdsourced a code of political ethics for its candidates including salary and terms limits for elected officials, as well as financial transparency requirements (Colau 2015).

Another example for crowdsourcing from Barcelona is the *Pla Buits,* an empty urban space with territorial and social involvement programme, offering vacant lots across the city to neighbourhood associations 3 years of land cession to non-profit entities that want to develop a self-organized project (Camps-Calvet et al. 2015). The plan invites the city's public and private non-profit organisations to propose a use or activity of general interest and temporarily run a site. Their proposals will be assessed and selected by an evaluation committee which will give special consideration to the programme's flexibility, its short-term and provisional nature, efficient self-management that keeps the facilities in good condition, and any positive social impact on the city (Ajuntament de Barcelona). ‘Since the start, almost 30 neighbourhood associations, foundations, and non-profit societies sent 32 proposals to manage the empty spaces. The most popular ideas to use the spaces were urban gardens, parks and sport-related or art-related activities’ (Agusti et al. 2014: 2).

For example, Barcelona runs the *IRIS* Project (*Incidencias, Reclamaciones y Sugerencias)* to invite its citizens to submit ideas on how their city could be improved. IRIS is a multi-channel program for managing service requests, incidents reports and complaints of the citizens, which embodies one of the first attempts to improve co-creation in Barcelona. It allows citizens to communicate with the city council by various means (mostly by telephone), it creates a database of ‘city problems’, fostering citizens’ civil actions. From this input, City Hall has

developed many projects based on co-creation thanks to the new platforms like *Arreglamicalle*, or *Pla Buits*.

3.3.7 Citizen scientists and Smart citizens

> Connected urban citizens, acting as active sensors, have the capacity to contribute even more efficiently to the spatial intelligence of cities; they have the potential to make a meaningful contribution to the citizen science of cites (Roche 2014: 707).

Citizen science refers to the participation of non-professional scientists in scientific research, e.g. residents living close to the London airport engage in measuring noise pollution levels with privately installed sensors. The recent surge of interest in citizen science has two reasons: first, the increasing range of mainly ICT-based, sophisticated toolkits fostering engagement and participation, and second, the realization in the professional scientific community that the public is a free source of skills, labour, independent and verifiable sensing capabilities (Hunt et al. 2015). As pointed out earlier, citizens are expected to be more than passive receivers of services and to articulate their own needs in a bottom-up fashioned smart city. Thus, for the bottom-up approach to become reality, citizens must be able to make sense of the increasing amount of urban data and exploit urban data for addressing local issues (Wolff et al. 2015). Today, however, citizens rarely have these skills, which is considered as a serious barrier to bottom-up initiatives in the future smart cities (ibid.).

Citizen observatories focus on the data collection and publication and can validate for top-down approaches and enable bottom-up urban design, where they can enable data to be gathered in a scientifically verifiable way to inform local decision-making in a transparent and credible way (Hunt et al. 2015). The topics of contemporary citizen observatories in the smart city context cover the monitoring of urban environments, water monitoring, water monitoring in the ocean, odour, and another project deals with biospheres and ecologically sensitive areas (Hunt et al. 2015). For smart citizens to use and even innovate their own smart city solutions using big urban data, they must have good understanding of sustainability issues and must possess the necessary skills to interact with large and complex data sets (Wolff et al. 2015), they need education and learning opportunities, which in turn are supported by citizen observatories and citizen science in general (Hunt et al. 2015). Although citizen science assigns a rather passive role to the citizens of measuring the environment, instead of engaging them actively as interpreters or analysists (Gooch et al 2015), it can be harnessed to learn the requirements for participation in the future smart city (Wolff et al. 2015).

For instance, *Awi.net* is an initiative found in *Vildecans* - a city with 60.000 inhabitants very close to Barcelona - aiming to reduce the digital gap. In this project, young people become teachers for the first time in their life and help the elderly using new technologies around them. It is an example of a tech-enabled civic engagement initiative, which was co-created by the

local government and by citizens to improve digital education (Garriga-Portolà & López-Ventura 2014)

Smart Citizen is a platform to generate participatory processes of people in Barcelona which started as a crowd-funded project in Fab Lab Barcelona and the Institute for Advanced Architecture of Catalonia. By providing citizens with a mobile app and *Arduino*-based boards equipped with environmental sensors and connectivity, citizens can create data own their own concerning humidity, noise, temperature or pollution, which then can be visualized on the www.*smartcitizen.me* website. The device is able to stream the measures taken by sensors over a Wi-Fi connection and to share the data on the internet in real-time (Capdevila & Zarlenga 2015). *Arduino* is a platform consisting of soft- and hardware used to prototype interactive electronic projects bringing 'physical computing skills to non-technical people' (Diez 2012: 460). This device is also named in another co-creation project, as it offers the 'ability to quickly create experience prototypes using the Arduino platform has proved to be an excellent method for participants with little technical knowledge to quickly and easily prototype quite complex Intelligent Products' (Hribernik et al. 2011).

After the smart citizen project's initiation, local governments showed interest to connect this citizen-generated data with their official data (Garriga-Portolà & López-Ventura 2014). On the project website (smartcitizen.me) the smart citizen kit can be bought and the platform displays sensor data of every online kit around the world. The project is based on geolocation, Internet and free hardware and software for data collection and sharing, and (in a second phase) the production of objects; it connects people with their environment and their city to create more effective and optimized relationships between resources, technology, communities, services and events in the urban environment. The crowd senses its environment leading to the term 'crowdsensing'. It is also an example of how technologies can be used to politize hidden urban problems like air pollution. Through the measured data, citizens are empowered to come up with hard facts in political debates. It helps to raise awareness and was used to create, e.g. local noise maps. It is widely celebrated as success-story as it deployed more than 1200 sensors around the world and the '*Smart Citizen Kit'* won the *World Smart Cities Awards* in 2013 (Calzada 2017).

There are other examples of how citizen initiatives drive climate-related action. Among the citizen-led projects is a Bike-Sharing application and a mobile app to swap goods and one project offers repairs called the green point 2.0. There is also training for citizens to renovate houses with passive and low-cost systems to reduce energy consumption (Cities100 2016).

3.3.8 Participatory Platforms

Participatory planning becomes e-planning when participatory are expanded beyond face-to-face interaction and include ICT-mediated interaction independent of spatial and temporal constraints (Saad-Sulonen & Horelli 2010). Those cities following a participatory and sustainable urban planning approach creating many open city spaces while ensuring citizen satisfaction are more likely to become a liveable city (Anthopoulos 2017). E-participation aims at increasing the citizens' abilities to participate in the political process, thus not only supplying citizens with information about public policies but giving them the opportunity to co-create them (Granier & Kudo 2016). Communication is key, thus, informing the public how their feedback has been taken into consideration in urban planning is considered important to satisfy citizens (Oksman et al. 2014; Ertiö 2015). The use of multiple channels for gathering and diffusion of information is important to support ICT-mediated participatory planning (Saad-Sulonen & Horelli 2010).

Urban places with interactive screens at transportation or municipal service points are good options to inform about plans of the future, but users may be more hesitant to use them to give comments or feedback when not using their own personal devices (Oksman et al. 2014). More tools are mailing lists, location-based participation software like the Urban Mediator, community websites and social media sites (Saad-Sulonen & Horelli 2010). More tools important for the domain of e-participation are: Email, Messaging and Filesharing, RSS Syndication, Streaming technologies, Computer Supported Collaborative Work, Semantic Web Technology, Extensible Markup Language (XML), Data Mining, Ontological Engineering, Computational Linguistics, Natural Language Processing (NLP), Identity Management and Filtering Technologies (cf. Tambouris et al. 2007).

Public Participation Geographic Information Systems (PPGIS) still remain expert-based systems (Saad-Sulonen & Horelli 2010) and did not reach general acceptance because its functionalities were difficult to use and citizens needed guidance and training for processing the data (Ertiö 2015). However, it is argued that GISciences directly contribute to increasing the intelligence of cities through mobile position technologies, methods for the validation and qualification of volunteered geographic information, and ultimately, teaching approaches, which can improve citizens' spatial skills and spatial thinking in order, not only to provide the data but also to participate in their analysis (Roche 2014). 'GeoDesign as part of the GISsicences' can provide 'innovative, creative, deliberative, uncertain, multi-actor, multi-scale and multi-thematic methods and tools to design smart cities and their physical and "senseable" structure' (Roche 2014: 708).

Research in user-driven innovation development reveals that people prefer generic tools or platforms, such as one-stop service points where they can find all the information they need

on a subject (Mechant et al. 2012). These ‘one-stop service points should contain the possibility to start a dialogue and direct interaction with the city council or other citizens (ibid). Various governments host and control proprietary platforms, which can include voting systems and allow citizens to receive information and to start a dialogue (Berntzen & Johannessen 2016). For example, ‘Digital planning dialogue’ is a web-based system to facilitate communication between stakeholders in planning processes that are used as a showcase in the Norwegian eGovernment Programme (Berntzen & Johannessen 2016). It presents both, maps and all relevant documents to its users including a timeline of the planning process where stakeholders may submit comments. It makes planning processes more accessible to the general population and maps let citizens grasp spatial aspects of the plan, while the timeline facilitates understanding temporal aspects (ibid).

Online town hall meetings have been set up in cities to facilitate engagement (European Commission 2016). Digital tools for bottom-up movement are usually websites that support ‘neighbourhood’ and ‘sharing’ through participation types like ‘helping and asking for help’, ‘Informing’ and ‘Connecting neighbours’ in the case of bottom-up movement in Amsterdam (Niederer & Priester 2016). Smart city platforms recently allow for new forms of co-creation and participation formats in terms of bigger size and scalability, as well as a higher activity and amount of contributions of participants. Smart city administrations can leverage these new participative platforms to increase the quality of life in cities (Robra-Bissantz et al. 2016).

Decidim Barcelona (www.decidim.barcelona) is the city’s main participatory online platform hosting participatory processes, government strategic planning, citizen initiatives, cultural activities, large-scale deliberation and other government services including online and offline participation sessions. The platform was developed with open source software and a modular architecture based on open standards allowing city organizations to run their own autonomous participatory processes, such as open budgeting and policy co-creation projects (Morozov & Bria 2018). Citizens are given the opportunity to propose, meet, deliberate, decide and monitor policy processes through the platform where they can find the necessary information about the participation phase, documents and deadlines. Interestingly, in the moment of writing this, citizens are invited to participate in rethinking the use of the *Poblenou* innovation district (22@) and to define common a strategy for solving social, economic and urban challenges of the district.

3.3.9 Superblocks

Morozov & Bria outline ‘one of the best use cases’ regarding participation has been the participatory urban planning process concerning the ‘Superblocks Program’, which is a redesign of streets and to limit traffic and increase amount of recreational spaces available to citizens (2018: 51):

> Here, the city involves neighbourhood groups and citizens in the planning process through offline citizens' assemblies and the online platform *decidim*. Together with its citizens, the city drafted an ambitious mobility plan to curb excessive air pollution, lower noise levels, and reduce traffic by 21%. The plan is based around the idea of *superilles* (superblocks) - mini-neighbourhoods around which traffic will flow, and in which spaces will be repurposed into green space for citizens, freeing up 60% of streets currently used by cars. Barcelona's new plan consists of creating superblocks through gradual interventions to repurpose existing infrastructure, ranging from traffic management to changing road signs, the creation of new orthogonal bus networks, and the introduction of 300km of new cycling lanes to increase mobility by foot, bike, and public transport. The use of sensor networks, digital signalling and Big Data analytics will help to better define and predict public mobility policies, as well as measure the urban impact.

These public spaces are reconfigured to be areas where citizens have the right to exchange, expression and participation, culture and knowledge, and to leisure. These new spaces will offer a healthier lifestyle and better air quality due to less pollution and most importantly, they create a community place for urban life designed by the citizens itself.

3.4 Conclusion

With the inauguration of the newly elected mayor Ada Cola, a former anti-eviction housing activist and considered as one of the most radical mayors in the world, who represents the radical grassroots movement '*Barcelona in Common'*, which is the main opposition against a political and economic elite who had led Spain into a deep financial and social crisis leaving hundreds of thousands of families homeless (Morozov & Bria 2018) – the initial smart city strategy transformed into an 'open source' strategy (Calzada 2017).

While the former smart city strategy was rather corporate-driven (Calzada 2017), the new strategy BITS (Barcelona Initiative for Technological Sovereignty) aims to rethink politics and democracy and understands Barcelona as 'City of Commons', thus seeking to avoid former technologically-dominated, neo-liberal approaches to the smart city run by big tech companies (Morozov & Bria 2018). The new strategy is influenced by renowned scholars such as Harvey, Morozov, and Subirats among others (Calzada 2017). Also, the City Council created a new office for Technological and Digital Innovation expressing 'a firm belief in the importance of data and technology in the city transformation: from delivering better public services to fostering a more open, agile and participatory government' (Basu & Bria 2017), and democratic, open source, and commons-based digital cities built from bottom-up (Morozov & Bria 2018).

One goal of this strategy of open sourcing the smart city for the people is the remunicipalization of critical urban infrastructures and public service delivery. The new government already

initiated a shift towards remunicipalization of infrastructure and public services such as water and energy. Some of their main actions comprise the fight against energy poverty, affecting over three million people. 'They promise to remunicipalize the water company and change public regulations, introducing labour, environmental, gender, open source, and ethical standards, as well as allow social enterprises and cooperatives to access public funding more easily' (Morozov & Bria 2018: 27). Also, Barcelona has launched a new project[5] with data commons based on the blockchain technology, where citizens own and control their data providing tools that put individuals in control of whether they keep their personal data private or share it for the public good.

Although there seems to be a clear revolution taking place in Barcelona from top-down to a bottom-up approach leading to more open, co-creative relations with its citizens, 'there are still inherent conflicts between the regional government (*Generalitat*) and the local authority led by mayor Ada Colau' (Calzada 2017), referring the fact that there is no shared and coherent smart city orientation for the Province of Barcelona (Tomás & Cegarra 2016). And referring to the city of Barcelona itself, there co-exist historically different governance modes and strategies for urban regeneration in different areas of Barcelona (Blanco 2015):

- The predominant regeneration model driven by the City Council's Urban Planning Department - the only department without a city-level mechanism of citizen consultation - is applied in the city's historic centre, the seafront and in *Poblenou* (with the @22 Barcelona as paradigmatic example) and concentrates mainly on establishing cooperation between public (e.g. local, national and European urban development departments) and private agents (e.g. ground owners, estate agents and service companies) resulting in a top-down approach excluding citizens and other city departments like social, environmental, etc.
- In response to the socio-spatial polarisation in the city, an alternative model of urban regeneration emerged from grassroots movement neighbourhood initiatives with the support of the Social Welfare Department of the regional government in some cases. Examples constitute the community plans of *Trinitat Nova, Roquetes* and *Verdum*, and in the working-class district of *Nou Barris*.

Blanco brings it to the concrete formula: 'the more intense the expectations of economic profit for business actors, the less the opportunities for citizen engagement', which has resulted in two apparently antagonistic regime practices (2015). In most of the projects, the citizens were not involved in decision-making and were not asked if they want their city to become smart and

[5] www.decodeproject.eu (accessed February 20, 2018)

how, rather they were expected to test new apps and services and behave like smart citizens, no matter if they want to, or not (Tomás & Cegarra 2016).

Smart Cities can intensify the process of 'urban splintering' (Graham & Marvin 2001) resulting in the exclusion of parts of the city to new privately-run infrastructures and services as they are deemed to be non-profitable (March & Ribera-Fumaz 2016). Barcelona's application of the smart city shows how the concept itself is imported, transformed and repacked and the intended solutions faced problems in different neighbourhoods (March & Ribera-Fumaz 2016). This is related also to the innovation district, as even the most positive commentators of the smartification acknowledge briefly that smart city initiatives faced 'a variety of challenges' and 'problems with adaption' (Harrison 2017: 28). Bakici et al. (2013: 145) admit that 'Barcelona faced certain challenges such as providing exact and appropriate infrastructure, deployment and management of wireless networks, and the creation of triple helix, networks, clusters and collaborations.'

The change of smart city orientation initiated by the new government illustrates the political nature of the smart city and illustrates an evolutionary path from a top-down strategy at the beginning of the smart city development during 2011-2015 towards more of a bottom-up strategy since 2015. It has been shown that the elections impacted upon the city's smart city strategy. Thus, it seems wrong to consider the smart city as 'apolitical' or as a neutral technical artefact, as this is denying the role of the local government in urban governance (Tomás & Cegarra 2016). Or to put it with the words of the city mayor, Ada Colau:

> Taking back a city also means putting decision-making in the hands of ordinary people. This doesn't just mean letting citizens vote on proposals made from above, it also means giving them the power to launch new initiatives themselves. For us, a 'Smart City' is one that harnesses the collective intelligence of the people who live in it. We drew up our election manifesto in an open, participatory way. Over 5000 people took part in its development, resulting in a programme that focuses on guaranteeing basic rights, making the city more liveable, and democratizing public institutions (Colau 2015: n.p.)

With its crowdsourced agenda and its involvement of citizens in active co-creation and participatory budgeting, the new government follows a participatory and deliberative democracy model using ICT to increase citizen participation and involvement in political decision-making beyond casting their vote in elections (cf. Päivärinta & Sæbø 2006). But not only political participation can help to empower people, also the relocation of production and research centres back in the neighbourhoods seem to have a positive impact on liveability and the local economy. Especially the fab city movement is a promising methodology towards a new understanding of production and a new value system trying to offset the negative consequences of neoliberal capitalism.

Another noteworthy example of a co-creation is *Guifi.net,* wherein citizens setting up a bottom-up Wi-Fi network that has progressively been extended from Catalonia to other regions. The network's structure is completely distributed, as anyone can to extend it by adding a Wi-Fi access node after accepting an interconnection agreement that guarantees the respect of the project principles (Capdevila & Zarlenga 2015). The project was inspired by the free software movement and is now the biggest free network in the world while clearly contradicting the interests of corporate Wi-Fi providers (Capdevila & Zarlenga 2015).

4 Toolbox for co-creating a Smart City

Additional to the methodologies already outlined in the case study of Barcelona, literature research suggests that participation in cities can be facilitated by ICT-enabled tools and methodologies. The goal of this chapter is to complement the methodologies found in the case study with additional insights from e-participation and smart city literature. The idea is to provide a toolbox founded in theoretical and practical research consisting of a catalogue of methods that can be used to foster co-creation in smart cities (Table 7). The toolbox serves as a methodology for urban planners and city managers for a building a participatory smart city fostering elements of co-creation in economic and urban development.

Table 7: Co-creative Methods and tools for urban planning

Method/Tool:	Example in Case-study:	Approach found in literature research:
Living Labs	*22@UrbanLab; Citilab-Cornella;*	x
Open Data	*Barcelona Open Data; iCity*	x
Hackathons	*Hackathon for Social good; Smart City Hackathon*	x
Fab labs and Makerspaces	*Ateneu de Fabricació Digital; Fab City*	x
Crowdsourcing & Citizen sensing	*Barcelona en Comú; Pla Buits; Smart Citizen*	x

Citizen scientists & Smart Citizen	*Awi.net; Smart Citizen;*	x
Participatory Platforms; Participatory Budgeting	*Decidim*	x
Redesigning city blocks	*Superblocks*	
Web 2.0 / Social Media		x
Gamification		x
Immersive Environments		x

4.1 Web 2.0 and Social Media

Contests, wikis, social networking, and social voting are identified as the main strategies for citizen sourcing using technologies (Wilson & Linders 2011). Social media enables establishing new connections between government and citizens, which could have hardly been created offline, and whose value depends on policy domain, institutional situation and the existence of citizen communities (Meijer 2012). Social media like Twitter and Facebook and online communication channels such as chats and blogging (the web 2.0) are causing real impact in terms of community activism, civic engagement, cultural citizenship and user-led innovation (Fredericks & Foth 2013).

In order to create responsive forms of governance, social media can have a key role when adopted by the public sector (Pereira et al. 2017). If integrated with digital and online tools current planning practices can help to increase accessibility for people unable or unwilling to attend conventional public participation sessions (Fredericks & Foth 2013). However, the long-term impact of web 2.0 on planning remains to be seen. The same holds true for mobile participation which is expected to increase, as apps will continue to thrive on location-based data, but also include more of the citizen's local knowledge and interactive features (cf. Ertiö 2015).

Social media can also facilitate both, individual and community co-production (Meijer 2012). Social media may be utilised in two ways: existing social media services may be used or new services may be developed. In comparison to proprietary platforms, social media is more inclusive because it attracts additionally regular users (Berntzen & Johanessen 2016). Social

media as complementary planning tool can capture a wider audience; attract younger participants and makes public participation less labour intensive (Fredericks & Foth 2013).

The issue of filter bubbles constite a risk for the user, as the algorithms of social media platforms such as Facebook or search engines tend to show results based on earlier search queries or alleged personal preferences and interest leading to loss of diversity and variation in the results. What can lead to beneficial results towards decisions on consumerism or leisure time might be precarious in informing political decisions such as voting or policy discussions (Fivaz & Schwarz 2016).

4.2 Gamification

Gamification, a recent trend in urban planning, is generally defined as the use of game elements in non-gaming contexts (Aversano et al. 2016; Opromolla et al. 2015; Coenen et al. 2013). 'Serious games' are games played for serious purposes like education, scientific exploration, health care, emergency management, city planning, etc. not only for entertainment but to educate players about a particular problem and train them to find solutions (Tan 2016). Gamification techniques are used in smart city projects to activate and engage local communities promoting social cohesion among the citizens (Aversano et al. 2016), in a socio-technological mobilisation system to consolidate and activate social capital in urban communities (Coenen et al. 2013) and can support citizen engagement in the co-design process of new products and services in the smart city (Opromolla et al. 2014).

Most smart city gamification approaches are used in mobile applications affecting mobility and environment issues and aim to motivate citizens to behave eco-friendlier by reducing CO_2 emissions, choosing sustainable means of transportation, promoting collaborative riding, recycling, fostering sustainable communities, and educating in energy conservation (Opromolla et al. 2015). Also, in tourism and leisure, gamification principles are found in geocaching activities such as 'treasure-hunts' (ibid.). Another game-based methodology is Future Cities, which is promoted by the British council to engage citizens in key planning issues across cities worldwide (European Commission 2016).

'City-gaming' is increasingly evolving as a field of gaming-stimulated knowledge production can embrace the complexity of the fields it addresses (Tan 2016). An important aspect about games is they foster perspective-taking, as playing other roles can foster empathy, which, in turn, is beneficial for planning processes, as it is a goal of planning to help community members understand another's stake in a decision (Gordon et al. 2011). City Games integrate the design and decision-making dimensions, the social and political structures of real cities, and the topological context in the design of the game. Therefore, the outcome depends on the stakeholders: 'whether they collectively decide to reactivate a frozen plan, co-create an

alternative one or map their individual initiatives to lobby for change at the institutional scale' (Tan 2016: 291). This method can successfully serve a range of purposes: simulating self-organizing urban mechanism, facilitating collaborative design, conflict resolution and unlocking conversations, mapping initiatives and ideas, testing urban plan rules, temporary city planning, programming and building (ibid). To conclude, games provide a very productive mechanism for immersing participants in planning decisions (Gordon et al. 2011).

4.3 Immersive environments

There is an increasing desire to give citizens the possibility to virtually explore spaces of envisioned urban redevelopment to improve democratic quality of in an urban planning process (Guggisberg & Burkhart 2016). New digital tools enable the lay public to actively participate in urban planning. It is argued that the more a process can be immersive, the more effective that process can be at engaging the public in discussing planning decisions and engaging in neighbourhood life more generally (Gordon et al. 2011). Immersion can be understood as the feeling of being physically present in a simulated reality.

Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) technology constitute different immersive platforms. While VR depicts a fully virtual reality, AR uses a few virtual elements, which are then projected into real space and MR refers to combining real and virtual objects (Guggisberg & Burkhart 2016). A study of urban design workshops suggests that mixed reality tools in the form of planning tables can offer participants a 'language of participatory creativity' which enables them to address relatively complex urban issues (Bratteteig & Wagner 2010). Immersive virtual environments are increasingly used in large projects to assist stakeholder interaction (cf. Airaksinen & Kokkala 2015).

Studies highlight the great potential of using immersive technologies, such as VR or interactive interfaces such as a multi-touch table, for engaging all urban stakeholders in the urban design process (Dupont et al. 2016). 3D City Models (opensource or commercial) can be an immersive experience enabling to learn by individual and autonomous exploring. In combination with 3D Glasses (a head mounted display), the user can immerse into urban plans without needing expert-based knowledge (Guggisberg & Burkhart 2016). Immersion means a deep involvement in the process of planning with all its political and economic complexity and means an improvement to everyday planning practice (Gordon et al. 2011). Empirical research suggests that the public's willingness to participate in urban planning increases when having access to a smart-phone augmented reality system, especially among the younger participants from the age of 18-25 (Allen et al. 2011).

5 Discussion

The goal of this research was to study differences in the concepts of citizen participation, co-production and co-design as well as their underlying methods. There is an ongoing conflation of inclusion and participation, although both terms can be understood as independent dimensions of public engagement, and are often simply referred to as 'participation' (cf. Quick & Feldman 2011). Inclusion practices refer to continuous efforts to create a community through co-production of public policies and programs for defining and addressing public issues, while 'participation' means efforts to increase public input oriented to the content of programs and policies. However, 'participation' refers to the involvement of the public in issues and decisions that would otherwise the exclusive territory of government (Davis & Bishop 2011), no matter if the participation exercise is bottom-up (citizen-driven) or top-down (administration-driven). Therefore, participation leads not always to inclusion, on the contrary, poorly exercised participation or tokenism can lead to mistrust in authorities and participation fatigue. Thus, it is good public participation, when people have power in decision-making or their input is valued.

Co-production and co-creation can be understood as instances of enhanced participation or as partnership regarding the participation ladder, as both concepts require equal relationships of people. Similarly, the co-design involves that designers and users have the same rights and possibility in the design process. Co-design like service-design are specific instances of co-creation and use methodologies from design thinking and human-centred design (cf. Table 3). Through co-design activities citizens can participate in the typical phases of design or innovation processes (cf. Nambisan & Nambisan 2013):

- Identifying, discovering, or defining a problem (explorer)
- Conceptualizing a solution (ideator)
- Designing and developing the solution (designer)
- Implementing the solution (co-producer)

Newer perspectives on co-production stress the urgency to leverage technologies like web 2.0 to make public services as participative, communal and collective by using user-generated content to co-create 'public services 2.0' by turning people into participants in the design of services (Leadbeater & Cottam 2007). This leads to the need for co-created innovations in the public sector, which result in a boost of citizen satisfaction, generate better outcomes and improve the image of the state, and ultimately can generate cost savings between 20% and 60% (Alves 2013; Bason 2010).

Research institutes and supranational institutions like the European Commission advocate focussing on co-creation with citizens and the social aspect of innovations in order to adjust smart cities more to the needs and wishes of its citizens. Citizens value specific city-spaces,

places, parks, bridges, etc. – it is a special connection between people and places that manifests itself in notions of 'identities and memories' (Dörk & Monteyne 2011), which in turn make the citizens more likely to participate, as it concerns their familiar surroundings (Stembert & Mulder 2013). Thus, in smart cities governance is essential to the success of smart city projects and the levels of co-creativity which can emerge among urban stakeholders. It is claimed that open data initiatives contribute to enhancing the delivery of public value in smart city context in economic, strategic, political, stewardship and quality of life dimensions (cf. Pereira 2016) and can enhance the concrete settings of collaborative governance (cf. Bartenberger & Grubmüller-Régent 2014).

What is a real-existing smart city?

Smart city strategies either concern an entire country, nation or greater region, although until yet most strategies focus more on the local level, be it a neighbourhood, municipality or city or metropolitan area (Alizadeh 2017). With being reproduced in America, Europe, a few countries in Africa, Asia and Australia the global smart city discourse has several political, social and economic underpinnings, but more generally, the logic behind smart city planning policies follows the idea of understanding cities in every detail, and, if provided with enough data being able to manage cities in a mechanical or engineering sense. The epistemological focus of the smart city definitions is either on infrastructure and ICT, creative economy, sustainability or human infrastructure preventing from finding a unique and holistic definition. The most publications represent separate knowledge entities divided along two main development paths of the smart city research.

Most digitally informed cities in Asia tend to prioritize the Transport and Mobility and the Buildings domain, experiencing high levels of pollution and congestion, whereas European smart cities emphasize the softer aspects of the smart city concept reflecting the EU policies supporting R&D and human capital investments in the Lisbon Agenda (Neirotti et al. 2014). Various scholars stress the importance of combining of hard and soft to optimise the use and exploitation of tangible assets, such as transport and mobility, and intangible assets, such as the organisational capital of public administration units (Albino et al. 2015; Neirotti et al. 2014).

> We believe a city to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance (Caragliu et al. 2011).

The definition is linked to traditional regional and neoclassic theories of urban growth and development, particularly, theories of regional competitiveness, transport and ICT economics,

natural resources, human and social capital, quality of life, and participation of societies in cities (Caragliu et al. 2011). It is the last aspect of this often-cited definition: 'through participatory governance' is what is often forgotten in smart city initiatives, but nonetheless essential for creating an understanding of the possibilities for public participation in the smart city.

The smart city discourse edges the urban governance away from politics towards technology and the environment, thus widening the influence of technicians, consultants and private companies leading to 'new geometries of power', 'post-political' urban governance (Vanolo 2014: 12) and to one-size-fits-all solutions, which fail to consider the historical, cultural and social, economic, political features of cities (Kitchin et al 2015). Despite the many claims to involve citizens not only on a passive level as users or consumers, little research has been produced so far about meaningful participation in smart city governance, as many publications consider smart city governance as 'managerial or technical issue', since citizen participation (and sustainability) are not analysed as issues of political struggle and debate but rather as desirables for a good society.

One challenge was to unpack 'smart urbanisms', which are 'deeply rooted in seductive and normative visions of the future where digital technology stands as the primary driver for change' promoted 'by international organisations, the corporate sector, and national and local governments alike' (Luque-Ayala & Marvin 2015: 2105). A growing body of critical literature targets the optimistic rhetoric of smart marketing materials and questions the logic behind smart initiatives and strategies (Greenfield 2013; Hollands 2008; March 2016; Wolfram 2012) and emphasizes that technologies are in fact social constructs with positive and negative implications and (over) celebrates the social and environmental opportunities offered by technology. Vanolo (2014) criticizes the mindset that 'technologies will save us' guards technological-related activities against criticism (2014: 13).

The Barcelona case illustrates first that smart city is far-away from being a neutral or non-political object, and second that there is a criticism against the smart city in Barcelona as an imported package of intended solutions facing problems in being applied in different contexts or neighbourhoods (March & Ribera-Fumaz 2016; Harrison 2017). This holds certainly true for examples of the squatter movement in the knowledge district and the fab lab that was turned into a community food bank. Barcelona's urban development model is polycentric, different planning policies and regimes coexist. The urban development in Poblenou is based on entrepreneurial and knowledge city planning. fosters culture and creativity not only to achieve cultural benefits but also to a 'greater social cohesion, economic growth, attraction of cultural tourism or knowledge workers' (Marti-Costa & Miguel 2012: 4-5).

Furthermore, it has been shown that smart city plans and lived realities not always matched, as in the case of the squatters in the *22@Barcelona* area and the fab lab that was turned into a food bank. The envisioned smart city transformation (as a flat network of interconnected hubs like the internet) witnessed a lack of citizen participation and faced opposition from neighbourhood associations. Which allows Harrison (2017: 29) to conclude that 'this vision of smart technologies that improved people's lives failed to be realised in a way that considered local conditions, and which ultimately was technology-centric rather than people-centric.'

The new digital strategy of the city of Barcelona might have incorporated some of its critique, as it seems that the city has understood that the corporate influence over city management creates a potential lock-ins and path dependency towards proprietary technology platforms and raises issues about the management of the systems after the departure of the corporates (Angelidou 2017a; Greenfield 2013; Luque-Ayala & Marvin 2015). The city puts efforts on experimenting with data as commons to give citizens back control over their personal data. The new approach seeks not only to remunicipalize services, another goal is to transform procurement, 'introducing innovative, ethical, gender equitable and sustainable clauses in how cities buy products and services' (Morozov & Bria 2018: 28).

Barcelona's new digital strategy seeking to transform Barcelona into a non-neoliberal smart city is a rebellion echoing what David Harvey understood as rebel cities (2012): The idea of technological sovereignty adopts open source software, open standards, and open architectures which, must be conceived as a prerequisite to developing a truly democratic technology agenda able to generate new productive economies and facilitate knowledge sharing between cities, countries, and movements (cf. Morozov & Bria 2018).

What roles play the citizens in smart city theory and development?

The deepness of the smart city concept varies from simply using ICT to optimise urban infrastructure to sophisticated visions of cities as integrated systems in which government, civil society and companies collaborate in new ways to improve quality of life in domains of health, education and leisure, aiming at 'smart' economic growth, less energy consumption and the creation of environmental-friendly cities (de Waal & Dignum 2017). It has been argued that a city is only 'smart' if it can generate public value for people (Dameri & Rosenthal-Sabroux 2014), which emerges when cities are performing efficiently, are accountable and responsive to public needs and manage to gain their citizens' trust (Cosgrave et al. 2014).

But not only receive citizens services making their life easier, they are also expected to make use of open government data, which are considered a method to strengthen the collective

intelligence of cities by enabling companies, innovators, NGOs and citizens to extract value from this data (Meijer & Bolivar 2016). Establishing open data in the government sector was already recognized in the European Union since the end of the 1980s (Janssen 2011). Thus, what is new are the possibilities through ICT and digitization to create value-added data or services (Mainka et al. 2015).

The role of the citizens according to the participation ladder in the smart city varies from non-participation as 'patients', to residents and users having the choice of consumerism towards more emancipatory roles like proposer, co-creator, decision-maker, leader or member. The value of the framework was supported by examples from the case-study related to the presented roles. However, in the smart city context, cases of 'citizen control' are hard to find in theory and in the case-study, as '[…] in cases where participation and co-creation are initiated by those in power, rather than from bottom-up by citizens themselves, the ideals of shared or citizen-dominated decision-making sought by Arnstein are rarely present' (Cardullo & Kitchin 2018: 6).

According to Cardullo & Kitchin, the number of citizen-led and grassroots smart city initiatives is small on one hand, because communities tend to organise their activism around addressing social or environmental issues through political solutions rather than technological ones, and on the other hand, because the imperative for creating smart cities is mostly being driven by a neoliberal ideology and corporate interest leaving little space for more political discourse of rights citizenship and urban commons (2018).

What methods and tools can support participation in the smart city development and implementation?

Smart cities are increasingly conceptualized as information gathering systems in which data become commons, a new resource containing valuable information for urban designers (de Lange & de Wal 2013). The government in Barcelona supports opening government data to co-create with civil society, business and third sector organisations in projects and hackathons and through their open data platform on the internet. Open data initiatives have led to applications regarding mobility and sharing. Citizens become co-creators together with professionals in formats like hackathons and urban laboratories where they can learn the skills to become 'data literate'. Methodologies of crowdsourcing and citizen science have been studied the examples of a technologically empowering project called the *smart citizen* and urban co-creation in the case-study of *Pla Buits.* Insights were gathered from the case-study of the digital participation platform *decidim* and the use case of the superblock programme where a citizen could influence urban design through the platform.

The case study shows the transformational effects of co-creative methodologies in the innovation district that is where an innovative economy of living labs, maker spaces and fab labs emerged, experimenting with tools to make almost anything and bottom-up forms of decentralised and open-source principles to create a future in which self-sustaining cities only need to import and export data, instead of products in and waste out (cf. Diez 2012). It seems that in Barcelona, a new collaborative attitude and participatory approaches constitutes a new social fabric shaped by new ideas towards of ownership, sharing and collaboration. Although it remains to be seen to which extend cities are going to transform into local innovation platforms and if the innovations generated in this smart ecosystem will prove of democratic character.

In the last chapter, a toolbox based on the extensive literature research and case-study is presented. The toolbox is a catalogue of methods and tools to inform urban planners and other urban development experts designing cities in a co-creative and democratic way.

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Appendix 1

Key-word based bibliographic clustering of peer-reviewed Journals used in this research effort (own research).

Geography, Urban Planning, Policy & Design	Information and Communication Technology	Economy, Business and Management	Policy & Government and Public Sector	Miscellaneous: Design, Psychology, Environment
•*7x Cities* •*6x Journal of Urban Technology* •*3x City* •*4x Cambridge Journal of Regions, Economy and Society* •*4x Environment and Planning Journals* •*3x European Urban and Regional Studies* •*3x Urban Studies* •*2x GeoJournal* •*2x Places Journal* •*International Journal of Social Science Studies* •*TeMA - Journal of Land Use, Mobility and Environment* •*Journal of the American Institute of planners* •*Sustainable Cities and Society* •*International Journal of E-Planning Research* •*Urban Research & Practice* •*Nexus Network Journal* •*The Journal of Public Space* •*Interaction Design and Architecture(s) Journal (IxD&A)* •*Planning theory & practice* •*Journal of Urbanism* •*Transactions of the institute of British geographers* •*Journal of Planning Education and Research* •*Journal of Planning Literature* •*Urban Affairs Review* •*Revista de Estudios Urbanos y Ciencias Sociales* •*Progress in Human Geography* •*Planning Practice & Research*	•*4x Technology Innovation Management Review* •*AI & society* •*European Physical Journal* •*EEE Systems Journal* •*Information, Communication & Society* •*International Journal of Computers & Technology* •*Journal of Information Technology Case and Application Research* •*It-Information Technology* •*First Monday* •*Interacting with Computers* •*Policy & Internet* •*Journal of the Association for Information Systems* •*Communications of the Association for Information Systems* •*Information Systems Frontiers* •*Information Technology for Development* •*Science, Technology, & Human Values* •*Bulletin of science, technology & society* •*The Journal of Community Informatics*	•*2x Journal of Academy of Marketing Science* •*2x California Management Review* •*The Service Industries Journal* •*Journal of the Knowledge Economy* •*Journal of Strategy and Management* •*International Journal of Hospitality Management* •*European Business Review* •*Journal of Open Innovation: Technology, Market, and Complexity* •*British Journal of Management* •*Journal of Services Marketing* •*Journal of interactive marketing* •*Journal of theoretical and applied electronic commerce research* •*Journal für Betriebswirtschaft* •*Organizational Dynamics* •*International journal of electronic commerce*	•*3x Public Management Review* •*2x Information Polity* •*Australian Journal of Public Administration* •*Voluntas: international journal of voluntary and non-profit organizations* •*Triple Helix* •*Science and Public Policy* •*Government Information Quarterly* •*International Review of Administrative Sciences* •*Journal of Democracy* •*Administration & Society* •*American review of Public Administration* •*JeDEM-eJournal of eDemocracy and Open Government* •*Local Government Studies* •*International Journal of Electronic Governance*	•*European Physical Journal* •*Design Management Journal* •*Journal of development Studies* •*Journal of Community & Applied Social Psychology* •*Journal of Consumer Culture* •*2x Co-design* •*Journal of Cleaner Production*

Appendix 2

All cited Journals in the thesis

6xJournal of Urban Technology
7xCities
4xTechnology Innovation Management Review
2x California Management Review
The Service Industries Journal
International Journal of Social Science Studies
TeMA
AI & society
Journal of the American Institute of planners
4xJournal of the Knowledge Economy
JeDEM-eJournal of eDemocracy and Open Government
European Physical Journal
Sustainable Cities and Society.
Australian Journal of Public Administration
2x Voluntas: international journal of voluntary and non-profit organizations
4Public Administration Review
Systems
Journal of Strategy and Management
International Journal of E-Planning Research (IJEPR)
2x GeoJournal
4x Environment and Planning journals
International Journal of Hospitality Management
Urban Research & Practice
Information, Communication & Society
International Journal of Computers & Technology
Journal of Information Technology Case and Application Research
Triple Helix
First Monday
Design Management Journal
It-Information Technology
Nexus Network Journal
The Journal of Public Space
Science and Public Policy
4x Government Information Quarterly
Interacting with Computers
2x Information Polity
2x Journal of Academy of Marketing Science
3x City
4x Cambridge Journal of Regions, Economy and Society
Policy & Internet
IxD&A
European Business Review
Planning theory & practice
Journal of development Studies
Journal of Open Innovation: Technology, Market, and Complexity
3x Urban Studies
Journal of Community & Applied Social Psychology
3x Journal of Cleaner Production

3x European Urban and Regional Studies
Journal of Urbanism
2x Places Journal
Transactions of the institute of British geographers
International Review of Administrative Sciences
Journal of the Association for Information Systems
British Journal of Management
3x Public Management Review
Communications of the Association for Information Systems
Information Systems Frontiers
Information Technology for Development
Journal of Services Marketing
Journal of interactive marketing
Journal of Democracy
Journal of Planning Education and Research
Journal of consumer culture
Science, Technology, & Human Values
2x Co-design
Journal of theoretical and applied electronic commerce research
Journal of Planning Literature
Urban Affairs Review
Revista de Estudios Urbanos y Ciencias Sociales
Administration & Society
Journal für Betriebswirtschaft
American review of Public Administration
Bulletin of science, technology & society
Organizational Dynamics
International journal of electronic commerce
Progress in Human Geography
Local Government Studies
The Journal of Community Informatics
International journal of electronic governance
Planning Practice & Research
Foreign affairs

Erklärung

Hiermit versichere ich, Felix Fabian Stroh, dass ich die vorliegende Arbeit selbständig verfasst habe und keine anderen als die angegebenen Quellen benutzt und alle wörtlich oder sinngemäß aus anderen Werken übernommenen Aussagen als solche gekennzeichnet habe. Diese Arbeit war weder vollständig noch in wesentlichen Teilen Gegenstand eines anderen Prüfungsverfahrens.

_____ _____

Ort, Datum Unterschrift