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Citizen Participation in the Design of Smart Cities: Methods and Management Framework

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Abstract

In the last few years, smart cities have attracted considerable attention because they are considered a response to the complex challenges that modern cities face. Smart cities can provide innovative solutions in various domains such as environment, economy, mobility, safety with technology as enabler. However, this is only possible if the citizens, the end-users, are involved in the design of the smart city. The aim of this chapter is to provide a repository of methods and useful guidelines to manage citizen participation in the design of smart cities.

By means of a literature review from different research areas and an analysis of concrete and well-established smart cities, the relevant methods of citizen participation are identified and described. These methods are bundled into three categories: citizens as democratic participants, citizens as co-creators, and citizens as ICT users.

Furthermore, we present the CitiVoice Framework, a management tool for decision-makers to manage citizen participation that we apply in the context of three Belgian Smart Cities (Mons, Namur, Brussels). This framework builds upon the identified participation methods and has three different uses: 1) as an evaluation tool allowing drawbacks and flaws in citizens' participation to be discovered and analysed; 2) as a governance tool to help define the citizen participation strategy; and 3) as a comparison and creativity tool to compare several cities and design new means of participation.

Keywords— Smart cities; Citizen; Participation; Methods; Framework;

I. INTRODUCTION

In the last few years, smart cities have been more popular than ever because they provide new solutions in the domains of mobility, environment, economy, governance, quality of life, and education, thanks to the innovative use of Information and Communication Technologies (ICT) as shown in fig.1 (Caragliu, Del Bo, & Nijkamp, 2011). Generally, the interest in smart cities is strongly linked with the rise of new information technologies such as mobile devices, semantic web, cloud computing and the Internet of things (Schaffers et al., 2011). The term "smart city" was adopted in 2005 by a number of technology companies as they offered complex information systems to integrate the operations of an urban infrastructure (Harrison & Donnelly, 2011). A number of other non-technological factors led to the larger adoption of a smart city strategy: the increasing size of cities, the need to safeguard the environment from pollution and energy consumption, or the higher requirements of citizens regarding the delivery of public services (Cocchia, 2014).

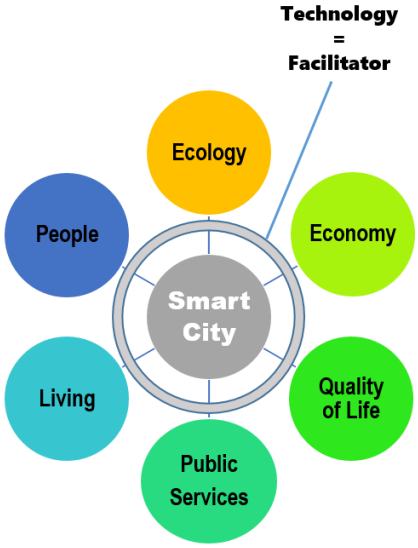

Figure 1. Smart City Dimensions

Although the technological aspects of smart cities have been well covered by the literature, the essential role of citizens in these cities has often been neglected. Too often, smart cities have not reached their objectives because citizens were not properly involved in their definition or the impact on their daily life was not taken into account (Dameri & Rosenthal-Sabroux, 2014). In the smart city research area, many authors have underlined the importance to discuss citizen participation in a smart city. However, so far, no article has attempted to summarize the different enablers of citizen participation in a smart city context. In this chapter, smart cities are considered as socio-technical systems with citizens as their end-users. The goal of this chapter is thus to find out which methods can be used to foster citizen participation in the smart city design and to provide a framework that help in the management of this participation.

This chapter is structured as follows. Section II presents the concept of citizen participation as well as its relevance for designing smart cities. In Section III, we describe the different methods of citizen participation. In Section IV, we present the different uses of the CitiVoice Framework thanks to its application to the cases of three Belgian Smart Cities (Mons, Namur and Brussels). Finally, Section V provides some closing comments and summarizes the contributions of the chapter.

II. Background : Role of Citizens in Smart Cities

The concept of citizen participation is not exclusive to smart cities, but smart cities have shed a new light on this concept and provide new means to enable this participation. This section positions citizen participation and its impact in different research fields.

Smart cities are currently benefiting from a positive buzz from supporting organizations and thus from a lot of economic support. Taking advantage of this support and the multitude of technological possibilities, cities must devise smart city projects, decide how they will use and advance their ICT infrastructure, and optimally exploit their assets. A key challenge is to carry out these actions in coordination with the citizens, since the ultimate goal of building a smart city is to improve their quality of life. Hollands (2008) underlines the importance of citizens and critiques the technological focus of smart cities. He also claims that smart cities must be based on something more than the use of ICT if they want to enable social, environmental, economic, and cultural development. The real smart city, according to Hollands, should start from the people and human capital of the city and use IT to favor democratic debates about the kind of city people want to live in. This radical critique led to a new stream in the scientific literature. A new definition of a smart city integrated the various dimensions of a smart city as well as the critique (Caragliu et al., 2011, p. 70): *A city can be defined as 'smart' when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic development and a high quality of life, with a wise management of natural resources, through participatory governance.* This definition is widely accepted and used in scientific literature and in practice (e.g. smart cities such as Amsterdam used this definition as a basis for their strategy). Fig. 2 represents these two conflicting views between top-down (with the focus on technology) and bottom-up (with the focus on citizen participation) approaches.

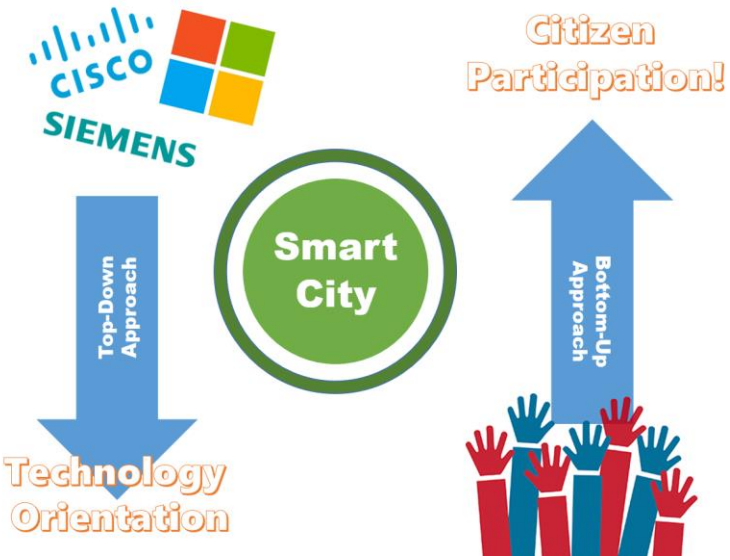

Figure 2. Smart City Approaches

Even though the traditional definitions of smart cities take the specific role of citizens in a smart city into account through the "participatory governance" or the "human capital" dimension (Albino, Berardi, & Dangelico, 2015), the input they can provide and how it can be gathered need further research. In their integrative framework, (Gil-Garcia, Zhang, & Puron-Cid, n.d.) attempt to conceptualize smartness in government. They state that fostering collaboration between citizens and governments is an essential dimension of smart government. Scientific literature acknowledges the essential role of citizens in smart cities and argues that the notion of empowerment of citizens and "democratization" of innovation should be added to this definition (Perera, Zaslavsky, Christen, & Georgakopoulos, 2014; Schaffers et al., 2011). The citizens must be able to identify priorities, strategies and goals for the smart city strategy and should be considered as actors at the center of the implementation and benefits of smart city projects (Albino et al., 2015; Nam & Pardo, 2011).

However, despite this crucial role for citizens, an holistic view on the different participation methods with concrete examples is still rare in scientific literature. Based on our observation in practical cases, this leads to the risk that "citizen participation" remains an abstract buzzword instead of an essential element of the strategy of a city aiming for the label "smart". In this context, this chapter aims at identifying the different methods of citizen participation in a smart city. Furthermore, it builds on previous research on the matter to present a framework to manage this participation (Simonofski, Serral Asensio, Desmedt, & Snoeck, 2017).

III. Participation Methods

The section presents the different methods of citizen participation with concrete examples. Building on previous literature and an analysis of some of the most well-known and successful smart cities (i.e. Ghent or Santander), we formalize citizen participation in three main categories as shown in fig. 3 (Berntzen & Johannessen, 2016; Callahan, 2007; Simonofski, Vanderose, Snoeck, Crompvoets, & Habra, 2017). Firstly, citizens can be democratic participants in the decision-making process of the city. Secondly, citizens can be co-creators in order to propose better solutions and ideas and to decrease the risk of failure early in the process. Finally, in the post-implementation phase, the citizens can also participate as ICT users by proactively using the smart city infrastructure to make them feel surrounded by technology and to enable them to participate more easily.

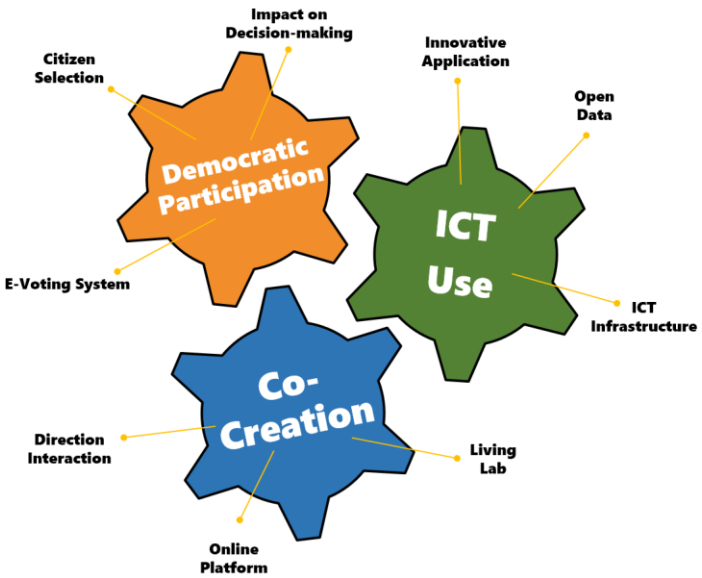

Figure 3. Citizen Participation Categories

A. Citizens as Democratic Participants

Seeing citizens as direct democratic participants in a smart city has several advantages (Irvin & Stansbury, 2004). By being involved in the decision process, the citizens can learn about difficult technical problems and become experts in matters of public relevancy. Moreover, the public servants are also learning from the citizens about the reasons why a policy might be unpopular and how to avoid this. Democratic participation of citizens is also cost effective as it reduces the chance for litigation or, in a smart city, useless investments that will not be helpful or used by the public.

In practice, the implementation of democratic participation of citizens faces numerous challenges. Firstly, the group of citizens involved in the process must be sufficiently representative for the population. For instance, the selected group could be biased towards people whose life is more heavily influenced by the decisions about the smart city strategy. This representation could be obtained through basic statistics about the population to ensure the representativeness of each sub-group. Secondly, the participation process can be costly in terms of resources, money, and time (Irvin & Stansbury, 2004). These challenges can lead to an overrepresentation of a certain social group having the time and money to participate (Weber, 2000). In order to reduce the time and money consuming nature of the decision-making process, this support can reward the citizens through financial but also other kinds of social benefits ("Citizen of the week" awards, free training courses…). The time consuming nature of the decision making process and, thus, the challenge of underrepresentation of people lacking time can also be tackled through to the introduction of **e-voting systems**. Since citizens may not be used to participate in this kind of meetings, facilitators should also ensure each voice is heard through the use of facilitating techniques such as described in (Mahaux & Maiden, 2008)

- Example e-voting system: E-Voting systems differ and can be decomposed in two main categories(Zissis & Lekkas, 2011). First, voting systems that are physically supervised by electoral authorities such as the electronic voting machines located at polling stations. Second, remote voting systems where the citizens can vote at home or without going to a polling station. In its most developed conception, E-voting enables the Electronic Direct Democracy paradigm where citizens can directly influence all matters of public life from a distance (ongoing legislation, new legislation, representatives…).

B. Citizens as Co-Creators

The traditional approach to innovation in cities consisted in urban planners making centralized decisions based on their own ideas, but in recent years, and in the smart city context, a new model that takes advantage of the citizens' input and ideas has emerged (Schaffers et al., 2011). Hence, citizens should not be considered as passive consumers but as crucial stakeholders that can generate valuable ideas that can meet social needs. This section explores how this co-creation can be applied in a smart city context.

There exist some **direct interaction techniques** to collect citizens' ideas such as conducting focus groups or interviews with experts and users, town hall meetings, testing usability, functionality, and accessibility, encouraging real-time comments and suggestions, and developing and adhering to measures and standards of service quality (Johannessen, 2010). Other means to gather citizens' ideas and needs for the smart city can be found in the area of requirements engineering for e-government services. Requirements engineering increasingly tries to reflect as accurately as possible the goals, needs and expectations of the users who are, in this case, the citizens.

- Example Direct Interaction Technique: A citizen-oriented approach (van Velsen, van der Geest, ter Hedde, & Derks, 2009) advises to conduct semi-directive interviews to explore the critical needs of the citizens for the potential system. Other approaches such as the application of the agile paradigm (Schön, Thomaschewski, & Escalona, 2016) and the crowdsourcing paradigm (Adepetu, Ahmed, & Abd, 2012) to the traditional requirements engineering method also provide new methods to collect citizens' needs in a more optimal way.

Another popular technique resides in the **living labs**, defined as "user-driven open innovation ecosystem based on business-citizens-government partnership which enables users to take active part in the research, development and innovation process" (European Commission, 2009, p. 7). The living lab methodology implies that the user is involved early in the development process when analyzing the needs and brainstorming about solutions. The panel of users can also be involved in the concrete development of ideas and finally in testing of prototypes. The goal is to get as close as possible to the citizens to connect with their expectations and to test how this innovation relates to the everyday environment of the users. The applications of the living lab methodology are very diverse and often relevant in the smart city domain: eHealth, ambient assisted living, e-governance, ICT for energy or environment (Pallot, Trousse, Senach, & Scapin, 2010), and so on. The motivation to engage in a living lab methodology not only originates from the willingness to improve user participation. It also ensures market evaluation, the exploration of a large range of ideas, and the reduction of business risks for companies (Pallot et al., 2010). However, the application of the living lab methodology for the public sector drives away these market-related motivations and increases the potential for citizen participation. Thanks to these labs, the needs, expectations and ideas of citizens about the smart city projects can be explored.

- Example Living Lab: The Ghent Living Lab is a collaborative platform which includes key stakeholders such as the local government, colleges and university, local developer networks, entrepreneurs and citizens (Gent City, 2014). The focus of this living lab is on the smart cities and the Future Internet evolutions that could support smart cities. It is also a Learning platform and a test environment. For instance they organized the "Citadel on the move" European project aims at facilitating the use of Open Data for Citizens so that they are able to build relevant mobile applications. In this philosophy, the Ghent Living Lab organizes "Apps for Dummies" sessions for citizens that are not use to program.

In the presence of time or space constraints, citizen participation can be enhanced by two means: centralized **platforms** and social media analysis (Berntzen & Johannessen, 2016). As centralized platforms can be expensive to develop and hard to maintain, social media can be used to reach a larger number of citizens in different contexts: crowdsourcing platforms, collaboration tools, social networking, questioning tools,… (Criado, Sandoval-Almazan, & Gil-Garcia, 2013). However, the gathering and analysis of social media data might require the support of proprietary platforms. Solutions to this challenge are hybrid systems where a social media interface is included in the proprietary platforms to favor the interaction between citizens and government (Dolson & Young, 2012). This kind of system could be applied in a smart city context to stimulate the citizen input.

- Example Online Platform: There exist a number of other platforms that are able to collect citizens' opinion and experience on certain public matters. For instance, "Civiocracy" (Canteneur, 2015)is an online platform that aims at involving citizens and other actors (companies, NGO's, political authorities…) in issues by offering information and discussion support about problems that go from very large subjects such as poverty to more concrete matters such as the opening of a commercial center or the closing of a school. The developers of this platform are currently working on an algorithm that is able to identify the reputation of the users in function of their past interventions. This platform could stimulate citizens to engage into public life and make them provide their own insight and experience problems that the city find hard to solve.

C. Citizens as ICT users

The presence of ICT as "the" defining element in smart cities does not suffice and the excessive emphasis on ICT has even been reported as the principal defect of a number of smart cities (Merli & Bonollo, 2014). The integration of ICT in a city can nevertheless offer a new range of opportunities and can change the landscape of the city.

Technological advances enable an "ubiquitous computing" infrastructure (Friedewald & Raabe, 2011), a term that is closely related to the concepts of sensors and internet of things. It refers to the embeddedness of wireless, intercommunicating microprocessors, etc. in objects of the everyday life such that these objects can record and modify the environment. The critical factor is to put these technological developments at the service of the citizens. These developments still remain too abstract for most citizens who are most interested in applicable solutions (Schaffers et al., 2011). New citizen-oriented applications can be mapped to the infrastructure. These **innovative applications** range from Augmented Reality systems (Gutierrez et al., 2013, p. 174), through Citizen Science platforms (Khan & Kiani, 2012) and Public Displays (Du, Degbelo, & Kray, 2017) to any innovative application that makes the citizens feel surrounded and supported by technology as well as motivated to engage in other applications.

- Example innovative application: The City of Santander developed a "Pace of the city" application that has three functionalities. The first one consists in the sampling of values sensed by the smartphones such as GPS location, acceleration, temperature, luminosity, humidity… The second one allows the citizens to create and share events. For instance, a user can make a photo of a hole in the road and send this event via the application. Since the city council is connected to the platform of the application, it can be notified of this event and sends someone to fix it. The third functionality results from the fact that a local newspaper "El Diario Montañes" is also connected to the application (Santander City, 2014).

Open Data refers to all publicly produced data that is diffused without restrictions (Janssen, Charalabidis, & Zuiderwijk, 2012). It stimulates the government to act as an open system and interact with its environment and thus, to welcome opposite views and ask for feedback. Open data focuses on several domains such as traffic, weather, public sector budgeting, tourist information, etc. However, the publication of open data will not automatically lead to citizen participation because it demands considerable transformations of the public sector and skills for the citizens to use this data. Even so, more active citizens can create open source platforms or applications to make use of Open Data, to ease collaboration among citizens in order to solve issues at any scale (neighborhood, city, or even country).

- Example Open Data: Numerous Open Data platforms and strategies are implement throughout the world. Previous research has already performed an international comparison of Open Data strategies (Huijboom & Broek, 2011). The particular case of the Open Government initiative launched by Obama in 2009 is interested to examine as it constitutes a repository of interesting data about regulations, IT investments, records, etc… (US Government, 2018)

IV. Evaluation of Participation

Figure 4 summarizes the the CitiVoice framework, with the proposed criteria organized hierarchically into categories and subcategories. It builds upon the participation methods identified in section III and constitutes an useful tool to manage citizen participation in the context of smart cities. We improved CitiVoice by applying it to the smart city designs of three Belgian smart cities (Mons, Namur and Brussels). These three uses allowed use to demonstrate the three uses of the framework: evaluation tool, governance tool and comparison and creativity tool.

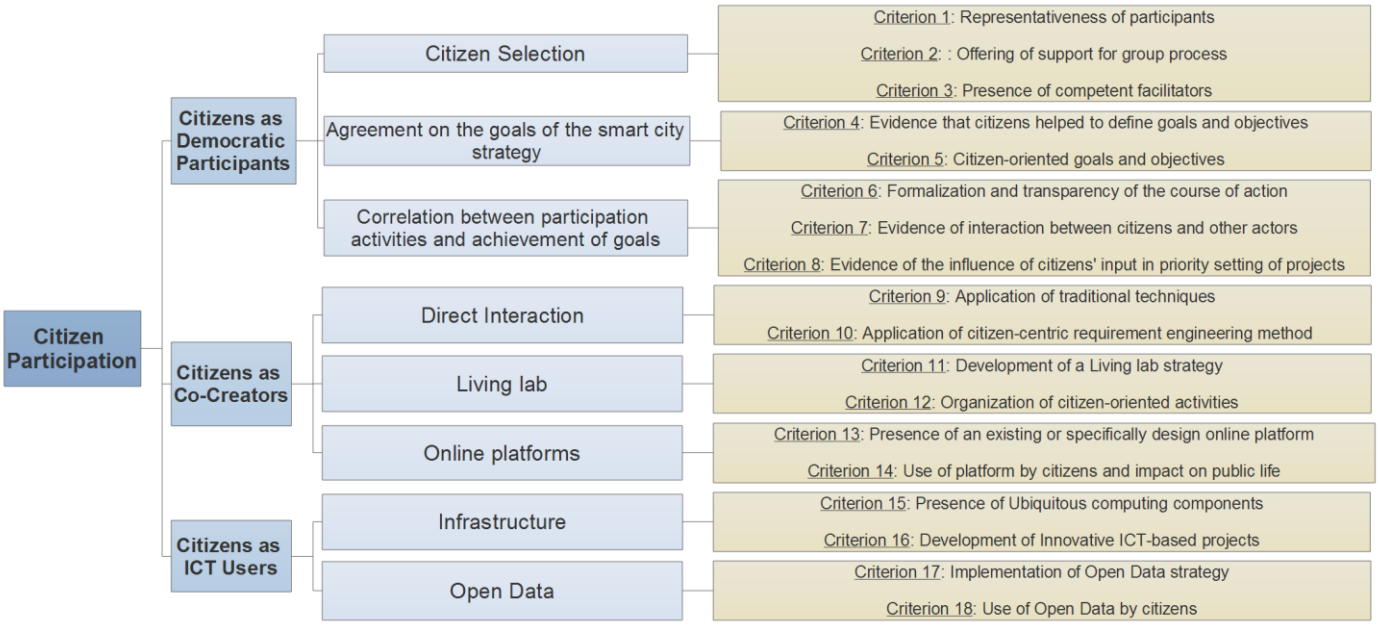

Figure 4. CItiVoice Framework

CitiVoice can be of interest for several stakeholders as it allows them to make better decisions about participation. Indeed, citizen participation is in fact not only about citizens but also impacts a multi-stakeholders ecosystem that includes:

- Public Servants: The integration of citizens' input is a challenge that has to be integrated by the public servants in order to rethink their internal processes. Administrations tend to have a hierarchical functioning which can be incompatible with the networking approach of working with citizens. Therefore, it is not surprising to see failure of participatory projects if the internal functioning of the cities is not ready to integrate this additional layer of complexity.
- Political Representatives: The political representatives show two contradictory attitudes regarding citizen participation in smart cities. On the one hand, they sometimes push the administration to engage in such projects due to the visibility of smart city projects. On the other hand, they are sometimes not completely committed to take the voice of the citizens into account because they fear that the participation of citizens will be limited to negative complaints and personal comments. There is thus a need to convince representatives about the usefulness of citizens' comments.
- ICT Managers: A strong tendency in Belgian smart cities is to assign the responsibility to implement the smart city strategy to the ICT Managers of the administration. This constitutes an opportunity and a threat. The opportunity exists that it allows re-using the best practices from e-government strategies and not to disconnect the two areas. The threat exists in falling back on the technology-oriented conception of smart cities.

A. Evaluation tool

It can be used ex-post as an evaluation tool to assess a smart city strategy. This evaluation refers to the analysis of one city along all the criteria of the framework. This evaluation is essential as the concept of participation has been theorized by Arnstein (1969) who suggests that participation is a spectrum that consists of three main steps: non-participation, consultation (gathering of ideas but no impact on decision-making) and co-decision (with decision making shared between officials and citizens). The criteria in this category aim at verifying that citizens' opinions indeed have an impact in decision-making. The main pitfall when including citizens in the decision process is to perform this in a purely instrumental manner. Governments might include citizens in the process only in order to obtain a more cooperative public hoping to face less resistance when the discussed project is implemented (Irvin & Stansbury, 2004). Similarly, administrations may revert to democratic participation to take decisions that they could never have taken unilaterally. This conception may lead to "routinized" democratic participation that serves only marketing purposes. This risk is considerable for smart cities because citizen participation is considered a matter on which cities want to capitalize to be labelled as "smart". Some strategies attempt to minimize this risk and aim to enable efficient democratic participation, e.g. through the evaluation of citizen participation (Rosener, 1978) In order to avoid the instrumental participation of citizens, there must be an established cause/effect relationship between the activities of the participation program and the achievement of the agreed-upon goals (Rosener, 1978).

CitiVoice takes as input all information that demonstrates the fulfilment of a criterion. The evidence for criteria can be gathered through, e.g., reviewing textual materials, interviews, excerpt from minutes, etc. For each criterion, a score of 0/0,5/1 can be attributed in order to quantify the state of advancement for each smart city. This scoring is not criterion-specific and is generic enough to be applied to all criteria. The general scoring rules are as follows. "0" means that the city has not considered this criterion or has rejected it. This criterion has no effect on the participation of citizens. "0,5" means that the city has considered this dimension but has not fully implemented it yet (for example, a project is budgeted and planned or at the beginning of its lifecycle without concrete effects yet). In this state of implementation, the criterion holds the possibility of improving the participation of citizens or already influence it at a minor level. "1" means that the criterion is fully implemented and has a clear effect on citizen participation. For more information about this use, we kindly refer the interested reader to the previous work and the application of the framework to the case of Namur (Simonofski, Serral Asensio, et al., 2017).

When used as an evaluation tool, stakeholders can use the framework as lens to analyze the strategy ex-post. Such analysis will reveal missing elements (for instance, no facilitators in group discussion), and provide stakeholders with a clear view on the orientation of participation of their current smart city. Furthermore, thanks to the potential automation of the criteria, it will provide practitioners with easy-to-read status reports of their participation strategy.

B. Governance Tool

CitiVoice can be used ex-ante as a governance tool for government officials that want to invest in a citizen-oriented smart city strategy. In that respect, the criteria can be considered as guidelines for implementation. In order to make smart cities as citizen-oriented as possible, the guidance of CitiVoice allows to issue more concrete recommendations for a specific city. Indeed, the different criteria could also be used as a checklist beforehand by any interested stakeholder (e.g. the smart city manager) to guide his actions about citizen participation.

CitiVoice provides practical guidelines for all the pre-cited stakeholders. By establishing a "dashboard" overview of citizen participation categories, we help stakeholders to think about their participatory strategies in a holistic way. For instance, the Democratic Participation category leads the interested stakeholder to think about the ideal organization of participation activities (representativeness, facilitators…) and to truly implement activities that will have an impact on decision-making in order to avoid manipulation or simple consultation. As far as Co-Creation goes, CitiVoice provides an inventory of co-creation methods to guide the interested stakeholder. This inventory enablers the stakeholders to develop a multi-channel strategy to reach the whole population. Finally, for ICT Use, the framework enablers stakeholders to invest or redirect ICT infrastructure investments to really think about the potential value they have for citizens.

Using CitiVoice as a governance tool ex-ante allows to guide stakeholders for specific projects. For instance, the city of Brussels used this framework in a participatory budget activity: they used the guidelines of the democratic participation category (presence of facilitator, impact in decision-making, representativeness of participants) to improve their strategy. Ultimately, they decided to use a multi-channel approach to enable the co-creation of projects with citizens (by using online platform and workshops).

C. Comparison and Creativity Tool

CitiVoice can be used as a comparison and creativity tool by enabling comparative analyses of best practices for one criterion or category across different smart cities. These comparisons allow differentiating by which means different smart city strategies can ensure citizens' participation and to design new means based on this comparison. For facilitating the visualization of citizen participation in smart cities, we have made use of a radar graph (see fig. 5). This form allows comparing in a straightforward manner in which forms of citizen participation the smart cities have decided to invest. The framework provides the dimensions to establish a "Dashboard" to monitor citizen participation strategies within smart cities. This Dashboard would allow to monitor in which directions (Democratic, Co-Creation or ICT) investments are made to stimulate participation.

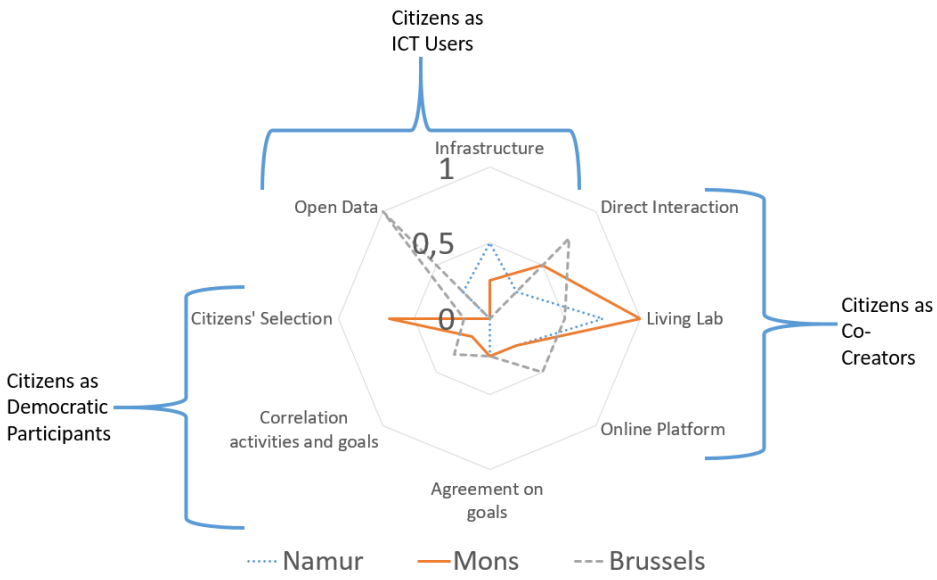

Figure 5. Participation Dashboard of Namur, Mons and Brussels

The comparative analysis of different cities could also help generating new methods for citizen participation thanks to the identification of different best practices within one specific category. In this chapter, we will not reflect extensively on that potential use as it would require the analysis of a higher number of smart cities in order to truly generate value. However, the comparison of three cities along one particular dimension is already promising. For instance, the specific case of the use of Online Platforms by the researched smart cities yielded interesting insights.

In the three cities reviewed, two categories of online participation platforms were present: large scope participation platforms that enables to collect an important number of ideas from citizens on the one hand, and more focused platforms that only enable participation on a specific issue (e.g. mobility, culture) on the other hand. Next to this difference in scope, there was also a difference in the degree of influence that the citizens truly have in the decision-making process. With focused-scope platforms, the administration will thoroughly process the ideas of the citizens and even provide some additional participation opportunities (such as Crowdfunding to invest in the projects). However, with the large-scope platforms, this processing will be more challenging depending on the resources of the administration. Furthermore, no real mechanism of feedback or additional participation opportunities are provided by the city.

Thanks to the analysis of three different cities, the framework allowed us to describe two relevant dimensions to consider when investing in an online platform: the scope of participation and the degree of influence in decision making. In that regard, cities must find a balance between the scope of the "Citizens as Co-Creators" and the impact of "Citizens as Democratic Participants". Currently, the citizens are generating ideas that do not always have a concrete impact on the city's strategy.

V. Conclusion

This chapter contributes on several levels. Firstly, a state-of-the-art was performed in order to summarize participation methods to enabler citizen participation in the smart city. The participation methods were grouped into three main participation categories: citizens as democratic participants, citizens as co-creators and citizens as ICT users. This state-of-the-art will provide a solid theoretical basis stimulate research to determine new means for participation. Secondly, a framework to manage citizen participation in smart cities was presented based on the aforementioned state-of-the-art. This framework can be helpful in different ways. For instance, CitiVoice can be applied as an evaluation tool thanks to defined criteria. Furthermore, this framework can also be used as a governance tool to provide governance recommendations to make smart cities more citizen-oriented,. A last interesting use that has been demonstrated was the comparison of several smart cities according to the main categories of the framework. Thanks to the guidance of the framework, a structured comparative tool was suggested to compare best practices among different smart cities. Finally, we expect this chapter to have relevant implications for research as it provides a structuring tool to analyze citizen participation in smart cities. We also expect the chapter to have implication for practices as the framework constitutes an interesting evaluation, governance, and creativity tool that help manage citizen participation in ongoing and future smart city strategies.

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